CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
Karen Ross, Secretary

2013
Specialty Crop Block Grant Program – Farm Bill (SCBGP-FB)
FINAL REPORT

USDA, AMS Agreement No:
Specialty Crop Agreement No. 12-25-B-1657

State of California
Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Contact(s):

Stephen Tachiera, Manager
Office of Grants Administration
Email: stephen.tachiera@cdfa.ca.gov
Phone: (916) 403-6525
Fax: (916) 653-0206

Kristi Duprey, SCBGP Manager
Office of Grants Administration
Email: kristi.duprey@cdfa.ca.gov
Phone: (916) 403-6536
Fax: (916) 653-0206

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California Department of Food and Agriculture
2013 Specialty Crop Block Grant Program –Farm Bill
Final Report
CFDA # 10.170

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SPECIALTY CROP BLOCK GRANT PROJECTS

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 1	**Project Title:** California, Always in Season	
Grant Recipient: Buy California Marketing Agreement	**Grant Agreement No.:** SCB13001	**Date Submitted:** December 2015
Recipient Contact: Nicholas Matteis	**Telephone:** (916) 441-5302	**Email:** nmatteis@agamsi.com

Project Summary

California has more than 25 agricultural marketing programs (Marketing Orders/Commissions) engaged in the promotion of specialty crop products. The marketing and promotional efforts of these entities independently compete in a highly diversified media environment for consumer visibility. There was a need for a promotional "umbrella" to help crosslink independent messaging of these entities to better impact consumer visibility, awareness, and increase the competitiveness of California's specialty crop industry.

This project modeled itself after Visit California's successful marketing campaign, which provided a generic statewide banner of media promotions that was leveraged by the local tourism bureaus and entities to promote their specific location/region. In the case of Buy California Marketing Agreement (BCMA), the project allowed California's agricultural marketing programs to leverage the visibility of a national media campaign to further cross promote their individual products in a competitive media market. This national media campaign focused solely on California's specialty crop industry.

This project was important and timely for California's specialty crop industry as it fulfilled a needed void in the generic marketing of specialty crop products and corresponded directly with the planning and implementation of Visit California's 2014 programming. Visit California was recently renewed as a marketing program, by assessed business in April 2013, ensuring the continued marketing of California as a tourist destination for the next six years.

Visit California has promoted the purchase and consumption of California culinary experiences as a pillar in their overall marketing campaign on California. Food and wine travel was an important and fast growing tourism segment nationally and resulted in direct sales within the food and beverage sector. BCMA promoted the purchase and consumption of California agricultural products to consumers domestically and internationally. The gained opportunity for BCMA and California's specialty crop growers was the leveraging of Visit California's global marketing budget of $42.6 million to further promote awareness and consumption of California's specialty crops.

This project created a promotional media marketing umbrella – *"California, Always in Season"* which highlighted the year-round growing season in California, its diversity of specialty crops/growing regions, as well as the food experiences that were uniquely Californian. The objective of this media campaign was to position California as the premiere destination for culinary travel as well as to increase the exposure, affinity, and sales of California grown specialty crops. This was achieved through capitalizing on the momentum of the Visit California overall media campaign ($42.6 million budget); heightened consumer interest in the food supply – where it grows, how it grows and who grows it; and provided the opportunity for California agricultural marketing orders/commissions to independently leverage the media messaging/campaign.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Activities that were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal were as follows:

Campaign finalization: All promotion campaign details were completed by BCMA and the California Tourism Commission by November 2013.

Media Campaign Engagement with Stakeholders: Meeting campaign engagement with stakeholders was conducted from November 2013 to March 2014 on an ongoing basis. There were 30 meetings with approximately 60 attendees. These meetings were successful in identifying specialty crop organizations to involve in the project by means of identifying specialty crops and specialty crop farmers that would be featured in the print and digital media developed by the project. This includes farmers and their specialty crops to feature in the custom videos and advertorial spreads as well as specialty crops to feature on the project's custom microsite hosted on *Food & Wine* website, http://www.californiasweeps.com - now hosted on the Visit California website, http://www.visitcalifornia.com/dream365tv and the BCMA website, www.californiagrown.org.

Media Purchase – Food and Wine: The media purchase was completed by *Food & Wine* by December 2013.

Content Development – Food and Wine, Earned and Owned Media: Six custom videos were completed by *Food &Wine.* For each video, chefs were featured along with specialty crop farmers. The first three videos represent spring and summer specialty crops and the final three videos represent fall and winter specialty crops.

Custom Rich Media Unit: *Food &Wine* created a custom ad unit with four tabs to feature a different chef and/or farmer within each tab. This effort is complimented by a sweepstakes experience (non-grant funded) to encourage interest and engagement with the program. Targeted Digital Media: Targeted web-based advertisement on the *Food &Wine* website – which included a Brandblock (1x) and custom co-branding: microsite, ROS banners and E-newsletter text links.

Distribution – Food & Wine, Earned and Owned Media: Six (two-page) advertorial spreads were distributed with unique and custom content appearing in the April, May, June, September, October, November 2014 issues of *Food & Wine* Magazine (see Attached Final Report). Additionally, the six short format videos (3-4 minutes) which coincided with the print advertorial spreads in each issue of *Food & Wine* Magazine were launched on a *Food & Wine* microsite and linked to a sweepstakes experience (non-grant funded), http://www.californiasweeps.com/. The videos were filmed in Santa Barbara, Guinda, Madera, San Diego, Chico, and Monterey, California. The videos are now hosted on the Visit California and BCMA websites (see links above).

During California Restaurant Month (January 2014), Visit California incorporated the CA Grown brand into an integrated campaign and connected California's bounty of specialty crops with the famous chefs and restaurants that use these crops to make unique California dishes.

The overall scope of the project did not benefit commodities other than specialty crops.

The media program also leveraged the owned media (in-kind) of Visit California's global marketing campaign:

California Restaurant Month: Visit California incorporated the CA Grown brand into an integrated campaign and connected California's bounty of specialty crops with the famous chefs and restaurants that use these crops to make unique California dishes.

Video Content developed by Food and Wine Magazine: The video content included specialty crop agritourism and the CA Grown brand in video creation and curation strategy to generate global assets.

VisitCalifornia.com: Included integration of the CA Grown brand and agritourism features in editorial content in the *Wine & Dine* section, including inside scoops, must-sees and trip ideas. Content was translated and localized with Visit California international domains.

Social Media Posts developed by Visit California to promote agritourism in California: Facebook and Twitter (VisitCA and DineinCA) with 435,000 followers – CA Grown messaging, including farm stands, farmers, chefs and restaurants were promoted. VisitCA and DineinCA contributed in extending the project's messaging to their 435,000 followers.

California Visitors Guide produced by Visit California: The CA Grown brand was used to identify unique specialty crop agritourism opportunities across the state in the printed guide (released January 2014) with additional linking to CA Grown web content from digital extensions of the guide.

California Road Trips Guide produced by Visit California: Specialty crop agritourism trips were incorporated into different routes features in the publication (released May 2014) and online.

The media program also leveraged the earned media (in-kind) of Visit California's global marketing campaign:

Global Press Trip: Visit California assisted in seeding 2014 culinary media campaign through their global press trip which brings 6-8 top tier foreign journalists to California in fall 2013. The itinerary focused on agritourism, California chefs, and interactive food and wine experiences.

Press Familiarization Trips: Visit California organized several media trips to California. BCMA worked with Visit California to develop customized itineraries to focus on the best food and agriculture California has to offer.

Global Broadcast PR Emphasis: Collectively, Visit California's PR representatives across 14 global markets focused broadcast pitching efforts on culinary themes in the 2013/2014 fiscal year. All markets proactively pitched culinary TV shows and food/drink storylines for targeted broadcast exposure.

Media Center: Agritourism, farm stands, farmers' markets, farm to fork, food festivals and other "CA Grown" ideas were featured on Visit California's media center – a digital resource accessed by tourism operators, foreign media and other entities to support external marketing efforts.

What's New in California: Agritourism "firsts" were featured in the Visit California's quarterly release highlighting new travel and tourism related attractions, hotels, events, and more in all the regions of the Golden State. The print publication has more than 3,000 subscribers (mostly media). Content was also available within Visit California's online media center.

Media Video Newsletter: Showcased specialty crop agritourism story angles to global media through a 1-minute "California Harvest" segment in Fall 2013 media video newsletter; content highlights included farm stays, ag tours, farmers' markets, food festivals, and more. October 2013 e-distribution reached more than 2,500 media contacts around the world. This newsletter was developed by Visit California to integrate their marketing and promotions efforts to promote agritourism, in line with their culinary promotional pillar, with the content created for the "Always in Season" campaign.

Media Events: BCMA also had the opportunity to feature CA Grown specialty crop products at Visit California's signature media events. These events bring a taste of California and included displays of California produce to top tier media in key markets. The events were hosted by Visit California to promote/support agritourism and incorporated the CA Grown brand and specialty crop products as a highlight of what California had to offer by way of culinary unique agritourism experiences.

Goals and Outcomes Achieved

Over a nine month period the BCMA campaign delivered 59,511,082 impressions sourced from Food and Wine's print, display and social media. Print media's total readership reached 46,200,000 over six print insertions. Display targeting recorded 13,055,594 impressions and social media reached 255,488.

Food and Wine's banner, rich media, and e-newsletter display placements drew 29,422 total clicks to the www.foodandwine.com/california microsite. A 0.23% campaign click-through rate was achieved - nearly three times the industry standard display benchmark 0.08%. High impact brand block placements on the Food and Wine homepage lent to a strong 0.40% click-through rate indicating strong contextual affinity to the BCMA content. Food and Wine's social audience yielded 12,205 social engagements including likes, comments, shares, favorites and mentions.

Six custom CA Grown videos accumulated 759,612 video plays from only 421,657 visits. Upon visiting the site, the auto-play video feature immediately captures user attention - leading to an efficient 180.15% visit to video engagement rate. Individual video views ranged from 80,000 to 150,000 where popular San Diego and Fresno videos each recorded approximately 150,000 video plays.

The chance to win the ultimate California foodie vacation sweepstake garnered 308,368 total applicants. Efficient behavioral targeting across Food and Wine's run of site and homepage placements converted 73% of all site traffic into a sweepstake entry. Explicit banner call-to-actions to "Enter to Win" combined with high post-click share of voice on the landing page ultimately enticed visitors to enter to win immediately upon visiting the site. Please note that no grant funding was expended to host the sweepstakes, as this was a component of the Visit California in-kind support for the project.

- Media Performance:
  - Impression Delivery (Target: 58,310,400 - impressions) (Total Impressions Delivered: 59,511,082)
  - Engagement with Custom Content (Target: 10% rate of engagement, 50,000 visits to food and wine content on VisitCalifornia.com) (Rate of Engagement achieved: 180.15% visit to video engagement rate, 421,657 visits to the Always in Season microsite. *Please note: The target was visits to VisitCalifornia.com but it was decided that the Always in Season microsite would be a better place to house the custom content.
- Earned Media Coverage:
  - # of media placements (Target: 30 - media placements) (Total media placements: 72)
  - Impressions (Target: 1.5 million impressions) (Total Impressions: 27 million impressions)
- Advertising Effectiveness:
  - Increased awareness of CA Grown Brand among target audience (Target – 25% increase from baseline) (Total increased awareness: 21%)

All goals for the reporting period were exceeded with the exception of the target set for increased awareness. Regarding brand lift specifically, people's association of California with seven culinary related topics were measured, comparing ratings among BCMA aware and unaware respondents. Those results are summarized below. Please note:

- Ratings were on a scale of 1-5, (1= Not at all, 5= Very much)
- Several categories- wineries, fine dining, California grown crops- had very high association among those with no recall of the campaign, making it more difficult to generate lift
- Following up on the point above, there is an inverse relationship between association scores and % increase- wineries have the highest levels of association with CA but the lowest % increase lift.
- Summing the scores for all seven categories shows a combined difference of 5.1 points, or a 21% brand lift. Though it doesn't quite reach the goal of 25%, the results are impressive - especially when compared to brand lift measurements in comparable 5 point rating scales for other components of the larger Visit California campaign.

Image of California	**No recall of BCMA**	**Recall of BCMA**	**Difference**	**% Increase**
Wineries	4.4	4.7	.3	7%
Fine dining	4.0	4.6	.6	15%
California-grown crops (e.g., almonds, grapes)	3.9	4.4	.5	13%
Local cuisine	3.7	4.5	.8	22%
Farmers markets	3.3	4.1	.8	31%
Breweries	2.9	3.8	.9	31%
Farm tours	2.7	3.9	1.2	44%
Total	**24.9**	**30.0**	**5.1**	**21%**

As a brand new project the baseline data was not provided. All targets set were achieved or exceeded with the exception of the increased awareness, which was reached a total of 21% rather than the targeted 25%. However, as noted above, achieving a 21% increased awareness is impressive when compared to comparable measurements of larger programs.

Beneficiaries

The following BCMA members benefited from the completion of the project: Kiwifruit Administrative Committee; California Association of Nurseries and Garden Centers; California Pear Advisory Board; California Asparagus Commission; California Avocado Commission; California Cut Flower Commission; California Farm Bureau Federation; Agricultural Council of California; Wine Institute, California Dried Plum Board; California Fig Advisory Board & California Fresh Fig Growers Association; American Pistachio Growers; Certified Farmers Markets of Sacramento; Pacific Coast Famers Market Association; California Certified Organic Farmers; California Olive Committee; California Cherry Board and many Company members.

Including the above mentioned BCMA member organizations and company members approximately 52 CA Grown members benefited from the accomplishments of the project. Please note that the benefit extends to all members of the BCMA member organizations and company members growers, whether they were featured directly in the content developed by the project or gained attention from social media efforts made by BCMA staff to capitalize on the social media following of Visit California and gain followers through collaborative social media posts.

The return on investment of the project was over 200%, as the total cost for the media spend was $688,500 for a total value of $1,513,667. The project resulted in 72 media placements that generated over 27 million impressions for a total of more than $3.4 million in earned media value.

Lessons Learned

Potential improvements to the project include:

- Stronger and more diverse farmer – culinary/agritourism stories. The greatest diversity possible in specialty crops and types of culinary/agritourism experiences that can be featured would be ideal.
- More crops and farmers featured in print and video content. More diversity of crops and farmers featured would also be ideal in order to tell an enhanced story about the diversity of specialty crops grown in California and their various uses and ways to experience them.
- Added print media that targets the California consumer i.e. Sunset Magazine to compliment the Food and Wine print distribution which is to a more national audience. This would round out the reach of content to in-state and out-of-state audiences.
- Integration of digital content into both the BCMA and Visit California websites would be ideal for closer association of the audience to both organizations. The Food and Wine microsite, though effective, took the audience away from other opportunities for site visitors to explore other culinary/specialty crop focused content.

All targets set were achieved or exceeded with the exception of the increased awareness, which was reached a total of 21% rather than the targeted 25%. However, as noted above, achieving a 21% increased awareness is impressive when compared to comparable measurements of larger programs.

Additional Information

Attached is the BCMA digital report which includes campaign highlights, stats, and print features.

USDA Project No.: 2	**Project Title:** Removing Barriers to Commerce to Reverse Market Share Decline	
Grant Recipient: California Flower Growers Cooperative	**Grant Agreement No.:** SCB13002	**Date Submitted:** December 2016
Recipient Contact: Alicia Adler	**Telephone:** (949) 584-3572	**Email:** Alicia.m.adler@gmail.com

Project Summary

California produces 75%+ of U.S. cut flowers but U.S. cut flowers have dropped from 60% of U.S. wholesale sales in 1989 to 29% in 2011 as imports (mainly Colombian) grew. This keeps prices stagnant (up just 2.7% over the past decade). Further, most South American imports enter a single port of entry (Miami) and are aggregated in warehouses with which buyers deal directly. This supply chain structure allows buyers to deal efficiently with a few sellers offering wide selections rather than multiple sellers for California flowers. This project created an online marketplace allowing buyers and California farmers a single point of contact for all California varieties to ease this burden. The industry must address this to remain viable and stop further market share loss. Accordingly, the California Flower Growers Cooperative (CFGC) is supported by the California Cut Flower Commission, representing all California cut flower farmers. As a farmer-owned cooperative, any profits flow back directly to the farmers and benefit only them. CFGC membership is open to all California cut flower farmers.

This project was important and timely because it aimed to create economic opportunities for specialty crop producers through market development activities that focused on local, regional, or international markets. The goal was to enhance the ability of California cut flower farmers to compete with imports by creating a website to provide online product aggregation and a single destination for buyers to purchase all California varietals in one place. The project objective was to recover at least a modest 1% of the total U.S. market share lost to foreign imports by July 2015, which would lead to about $9.5 million in additional annual revenues to California cut flower farmers. After development and initial promotion of the website was completed, ongoing maintenance costs for the site would be modest and covered by a transaction fee to the farmers.

This project did not build upon a previously funded Specialty Crop Block Grant Program project nor has this project been submitted to or funded by another Federal or State grant program.

Project Approach

From December 2013 through January 2014, grower and buyer input was gathered and assessed for the planning and design of the website. The website was designed, but limited input was provided by stakeholders, so further development of the website was postponed.

In January 2016, the CFGC retained a new Project Manager (PM) to ensure the remaining activities were completed by the end of the project period.

Since January 2016, the CFGC focused efforts on completing the development of the website. By April 2016, the database design for grower inventory was developed and provided to growers to provide sample data. Three CFGC member companies provided data samples to populate the website and simulate transactions for testing. The website designer then completed development of the base transactional e-commerce code, shipping module, purchase order module, grower module and HTML5/CSS3 templates for backend code.

By June 2016, the website "went live" and CFGC leadership was trained to use and maintain the website after the grant period is over. Sales data will be tracked and reported as they are achieved.

California cut flowers are the only commodity that benefited from this project. No other commodity benefited from this project.

The website contractor developed and designed the database for grower inventory and collected sample data from selected CFGC members. They also led training webinars and "on boarded" CFGC members as they were available.

Goals and Outcomes Achieved

The primary goal of this project was to reverse the trend of losses of California farmers' market share to imports. The performance measure that was to be used to monitor this goal was the market share percentage held by California cut flower growers. The benchmark was current California sales as estimated by the California Cut Flower Commission (CCFC); the target was to add revenues equal to 1% of the total domestic market, taken from the share currently held by imports, by the end of the project period (June 2016). The secondary goal for this project was to generate web traffic to the site and to measure flower sales initiated on the site. The performance measures for these goals were web page visits and totals sales dollars for online sales. The benchmark was zero as the site did not yet exist; the target was to generate an average 800 monthly page visits and get to $9.5 million in total annual sales by the end of the project period.

The website is functional and three CFGC members have uploaded their inventory. Unfortunately, due to delays in website development and member on boarding, the site has yet to be used to conduct flower sales. The Cooperative hopes to achieve this goal in 2017, once all members are fully registered on the site and trained.

The outcome measures for this project are long-term. To date, CFGC has successfully developed and launched their e-commerce website in 2016, but members are still uploading product information and learning how to use the site. CFGC expects initial sales to take place early 2017.

All tasks specified in the approved work plan were completed, except for the public relations and industry outreach component. This component will need to take place after the end of the grant period, and CFGC will not use grant funds to cover these costs.

CFGC did not achieve its expected measurable outcomes by the end of the grant period, due to various project delays. However, the website is developed, and sales are expected to begin early 2017

Additionally, CFGC collected flower and greens total annual sales data from the CCFC flower farmer members for 2012, which totaled $231,499,806. This benchmark will be compared to total annual sales of cut flowers in 2017, one year after the launch of the e-commerce website.

Beneficiaries

The primary beneficiaries of this project are California's 225+ cut flower farmers; current CFGC membership represents nearly half of California's cut flower industry by dollar volume (any California flower grower may join CFGC).

California accounts for over 75% of the U.S.'s total cut flower production. Domestic farmers have lost significant share of the U.S.'s $1.24 billion cut flower market to imports (U.S. share, of which California represents 75%+, has dropped from 60% in 1989 to 29% in 2011 according to statistics provided in a presentation at the International Floriculture Expo). The over 16,000 retail florist shops across the country will benefit as they will have the convenience of a one-stop supplier for all California cut flower varietals, saving them time and logistical hassles; accordingly project supporters include florists who have committed to serve as beta testers for the new site, and more can be easily added, if needed. California's cut flower industry accounts for approximately 14,000 jobs directly (through farms and cut flower wholesalers and retailers), indirectly contributes to an additional 122,000 jobs, and had a total economic impact of $10.3 billion in California in 2007 according to an economic impact study performed by Tootelian & Associates.

Lessons Learned

After unexpected delays due to limited availability of project leadership, the CFGC retained a grant management contractor to assist with the completion of the project and reporting by June 30, 2016. The new PM joined the CFGC's management team in January 2016. The CFGC completed the project, but has not yet achieved expected measurable outcomes due to a delay in member "on-boarding" to the website. Several members are still uploading their product information onto the website, and expect to utilize the website shortly after.

There were no unexpected outcomes or results during the life of the project.

A lesson learned for those working on e-commerce industry websites is to provide education and outreach to the cooperative membership who might participate to ensure they will efficiently provide product information in a timely manner.

Additional Information

americanflowerfarmers.com

USDA Project No.: 3	Project Title: Market Match Consortium	
Grant Recipient: Ecology Center	**Grant Agreement No.:** SCB13003	**Date Submitted:** December 2015
Recipient Contact: Martin Bourque	**Telephone:** (510) 812-5514	**Email:** martin@ecologycenter.org

Project Summary

Direct marketing through Farmers' Markets (FMs) is a critical survival strategy for thousands of California Specialty Crop (CSC) farmers. Simultaneously, California's low-income residents suffer disproportionately from diet-related diseases from lack of CSC consumption while currently receiving $7.6B in CalFresh Benefits. The Market Match Consortium (MMC) is a statewide coalition of FM operators and organizations working to enhance the competitiveness of CSCs by driving California's 7-to-17 billion dollars in Supplemental Nutrition Assistance Program (SNAP) benefits [aka CalFresh or Electronic Benefits Transfer (EBT)] and other benefits directly to CSC growers.

The impacts of the global recession have been long lasting and have been followed by deep cuts to federal and state safety-net programs. This is now coupled with the ongoing drought in California, which significantly increases the cost of water – and thus the cost of growing and the cost of living. Farming communities and low-income communities have been particularly hard hit. These economic stressors have changed people's shopping habits and the burgeoning awareness of healthy food, and the movement towards purchasing direct from farmers, both faltered. Much of the momentum that had led to increased sales by CSC growers in California was lost during the recession. For low-income shoppers the situation was equally precarious.

The California Obesity Prevention Plan states that meals containing more fruits and vegetables cost 41% more than meals of lower nutritional quality. The higher prices are associated with lower purchasing and intake. Market Match (MM) helps low-income families bridge this food gap by increasing affordability, food access, and overall food security while simultaneously building a healthy habit of farm-direct shopping with their local CSC grower. The 2013 California MM Cluster Evaluation showed: 78.5% of CalFresh shoppers surveyed reported MM was their reason for shopping at market; 80.5% of the CSC growers reported selling more CSCs as a direct result of MM, 69% had more new customers, 72% had more repeat customers, and nearly 20% of the CSC growers were increasing their acreage to meet demand caused by MM.

The MMCs goal is to drive 1% of Cal Fresh sales, $76 million, directly to CSC growers by 2020.

From 2009-2012, the MMC was run by Roots of Change. Ecology Center (EC) assumed coordination in 2012 under 2012 Project 26: *California Farmers Market Consortium*. During the first phase of MM, each implementing subcontractor (Partner) was encouraged to find the shopper recruitment and MM delivery system that worked best for their budget and location. Great innovations were tested. Project 26 (2012) was utilized to: 1) study best-practices from the proof of concept phase; 2) expand MM to new markets and CSC growers; and 3) support the MM programs with the existing 11 Partners. The intended enhancements for this project were to: 1) grow the MMC from 11 to 17 partners at 150 FMs (up from 138) serving 1,140 CSC growers (up from 840) to facilitate $1.2 million (from $1 million) in farm-direct CSC sales via MM; 2) develop best infrastructure/practices for a consistent program that is cost effective for all California FMs.

Project Approach

The following activities and tasks were performed during the course of the project:

Establish and implement CalFresh Matching programs in at least 150 partner FMs throughout the state in order to boost sales for CSC farmers:
The Ecology Center added 7 new partners through a competitive application process bringing the MMC up to 18 funded and 5 unfunded partners that served 153 FMs in 2014-15. There were at least 840 CSC growers being served through the pre-existing MMC partners; when the 7 new partners were added, this number grew to a total of 1,033 CSC growers that were served.

Pre-screen 3,500 CalFresh eligible shoppers at FMs: The MMC partners screened 927 CalFresh eligible shoppers. Please see Lesson's Learned section of this report.

Recruit and provide technical assistance to new FM partners adding MM programs: Ecology Center staff and other Consortium members reached out to new FM operators to encourage them to join the MMC and provide MM at their markets. Nineteen FM operators applied to join the MM program. Recruitment and technical assistance were conducted through email, phone calls, webinar, and in-person meetings. As a result, 7 new funded market operators and 4 unfunded market operators joined the MMC.

Establish and implement CalFresh Access in at least 20 new FMs throughout California: the Ecology Center was in communication with market operators representing 90 FMs. Of those, 28 established CalFresh access; the Ecology Center assisted 16 others in further implementation and promotion of existing CalFresh Programs. Together, these two outcomes benefitted approximately 557 CSC growers.

Track MM sales data and MM market locations throughout the State: all MM partners reported monthly to the Ecology Center with their complete sales and customer tracking data. The Ecology Center collated the individual reports into a master that shows all MM activity for California. In addition (under separate funding and not using any Specialty Crop Block Grant Program funding), the Ecology Center fully launched Farmers' Market Finder (www.fmfinder.org), which allows users to find their local markets and to see if those markets offer MM.

Convene the full MMC - twice in person and 10 times via phone: Eleven monthly conference calls were conducted. A two-day, in-person meeting was also held in Oakland in March 2014 with all partners in attendance. In November 2014, a second two-day, in-person meeting was held in Fresno. In addition to the existing MMC listserv, the Ecology Center also established an internal MMC website that was updated for communications and sharing of meeting agendas, best practices, and reporting forms.

Partner with 15 partner organizations throughout California in order to reach out to CalFresh eligible populations and promote using benefits at FM for the purchase of CSC: the MMC had 18 formal funded partners. In addition, the Stanford Law Clinic created a Memorandum of Understanding (MOU) that allowed additional, unfunded partners to participate in the Consortium's learning community in order to expand the

MM outreach and implementation. Utilizing this MOU, the Ecology Center on boarded an additional five unfunded partners, representing seven FMs.

Partner with local media, social service agencies and community based organizations to distribute posters, flyers and other outreach materials to promote the purchase of CSCs at the local FMs: the MMC partners worked with agencies across California to get out posters, fliers, emails and other outreach materials viewed by approximately 227,962 MM eligible shoppers for the purpose of recruiting them to shop with their local CSC grower at the FM. In addition to the 227,962 printed materials distributed, in May of 2014, MM experienced significant attention in the news media. Through funding from First5 Los Angeles, the MM program received press in 14 online and print media outlets, including the Los Angeles Times, which together receive over 4 million daily views. Ecology Center staff and MMC partners also worked to develop the statewide MM website and online presence in order to promote CSCs; promote and educate farmers, market managers and the public about the MM program; onboard new partners; and support program legitimacy. The MM site went public in February of 2014. Visit it at www.marketmatch.org .

Administer market manager, customer, and CSC farmer surveys at target MM locations in order to evaluate the program efficacy: MM customer and farmer surveys were administers by MMC partners July through October 2014. A total of 503 customer and 187 farmer surveys were collected during this time. (See Attachments 1 and 2) Market Operator program feedback was solicited through the 11 MMC calls and two, in-person meetings.

Foster a learning community in the MMC through executing face-to-face meetings, trainings, monthly calls, and online toolkit: the calls and meetings took place as scheduled, and the resulting MMC learning community was very active. The new MarketMatch.org website includes an internal partner area where MMC partners can securely login, submit monthly reporting, market information, and utilize a toolkit in order to better implement and promote their MM programs. The MMC Project led to tremendous collaborative efforts on behalf of CSC growers, including the (funded separately) California Alliance of Farmers' Markets that is working to make the selling atmosphere for the specialty crop growers more consistent and profitable. Long-term MMC partners have actively recruited and mentored new members, assisting them in offering MM, and have been extremely generous with their time. The MMC has created a very strong community that is turning out to be of tremendous benefit to CSC growers.

Report monthly on outreach conducted and redemption at FM of CalFresh (67% of total and tracked by vendor where possible) and MM: all MM partners reported monthly to the Ecology Center with their complete sales and customer tracking data. The Ecology Center collated the individual reports into a master that showed all MM activity for California. The MMC generated a total of $2,120,607 for CSC farmers. This includes 67% of CalFresh redeemed at participating FMs and 100% of the Women Infant and Children, Farmer's Market Nutrition Program (WIC FMNP) and 100% of MM dollars redeemed. All $2,120,607 was spent, 100%, with CSC farmers.

Build program scale and sustainability though national and state partnerships: the MMC has created very active partnerships with national partners such as Fair Food Network and Wholesome Wave in order to ensure that California is always utilizing best practices and is helping to shape the sustainability and scale of MM.

Create a MM program report and evaluation: All reports were executed as planned and the evaluation surveys were conducted in late July to October 2014. The final survey analysis is included as an attachment to this report. (Attachment 1 and 2)

Expand and enhance MM Program by improving At Market Customer and Farmer experience: three hundred large format MM banners were printed to increase visibility and ease of customer use, clearly directing them to the site for EBT Point of Sale (POS) use and token distribution. Additionally 3,600 farmer booth signs were printed to help direct MM customers to eligible CSC growers' booths, and 3,000 market booth signs were printed to help inform customers on how the program works.

Ensuring that funds are used solely for CSCs is core to the Ecology Center's workplan. MM incentives are only redeemable with CSC growers. This is achieved through restricting the growers who are allowed to redeem MM scrip to those who grow and sell CSCs, restrictions printed on the MM scrip, shopper and farmer education, clear policies and careful training and oversight.

MM is designed to drive CalFresh shoppers and revenue directly to CSC growers who retain 100% of the revenue. As part of this process, it is necessary to increase the number of markets that accept EBT and the number of EBT shoppers that come to FMs so the CalFresh shoppers are able to shop directly from CSC growers at the market, and know their benefits are redeemable at that market. To avoid using project funds for unallowable products, all aspects of the needed CalFresh outreach are capped at 67% of their total cost. While CalFresh can be spent on unallowable products, the ineligible crops/foods available at certified FMs are a small fraction of their offerings and therefore eliminating 33% of all CalFresh purchases allows for an ample "cushion" of potentially unallowable purchases, ensuring that all CalFresh expenses billed to the project are 100% for CSCs. Recent review of EBT expenditures at over 60 northern California markets show that more than 80% of all EBT redeemed at FMs is spent on CSCs. This further demonstrates that the 67% number is indeed conservative. To ensure no project funds support ineligible crops/foods, Ecology Center is presenting no more than 67% of the EBT/CalFresh outreach program expenses for project funding; the other 33% of expenses, covered by matching funds, will cover any unintended contact with ineligible crops or producers. Example: project funding will only support 67% of the cost of the EBT specialist.

In order to increase safeguards and more accurately measure the true percentage of CalFresh funds that go to CSC growers, the Ecology Center worked with seasoned MMC partner, Pacific Coast Farmer Market Association (PCFMA), and others, to pilot several methods to ensure that the benefit matched by incentives also went to SC farmers.

All marketing messages and materials created with project funding focused solely on the purchase of CSCs. The outreach either promotes the MM program (which solely benefits CSC farmers), a specific specialty crop (i.e., "Buy local strawberries today at the XYZ Market with your EBT card"), or is focused on the purchase of state grown fruits and vegetables (i.e. "You can use your CalFresh EBT card and MM to purchase fresh, California-grown specialty crops at the XYZ Market from 10-2 each Tuesday!"). This ensures that project funds solely support the sales of CSCs, while enhancing the shopper base for the CSC growers. The Ecology Center ensured that messaging was in alignment with the Specialty Crop Block Grant Program requirements.

Ecology Center undertakes partner contracting, site visits, reviews all materials, leads monthly calls, and conducts two face-to-face meetings in which adherence to rules are discussed with all MMC partners in order to maintain vigilant enforcement of the intended goals.

The MMC Partners worked in 23 counties at 153 farmers' markets: Agricultural Institute of Marin – operates farmers' markets in Marin, Alameda and San Francisco counties; Alchemist Community Development Corporation – partners with farmers' markets in Sacramento and Yolo County; North Coast Growers Association – operates farmers' markets in Humboldt County; Coastside Farmers' Markets – operates farmers' markets in San Mateo County; Visalia Farmers Market – operates farmers' markets in Tulare County; Agricultural & Land-Based Training Association – working in Monterey, San Benito and Santa Cruz Counties; Fresno County Economic Opportunities Commission – partners with farmers' markets in Fresno and Madera Counties; Hunger Action Los Angeles – partners with farmers' markets in Los Angeles County; Pacific Coast Farmers Market Association – operating farmers' markets in Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara and Solano counties; Sustainable Economic Enterprises of Los Angeles – operating farmers' markets in Los Angeles County; Phat Beets – operating farmers' markets in Alameda County; Mission Community Market - San Francisco county; Laytonville Farmers' Market - in Mendocino County, North Coast Opportunities - partners with the Ukiah farmers' market in Mendocino County; Valley Farmers' Market Association operates farmers' markets in Kern County; Point Reyes Farmers' Market - Marin County; Contra Costa Certified Farmers' Markets operating farmers' markets in Contra Costa County; Agricultural Community Events Farmers' Markets –in Marin and Sonoma County; Child Parenting Institute –in Sonoma County; Sebastopol Farmers' Market – in Sonoma County; Quincy Farmers' Market – in Plumas County; and Crescent City Farmers' market – in Del Norte County.

Goals and Outcomes Achieved

The activities completed in achieving the goals and outcomes of the project are as follows:

Grow the MMC from 11 partners at 130 FMs serving 840 CSC growers, to 15 MMC partners serving 150 FMs and 1,140 CSC growers: This project resulted in 23 partners offering MM at 153 FMs serving 1,033 CSC growers.

Partner with local media, social service agencies, and community-based organizations to distribute posters, flyers and other recruitment materials to 500,000 CalFresh consumers: MMC partners reported 227,962 pieces of outreach materials distributed. In addition, since its launch in February of 2014, the new MM website received 1,838 page views. Through funding from First5 Los Angeles, the MM program received press in 14 online and print media outlets, including the Los Angeles Times, which together receive over 4 million daily views.

Establish and implement CalFresh access in at least 20 new FMs throughout California in order to boost sales for CSC farmers and make them MM ready: the Ecology Center established CalFresh access at 28 FMs and further implemented and promoted CalFresh access at 16 others, benefitting approximately 557 CSC growers.

Pre-screen 3,500 CalFresh eligible shoppers at FMs across the state: nine hundred seventy-five eligible shoppers were pre-screened. The pre-screening process is conducted by project partners at FM, ideally in conjunction with CalFresh agency staff. Individuals are asked a series of questions to determine whether they may be eligible and then as appropriate are assisted with the application process. In some cases, CalFresh agency staff support these efforts by attending market to facilitate the application process.

Foster a learning community in the MMC through executing 2 face-to-face meetings, trainings, monthly calls, and an online toolkit: this project resulted in 11 monthly MMC calls, one MM workshop, and two, two-day, in-person MMC training. One webinar training for new partners was executed April 7, 2014. The new MarketMatch.org website includes an internal partner area where MMC partners can securely login, submit monthly reporting, market information, and utilize a toolkit in order to establish and promote their MM program.

Leverage over $260,000 in matching funds to build program scale and sustainability though public and private, national, state, and local partnerships: the Ecology Center and the MMC members successfully leveraged the MM program into two large-scale expansions. (1) First5 Los Angeles engaged the Ecology Center's MM program under a 5-year, $2.5 million contract to expand MM to children and families throughout Los Angeles County; (2) the statewide partner expansion, infrastructure, learning community, local funding, and training was all leveraged to garner a 2-year, $3.7 million grant from the United States Department of Agriculture's new Food Insecurity Nutrition Incentive program, which will result in significant expansion of the project. No project funding was used in order to raise these additional funds in support of the MM program.

Based on best practices, research and test the minimum MM incentive amount required to recruit the maximum number of CalFresh shoppers: the Ecology Center's Executive Director, Program Director, and Program Manager have conducted extensive review of previous data to analyze this issue. Several MMC partners (Alchemist Community Development Corporation in Sacramento and Fresno Economic Opportunities Commission) have conducted preliminary incentive level change pilots. The data from these pilot sites are currently being analyzed.

As technology develops, explore token-less, electronic delivery systems to replace market scrip: the Ecology Center has identified possible token-less systems that improve efficiency, reduce administrative overhead, reduce the potential for fraud and can be scaled to an electronic delivery system that would eliminate the need for market scrip. Explorations allowed the project team to develop a concept and plan to pilot and test bar code scrip and then electronic scrip to analyze outcomes and determine best practices that will be utilized in future years.

Determining the long-term health benefits, benefits to the CSC growers, and the optimal incentive amount are all long-term goals. This project has allowed Ecology Center to make progress on these long-term goals. The project team developed forms, templates and systems, as well as knowledge and familiarity to track data and expenses, and ensure compliance with federal regulations. Much of the infrastructure was created because of the unique nature of this grant program and the number of partners involved.

The majority of the Ecology Center's goals were met or exceeded! Three areas where totals fell short of the goals were: the goal of pre-screening 3,500 CalFresh eligible shoppers (975 were pre-screened), reaching the anticipated 1,140 CSC growers (reached 1,033), and distributing recruitment materials to 500,000 CalFresh consumers (269,598 consumers received recruitment materials).

In the case of reaching CalFresh shoppers with materials, the MM program opted to use fewer printed materials and focus more heavily on electronic views on the website and through earned media. When "views" from MM earned media are counted into the total, this goal was exceeded by several million views.

The MMC partners that were engaged in pre-screening found that this aspect of the program has significant structural challenges and it has been eliminated from the program design going forward. While MM incentives have proven again and again to be extremely effective, prescreening for SNAP eligibility at FM has proven impractical. This is discussed further in “lessons learned”.

The CSC grower goal of 1,140 was set without knowing which new markets/partners would be added to MM. As it happened, the MMC added 12 partners and 23 new markets, but the markets were not as large as anticipated.

The Ecology Center grew the MMC from 11 partners at 130 FMs serving 840 CSC growers, to 23 MMC partners serving 153 FMs and 1,033 CSC growers; helped 28 new FMs come online with EBT access, which all resulted in 1,033 CSC growers making $2,120,607 in federal nutrition benefits and MM sales during this project term, which is $654,168 more than 2013.

The major successful outcomes of the project are as follows:

- Nearly 20% of farmers reported sales increase of 25% - 49% due to CalFresh and MM at the FM.
- Eighty eight percent of MM customers reported that MM was important in their decision to spend their benefits at the FM instead of elsewhere.
- Seventy nine percent of customers reported the amount of CSCs purchased increased as a result of MM.
- Eighty percent of customers reported that their trips to the FM had increased and they buy CSC as a result of MM.

Beneficiaries

The primary group that benefited from the completion of this project’s accomplishments was CSC growers selling through FMs. Other groups that benefited from this project were low-income shoppers who benefitted from an increased number of FMs accepting EBT and the added buying power needed for SNAP shoppers to purchase sufficient quantities of fresh SCs.

One thousand thirty three CSC growers and 70,542 low-income shoppers benefited from this program during this project term.

Lessons Learned

As a result of completing this project, the project staff has learned the following:

There is strong demand for the MM program from FM operators. During the course of the project many more FM operators expressed interest in offering the program than the Ecology Center could accommodate as part of this project.

MM is an effective tool to leverage CalFresh usage at FMs. The addition of a MM program significantly increase the use of CalFresh, and other nutrition benefits, at FMs. This is an important lesson as it shows that investing in an incentive program can result in an increase in revenue for specialty crop growers in California.

FMs are challenging settings for pre-screening of CalFresh eligible shoppers. Two of the more significant challenges include finding qualified personnel available to work during the market hours (markets are often on weekends), and convincing customers to take time out from their shopping trip. Many customers are unwilling to take time from their shopping to participate in the pre-screening process. Anyone attempting to conduct pre-screening of market customers should be aware of these challenges and plan strategies to overcome them. These challenges are particularly difficult to overcome, as they require the cooperation of individuals outside the scope of this project.

Local conditions heavily impact the implementation of the MM program. The degree to which there is effective outreach, transportation to and from the market, support of relevant local agencies, and how easy it is to access specialty crops from other sources all can have a significant impact on use and redemption of the MM program.

The capacity and size of the organization implementing MM affects the cost of incentive delivery. Economies of scale exist that allow larger organizations and organizations with greater resources to distribute incentive at a lower per unit cost.

The goal of researching and testing best practices for the minimum MM incentive amount required to recruit the maximum number of CalFresh shoppers was not achieved through this project. Those tests and evaluations, in order to be robust, require the guidance and oversight of a trained evaluator and more time was needed than was available during this project period.

In the case of reaching CalFresh shoppers with materials, the MM program opted to use fewer printed materials and focus more heavily on electronic views on the website and through earned media. When "views" from MM earned media are counted into the total, this goal was exceeded by several million views. This focus on electronic materials represents both a change in how people receive information away from printed materials and towards websites, apps and other electronic forms. The effectiveness of the incentive distribution indicates that this strategy for distribution of information was very effective.

Additional Information

Please see: Attachment 1 California Market Match Consortium Customer Survey
Attachment 2 California Market Match Consortium Farmer Survey

USDA Project No.: 4	Project Title: Solano Grown Online Farmer's Market	
Grant Recipient: Solano Grown	**Grant Agreement No.:** SCB13004	**Date Submitted:** December 2016
Recipient Contact: Michelle Stephens	**Telephone:** (530) 863-9073	**Email:** michellelinstephens@gmail.com

Project Summary

The food hub and online farmers market were designed to provide an additional venue to market local agricultural products for specialty crop producers.

Many Solano County farmers do not participate in local farmers markets. They cited lack of customer base at some markets, inability to get stall space at more popular markets, cost of booth fees, loss of product due to transportation, and time away from production activities as some reasons for this. Many growers also do not sell via the internet as they do not have websites and those with websites often cannot afford the point of sale software or vendor fees.

The goal of this project was to expand a newly developed online farmers market, a local market enterprise, which would produce increased income flow without increasing the amount of upfront costs to the growers. By using an online market, the grower could sell without being away from the farm, deliver only product that is already sold to the market, adjust prices as warranted, manage inventory, include a description of the products, growing methods, and highlight their farm in a farmer biography. The project's long-term impact was expected to be the establishment of a viable collaborative market linked to other community organizations, enhanced public awareness of local farmers, and increased income for participating specialty growers.

Project staff believed that the expansion of the online market would build upon the successful "Solano Grown" branding that has been created in the past in partnership with the Solano Community College (SCC), the Solano County Department of Agriculture, and Solano Grown members. Project staff hoped to create a sustainable food hub that provided a long-term source of fresh local foods for the community.

Specialty crop producers comprise ~27% of the farm gate value in the county and represent 70% of the members of Solano Grown, a cooperative marketing organization for Solano growers. Previous outreach to Solano County buyers included a survey of residents regarding purchase methods. Survey results indicated interest in online purchase methods and distribution hubs. Based on this response, project staff felt an online farmer's market would be a successful tool for specialty crop growers.

The purpose behind the food hub was to create economic opportunities for specialty crop producers by providing an alternative venue to conduct sales and provide access to local farm fresh products to consumers through online shopping. The benefits included: (1) an opportunity for growers to draw from a larger demographic, expanding the customer base beyond the immediate area of physical distribution, such as a farm stand or farmers market; (2) seasonal market opportunities; (3) the market fit well with existing direct marketing already being used by growers as producers can list as little or as much product as they have available, providing another outlet for products; (4) an entirely new marketplace for many producers (online);

and (5) a new cooperative local enterprise that is projected to provide long-term partnership benefits for growers and the community.

Solano County received funding under the 2011 Specialty Crop Block Grant Program (SCBGP) Project 36: *Solano Grown Marketing*, to advertise specialty crops produced in Solano County. This project built upon this previous work by providing a place for consumers to purchase specialty crops directly from specialty crop producers. This funding built upon previously established brand development and moved that branding into advertising for specialty crop producers. The campaign included: billboards, radio, print and other media and resulted in increased knowledge of specialty crop producers and products available within the county and neighboring Bay Area. This in turn spurred purchases from those producers. The project also included a survey of residents regarding purchase methods. Survey results indicated interest in online purchase methods and distribution hubs.

Solano Grown is now an independent 501(c)(6) non-profit organization, and proceeds from the overall sales conducted at the market will be used to continue marketing efforts for specialty producers in the future. The first step toward sustainability was the establishment of a cooperative relationship with SCC. SCC hosted the distribution food hub location. This location provided access to the public for pick-up but also provided a distribution center for fresh local foods on campus. This project also built on the foundation of specialty crop growers involved in Solano Grown. By reaching out to this network of farmers, Solano Grown had an already identified group of farmers who could benefit from the online farmer's market.

Project Approach

At the beginning of this grant, Solano Grown lost its non-profit status because of a filing error. As a result, the grant was immediately put on hold with approval from the California Department of Food and Agriculture, while Solano Grown worked to have its non-profit status reinstated. Once that was accomplished, it was necessary to re-establish contact with the specialty crop growers that had already been contacted. The start and stop nature of things made it difficult to reestablish good connections with the farmers. The farmers were skeptical and hesitant to sign up for the online marketplace because they did not know if the project was going to move forward. Subsequent farmer collaboration suffered because of this event.

Specialty crop farmer outreach continued and a small group of farmers signed up to sell crops on the website in 2014. This was an abbreviated selling period which only lasted two months, May and June 2014. During this time, sales were minimal. In 2014, a Market Manager was hired to conduct outreach to farmers and accept and distribute specialty crops through the Food Hub.

In 2015, the Solano Grown Board began outreach again with renewed energy and was able to engage and include 13 farmers on the website for the opening of the market in May. The year of 2015 also marked the hiring of a new employee, a Farmer Liaison. For the remainder of the grant, a Market Manager and a Farmer Liaison helped to achieve the goals of the grant.

Project staff began a concerted advertising effort in 2015 to let potential specialty crop buyers know about the resource available to them. Advertising efforts included online Facebook ads, online ads through local publications, print ads in local publications, rack cards to be handed out at tabling events, and direct mailers to potential customers. The online marketplace was also advertised to local specialty crop farmers through ads with the Solano Farm Bureau.

The Market Manager and Farmer Liaison reached out to farmers and noted time spent on outreach to specialty crop farmers. Any time spent on non-specialty crop farmers was paid with Solano Grown funds, not SCBGP funds. That being said, both the Market Manager and the Farmer Liaison focused efforts on specialty crops and therefore did not have many hours that were outside of the grant purpose. The online host of the farmer's market also tracked the products offered by each farmer participating in the online marketplace so it was easy to calculate which specialty crops were being sold on the marketplace.

Solano County has been a strong supporter of this project from the beginning and continually provided guidance and assistance in the outreach to specialty crop growers. The county also waived fees for Solano Grown to help keep this endeavor cost-efficient. In addition to the county, the SCC Horticulture Department was also supportive. SCC provided the Food Hub location to Solano Grown free of charge. This represented a huge savings and enabled Solano Grown to focus the majority of the grant funds on specialty crop farmer outreach and the increase of specialty crops sales. Additionally, members of the Horticulture Department provided countless volunteer hours to ensure the success of the Food Hub. Without this time and energy, project staff would not have been able to accomplish what it has.

Goals and Outcomes Achieved

The online marketplace was created to help specialty crop growers sell more specialty crops. The project had the following goals: 1. Increase in overall gross sales volume online of 2% each month from launch, and; 2. Increase in farmer participants by 4% each month. In order to achieve these goals, the marketplace was advertised throughout the Solano County region to engage potential buyers. This advertising was done via larger online mechanisms like Facebook and also through more local channels such as local newspapers, weeklies, and direct mail campaigns to the neighborhoods closest to the food hub. In addition to print and online advertisement, the board attended and tabled at local events to spread the word about the online marketplace to potential customers.

When focusing on the increase in specialty crop farmer participants, project staff used the existing Solano Grown membership to advertise the availability of the marketplace as a new sales channel, as well as the local Farm Bureau to entice new farmers not already associated with Solano Grown to join the marketplace.

There has been gradual growth for both farmers and buyers which is beneficial to specialty crop growers in Solano County. It is difficult to say if this growth will have a lasting effect though because the feasibility of the online marketplace is still to be determined. Without outside grant funding, it is doubtful that the marketplace can cover the base costs of the online marketplace itself and advertising costs. While there has been mild interest, it may not be enough to support the marketplace moving forward.

The overall goal of this project was to increase the sales of specialty crops in Solano County through the use of the online farmer's market. The Solano Grown Board worked toward that goal by specifically trying to increase in overall gross sales volume online of 2% each month from launch and an increase in farmer participants by 4% each month.

During the duration of the grant period, the sales were somewhat regular, but did not result in a steady 2% increase each month. When there was an increase, it was often more than 2%. Throughout 2015, sales fluctuated in the hundreds of dollars, with a high of $317.80 and a low of $105.20. The sales from 2016 showed steady interest through the end grant period, with a small dip between January and February and from

March to April. As the heavy specialty crop growing periods started, sales looked strong. Below is a chart showing the sales numbers and the percent change from month to month.

Specialty Crop Sales through Online Marketplace:

Year	Month/Year	Sales	% Change
2014	5/14	$36.00	
2014	6/14	$25.20	-30.0%
2015	5/15	$279.68	1009.8%
2015	6/15	$272.02	-2.7%
2015	7/15	$105.20	-61.3%
2015	8/15	$173.50	64.9%
2015	9/15	$317.80	83.2%
2015	10/15	$160.90	-49.4%
2015	11/15	$156.00	-3.0%
2015	12/15	$146.80	-5.9%
2016	1/16	$208.22	41.8%
2016	2/16	$139.96	-32.8%
2016	3/16	$154.66	10.5%
2016	4/16	$116.32	-24.8%
2016	5/16	$260.40	123.9%
2016	6/16	$275.33	5.7%

The goal to increase specialty crop farmer participation by 4% each month has been achieved though it has been uneven. During the bulk of 2015, there was a steady increase in farmers, going from 11 in July of 2015 to 18 by the end of 2015. At the beginning of 2016, there was a drop off as many farmers did not have product to sell and postponed marketplace participation until they did. Project staff anticipated an increase in participating specialty crop farmers as more specialty crops were ready for sale and that came to fruition. Starting in January of 2015 with five farmers, the farmer participation grew steadily through the end of the grant period. Below is a chart showing the farmer participation numbers and the percent change from month to month.

Specialty Crop Farmers Participating in Online Marketplace:

Year	Month	Farms	Growth from Previous Month
2015	May	13	
2015	June	12	-7.7%
2015	July	11	-8.3%
2015	August	13	18.2%
2015	September	13	0.0%
2015	October	14	7.7%
2015	November	16	14.3%
2015	December	18	12.5%
2016	January	5	-72.2%
2016	February	5	0.0%
2016	March	9	80.0%
2016	April	13	44.4%
2016	May	16	23.1%
2016	June	19	18.8%

As shown above, the 2% growth in sales from month to month was achieved at times but was more sporadic and uneven than hoped for by project staff. There were eight instances of a drop in sales from the previous month during the duration of the grant but when there were increases in sales, they outpaced the 2% goal. This shows that while the growth was uneven, it represented steady sales for the specialty crop growers. This is a success in the eyes of the project staff because even incremental increases in sales can have a dramatic impact on small- and medium-farmers.

The 4% specialty crop farmer participation was met regularly during the grant period. There were only three instances of a drop in farmers from month to month and two months that showed flat growth. As with the sales goal, the farmer participation was steady. While these metrics did not reveal the dramatic impact that was anticipated, it did show that there was benefit derived from the online marketplace and the farmers that participated were able to see value in their participation.

The steady participation by the specialty crop growers is a success. Business owners do not continue activities that do not benefit them and by staying active within the marketplace, the growers showed that this was a valuable tool in their larger marketing and sales portfolio. This participation in conjunction with the small but steady sales shows a successful impact within the farming community.

Beneficiaries

The specialty crop farmers that sold their products through the website benefitted from this project by having an additional sales avenue. Often, farmers are constrained by the availability of markets and the online marketplace provided a low-risk sales opportunity. The marketplace customers also benefitted from the project by being able to purchase locally grown specialty crops through a relatively easy, online mechanism that allowed mixing and matching of different farmers' products with a quick, one-stop pick up. The online marketplace had 19 farmers that participated and benefitted through increased sales and access to an additional sales channel. The online marketplace was used by approximately 60 customers throughout the grant period. These customers benefitted by having access to fresh, locally grown specialty crops. These purchases totaled over $2,800.

Lessons Learned

Positive outcomes include increases in sales for the specialty crop farmers that participated in the online marketplace. Those farmers that sold product were able to increase their sales, even if only incrementally. These sales are still important and help make ends meet for smaller and beginner farmers. Project staff saw that it was important to make it as easy as possible for specialty crop farmers to use the online marketplace. The Food Hub Manager and Farmer Liaison both spent time assisting farmers with the uploading of their products and other troubleshooting. Without that support, the specialty crop growers would not have had the sales they did.

Lesson: Small farmers need a variety of sales channels but also need assistance so it is easy to sell within these channels.

Project staff found during the grant that advertising in local publications, whether online or print had the greatest return on investment. When the grant proposal was originally written, all online advertising was focused on Facebook ads; however, it was found that very few, if any, sales resulted from the Facebook ads. As a result, the grant funds were redirected to local online advertising with the community newspaper. These ads received immediate attention from local buyers. In a one-week period in June, online wallpaper ads received over 25 click-throughs and the mobile ad received 13 click-throughs in the same amount of time.

Lesson: For the type of hyper-local sales that the Solano Grown Online Farmer's Market is promoting, hyper-local advertising should be used as well.

This project also had to battle low sales during the entirety of the grant period. Originally, project staff thought that the problem stemmed from the abrupt closing of the online farmer's market in 2014 due to issues with the non-profit status. While that definitely played a part and the steady sales from the peak season (June-September) in 2015 gave project staff hope, the sales dwindled once again in November 2015. Part of this may be the seasonality and lack of product diversity through the winter but there are bigger issues at play regarding the viability of an online farmer's market in the Solano area.

The Board discussed this topic in depth and emerged with theories and lessons on why the online farmer's market was not as successful as the original grant writers anticipated. These ideas are below:

1. Consumers want to see and touch their produce before buying it. The online farmer's market takes this tactile element out of the shopping experience and many customers have been reluctant to use the farmer's market for purchases as a result. Without that in-person component, consumers have difficulty getting over the hurdle of trust in the product. They were reluctant to take a risk on buying a product and hoping it was fresh and in good condition.

Lesson: It is important to establish trust with customers regarding product quality before expecting online purchases.

2. Community College students are not the ideal customer for the online farmer's market. Originally the thought was that placing the food hub at the college would bring a critical mass of customers who were already on site for other reasons. Unfortunately, this line of thought has not borne fruit. The average community college student is either a. still living with their parents and not cooking meals or b. is more budget minded and not purchasing local specialty crops from an online farmer's market. The food hub never sold to a student at SCC though some of the faculty purchased specialty crops. As a result, what was originally thought to be a central location with many buyers in a mile radius ended up being out-of-the-way for the customer the marketplace ended up attracting. That lack of a central location was a hindrance to both customers picking up specialty crops and farmers delivering their specialty products.

Lesson: When choosing a location for a Food Hub, thoroughly research potential customers ahead of time to identify the most central location.

3. The cost of the specialty crops on the marketplace can be high at times. This problem was identified and discussed early with some of the specialty crop farmers. Unfortunately, for the most part they were not interested in lowering their prices. The price variability made it difficult to have steady sales for some farmers and they did not necessarily see it as something they could or were willing to fix.

Lesson: Competitive pricing is necessary for the sales of average specialty crops.

Project staff were surprised with the lack of traction the online marketplace had with customers in Solano County. There is steady interest in buying local in Solano County and at the beginning of this process the Board thought that interest would translate to specialty crop sales. This was not the case.

The Board was also expecting more interest from the farming community. This might be a good thing though because it may reflect that Solano County farmers have quality sales channels in place and did not need additional ones. That being said, project staff thought there would be more participation from local farmers and this was not the case.

While the overall goals of this grant were achieved, the grant was not a huge success. The number of farmers participating and the amount of sales never reached what was anticipated when the grant proposal was drafted. The Board feels that there were many reasons for this ranging from difficulty using the online marketplace to customer's preference for a tactile experience when buying produce.

Additional Information

The website for the Online Marketplace is https://www.localfoodmarketplace.com/solano/.

USDA Project No.: 5	**Project Title:** NCO Food Hub Project	
Grant Recipient: North Coast Opportunities (NCO)	**Grant Agreement No.:** SCB13005	**Date Submitted:** December 2016
Recipient Contact: Patty Bruder	**Telephone:** (707) 467-3200 x282	**Email:** pbruder@ncoinc.org

Project Summary

The NCO Food Hub Project was designed to expand market access for local specialty crop producers by developing a food hub to manage and streamline aggregation, distribution, and marketing of source-identified local foods to distributors, wholesalers, retailers, and institutional purchasers. The project was developed to address the fact that many local specialty crop producers were unable to access mainstream markets, largely because of the remoteness of the area and its widely scattered communities, although some producers also lacked the technical knowledge to produce a consistent, quality, and reliable supply of specialty crops and lacked access to infrastructure for aggregation and distribution. NCO also recognized the needs of buyers, who wanted to benefit from the growing consumer demand for local specialty crops but lacked a full understanding of the variety and quantity of specialty crops being produced throughout the area. Some also lacked the experience and/or capacity to deal directly with individual growers.

NCO planned the food hub to prepare specialty crop growers to connect with the mainstream food system by developing aggregation and processing infrastructure and providing technical assistance (TA) to help them satisfy the requirements of institutional and commercial buyers. To better understand the specific needs of both producers and buyers, NCO initiated the project by carrying out preparatory activities as listed in the project workplan. These included: establishing an Advisory Council to provide guidance and oversight; thoroughly researching existing food hub models and best practices; and convening stakeholders from throughout the value chain and conducting focus groups, baseline surveys, and individual interviews to assess their specific needs and challenges. These initial efforts made it clear that obstacles to efficient aggregation, distribution, and marketing of local specialty crops were numerous and complex, as described below.

- Geography. Lake and Mendocino Counties together cover 4,762 square miles, an area almost equal in size to the state of Connecticut. Communities are small and scattered throughout the rugged terrain.
- Farmer demographics. The average farmer age is 58, and would-be farmers are slow to enter production because the extensive export-oriented viticulture in the area has made access to affordable farmland for specialty crop production very limited.
- Price. Small-scale farmers want to diversify their marketing channels beyond farmers markets, but must secure the highest price point possible to ensure their financial viability, which has led to a general aversion to wholesale marketing and any strategy that adds cost to a product already perceived as “too expensive” by buyers. Buyers have stated they are operating on razor thin margins and have difficulty justifying higher prices considering the time, labor, and administrative burden of local procurement.
- Volatile supply and demand. Buyers want to connect with local specialty crop producers, but have been frustrated by the lack of consistent supply of quality products and the inability to track and anticipate production from local farms. For their part, producers are independently planning their production without a clear understanding of demand and competition, resulting in unmarketable surplus and insufficient diversity of products.

- Lack of technical capacity. Many producers lacked the business acumen to operate a financially viable farming enterprise, had inadequate post-harvest practices (grading, packing, etc.), lacked access to needed infrastructure, and lacked the time and expertise to effectively and efficiently market their products. These conditions posed significant barriers to increasing their market share. Many buyers lack understanding of seasonality, regulations, and small-scale growing practices and challenges, and may have inflexible and varied purchasing practices that complicate local procurement.
- Conflicting definitions of local. While eating local is a popular phenomenon and demand is seemingly increasing, it has not necessarily resulted in increased sales for farmers, since many corporate chains are promoting all California-grown produce as local. Consumers who think they are purchasing local produce may in fact be consuming produce grown hundreds of miles away.
- Financial risk. Inconsistent and low-volume supply, coupled with volatile demand, competition with mainstream distributors, and widespread geographic dispersion of local farms and end-users placed the long-term financial viability of a centrally-located, physical aggregation and distribution hub in doubt.

In spite of the challenges, local specialty crop producers and buyers were committed to improving the viability of the local specialty crop market, and both were willing to collaborate toward this end. With essential components in place—producers, willing buyers, existing distributors, and the beginnings of a marketing campaign—project staff developed a revised plan of action that addressed the same outcomes as the original proposal but focused on maximizing access to quality, reliable, and consistent local product through decentralized nodes (see Attachments 1, 2, and 5) and multiple delivery routes to facilitate aggregation and distribution. NCO placed greater emphasis on building the long-term capacity of the local food value chain and empowering stakeholders with the information they need to work together effectively. The primary difference was the removal of the centralized aggregation, packaging, and distribution component. food hub operations were supported with specialty crop buyer education, specialty crop producer training and technical assistance, and streamlined sales and marketing.

Although Mendocino and Lake Counties were historically primary breadbasket producers, much of the area's production capacity has been lost, and many small-scale crop growers lack the time and infrastructure to connect to the regional distribution system as well as the capacity to market, package, and distribute their produce to comply with the requirements of institutional and other large buyers. These gaps limit their ability to access mainstream retail and wholesale markets. In recognition of the growing demand for local foods, the food hub was designed to enable specialty crop growers to connect effectively and efficiently with the regional food system by addressing gaps in the value chain to increase their access to business and institutional buyers.

The Food Hub Project built on two previous Specialty Crop Block Grant Program (SCBGP) grants, neither of which included the aggregation, distribution, marketing, and technical assistance components that were integral to the food hub.

- 2011 SCBGP Project 46: *North Coast Opportunities Farm2Fork Project* provided training, equipment, and TA to specialty crop producers and to schools and other buyers to increase institutional purchasing of locally grown specialty crops. This effort trained 65 school food service staff, and as a result 4 school districts began buying fresh produce from 12 local specialty crop growers, representing a sustainable 100-250% increase in local farm-to-school purchasing. An additional 9 school districts, 3 hospitals, 7 grocers, and 15 restaurants also developed their local purchasing capacity through

Farm2Fork and over 100 regional producers had the opportunity of benefiting from the increased institutional demand for local specialty crops. The food hub project created processes and an infrastructure to support continued access to local markets for specialty crop producers.

- 2009 SCBGP Project 32: *A Growing Movement to Seed Healthy Eating* worked to maintain and expand the Lake County Grown online ordering system and to facilitate partnerships to increase market access for local farmers and buyers. NCO recognized that an online ordering system would play a key role in developing the link between institutional buyers and growers by allowing orders to be placed through the food hub while retaining individual grower identity. The food hub project built on the foundation laid to develop and operate the NCO Food Hub online marketplace (www.localfoodmarketplace.com/mendolake/Products.aspx).

Project Approach

PHASE ONE: PREPARATORY WORK (October 2013 – March 2015)

During the first 18 months of the project, NCO carried out a range of preliminary work, as described below.

- NCO conducted outreach to inform specialty crop producers and buyers about the project through press releases, live radio interviews, email correspondence with 125 specialty crop producers and 30 buyers, and presentations to the Mendocino County Food Policy Council, Mendocino County Farmers Guild, and Mendocino County Farmers Market Association (McFARM). Staff also met individually with key stakeholders, including Agricultural Commissioners and Environmental Health Directors. An informational meeting was held with local United States Department of Agriculture (USDA) representatives and 15 community partners to leverage their support and networks for disseminating project information to specialty crop producers.
- In December 2013, NCO partnered with the Mendocino County Farmers Guild to convene a forum of 65 specialty crop producers who provided input on aggregation, marketing, and distribution needs.
- NCO recruited 22 producers, buyers, and community members to participate in an Advisory Council that began meeting in March 2014 and met regularly throughout the project. Members included professionals from County Departments of Environmental Health, local banks and credit unions, specialty crop producers and buyers, independent marketing consultants, and non-profit managers.
- NCO performed extensive research on food hub models and best practices.
- To assess local needs, NCO held three focus groups with 20 producers, collected 24 baseline producer surveys, and conducted one-on-one interviews with 40 specialty crop producers, 10 restaurants, four retailers and grocers, three distributors, and 25 nonprofit, governmental, and other stakeholders.
- NCO worked with an external evaluator to develop project monitoring instruments and compiled data collected through the assessment process into comprehensive producer and buyer databases that included information on location, existing market relationships, specialty crops and quantities produced and sold, buyer requirements in terms of quantity, standardization, order size, ordering and delivery specifications, producer capacity, and interest in participating in the food hub.
- Assessment information was used to create both physical and digital maps of specialty crop farms, buyers, and distribution routes to facilitate communication and logistics (see Attachment 1).
- Drawing on information collected through the assessment process, staff provided a range of training and technical assistance to address identified needs, as summarized below.

Table 1. Training and TA activities

Date	Activity	Participants
March 2014	Farmers Convergence Event, with workshops on local distribution, food safety, farm financing, farm-to-institution sales, value-added production, and USDA support services.	175 specialty crop producers and buyers
December 2014	Wholesale Success for Specialty Crop Producers Training	12 producers
December 2014	Capay Valley Farm Tour	12 producers
March 2015	Farmers Convergence: workshops on farm mapping, soil health, financing, small farm economics, food hub sales, retail produce management, labor laws, GAP, small farm production techniques	140 producers and buyers
March 2015	Specialty Crop Farm Recordkeeping	11 producers
February 2016	Wholesale Success for Specialty Crop Producers Training	23 producers
March 2016	Farmers Convergence: workshops on direct marketing, going wholesale, farm financing, no-till production, labor, ask a retailer, farm accounting, composting, hedgerows, Food Safety Modernization Act (FSMA)	150 producers and buyers
March 2016	Food Safety full day workshop	19 producers
April 2016	Sales and Marketing for Specialty Crop Producers	12 producers
May 2016	Specialty Crop Farm Equipment	14 producers
2015-2016	A total of 160 hours of 1:1 training and TA provided to specialty crop buyers, chefs, and school district food service directors to demonstrate the process of purchasing through the Food Hub and provide support with production planning and other topics.	25 producers

- Working with a contracted marketing consultant, project staff developed a comprehensive branding campaign aligned with the Grown Local brand, to promote local specialty crop purchasing and consumption.
- In collaboration with three other food hubs in development or operation in the region, project staff developed a Community of Practice with regular conference calls to share hub-related information and resources toward the development of a future regional network to expand market opportunities for specialty crop producers.
- After assessing a number of existing online ordering systems, including the version that was being used by Lake County Grown, Local Food Marketplace was selected and project staff worked with them to adapt the existing online ordering system to meet food hub requirements for online ordering, invoicing, billing, and tracking while providing real-time online availability listings to enable buyers to purchase from multiple producers (and vice versa) through one invoice and one payment.
- Using in-house accounting expertise, an internal accounting system was set up to integrate with the online ordering system.
- The policies, procedures, and logistics of availability, ordering, and delivery were developed in partnership with farmers and buyers. NCO finalized food hub procedures to ensure that all specialty crops were packed in closed full cases by producers and not opened until they reach the buyers. This structure minimized overhead and eliminated the need for organic certification or produce handler licenses. Through ongoing communication, NCO determined that the food hub could be licensed as a Commissioned Merchant, given that it would not be in possession of specialty crops sold through the food hub. The hub also managed financial transactions, thereby eliminating cash flow issues. The sales

system has the added benefit of providing records and tracking production for participating producers. Surplus production that is not purchased through the system can be channeled to secondary markets at discounted rates, if desired by producers. Labels that properly identify local products according to regulatory requirements are utilized. Source identification and growing practices are communicated to buyers and customers utilizing local branding materials.
- In order to decrease transportation costs and increase geographic reach for producers, NCO worked with producers, distributors, and other partners to coordinate delivery routes. Mendocino Coast Produce, a local delivery business, agreed to reserve space on their truck for up to 100 cases of produce per each delivery cycle, with a minimum of one case per delivery location and four cases per pickup location. Project staff also developed a series of delivery routes spanning the two counties that ensured that specialty crops could be picked up from and delivered to most areas within the target area. There were two weekly deliveries, Tuesdays and Fridays, based on buyer and producer needs.
- Regional nodes were developed as aggregation points, mobilizing existing cold-storage infrastructure where possible and investing in additional storage capacity to enable safe cross-docking. The nodes use shipping containers and CoolBot air conditioning systems with two areas cooled to two different temperatures to accommodate varying specialty crop temperature requirements. Node sites include Caspar, Ukiah, and Willits, where NCO installed the shipping containers, as well as locations with storage solutions made available at no cost by four local specialty crops producers.
- NCO piloted the food hub in late 2014. Through the pilot, staff were able to understand the platform from both buyer and seller points of view, and to make appropriate modifications.
- NCO began accepting applications from producers and buyers in the spring of 2015. (See Attachment 4 for Farmer Guide to Using the Food Hub)

PHASE TWO: IMPLEMENTATION (April 2015 – June 2016)
- Food hub operations began in May 2015, with staff coordinating twice-weekly sales and deliveries. Total revenue by the end of the grant was $103,915 with a gross margin of $12,769. Most of the margin was spent on delivery fees, with a small amount held in reserve for unanticipated future expenses.
- The marketing campaign launched in June 2015 concurrently with full food hub implementation. Marketing strategies included customized point-of-sale materials; radio and print advertisements; news articles and editorials (see Attachment 3); social media; photo ID cards for participating farmers; and online videos and blogs. The Grown Local logo, deployed in neighboring Sonoma County with great success, is used as an identifying brand. Later in the period, beginning with the surge of late summer and fall produce, radio ads highlighted the food hub and key local specialty crop buyers. Staff also worked with key buyers to develop in-store signage to introduce local specialty crop farmers.
- Project staff led specialty crop producers and school district food service directors in coordinated production planning to meet institutional needs, first determining which crops producers could grow in larger quantities and then working with food service directors to plan a calendar of monthly purchases based on the statewide Harvest of the Month program. These plans resulted in forward contracts for more than nine tons of local specialty crops (e.g., apples, cantaloupe, pears, peppers, slicing tomatoes and cherry tomatoes, spinach, summer squash, and watermelon) from three specialty crop producers during the coming school year.
- Project staff carried out ongoing efforts to identify opportunities to utilize existing distribution channels, through backhauling or backfilling agreements with established distributors already serving

the region and with producers who have existing delivery routes to bring their harvest to regional markets.

The active participation of the Project Coordinator at all stages of the project enabled NCO to monitor activities to ensure that all transactions involved only specialty crops. Specific strategies to ensure that the project would solely enhance the competitiveness of specialty crops are described below:

- Members of the Food Hub Advisory Council were informed at the start of every meeting that the focus of the food hub is exclusively on specialty crops.
- During interviews with specialty crop producers and buyers, project staff specifically stated that only specialty crops were eligible for participation in the project, and staff made regular visits to participating producers to ensure that the project worked only with specialty crops.
- All direct technical assistance, consulting, and trainings were offered only to specialty crop producers.
- For workshops and conferences, tracking mechanisms were established to ensure that grant funds supported only costs directly related to specialty crops. NCO and its partners secured donations to support the approximately 20% of costs that were not specific to specialty crops.
- Outreach efforts targeted growers and buyers who purchase specialty crops. To ensure outreach solely enhanced California specialty crops, this was explicitly stated in all outreach materials.
- No non-specialty crops were handled or sold by the food hub, as confirmed by sales records. The food hub's online sales software allowed only specialty crops to be listed, and all food hub sales were carefully tracked by type and quantity of each crop.
- Packaging developed or purchased through the food hub was provided only for specialty crops.

The project benefitted from close partnerships with stakeholders who provided valuable input and support throughout the project. Contributions made by each partner follow.

- Capay Valley Farm Shop partnered with NCO to offer two "Wholesale Success for Specialty Crop Producers" technical trainings.
- Clearlake Community Food Pantry partnered with NCO in distributing food hub specialty crops.
- Food Hub Advisory Council members met regularly to advise NCO on issues ranging from logistics to pricing to ownership structure.
- General Produce trucked food hub produce to communities not served by other routes.
- Mendocino Coast Produce carried food hub produce and arranged delivery schedules, allowing the food hub to operate with low overhead during the initial phase of the project.
- Mendocino County Department of Agriculture provided support through the County's Approved Source Food Safety Program and also provided meeting space for Advisory Council meetings.
- Mendocino County Farmers Guild provided meeting space and facilitated connections with other regional Farmers Guilds. Through these networks, NCO reached more local specialty crop producers, and specialty crop producers gained access to Guild trainings and resources.
- Mendocino Food Policy Council provided input on project development and promoted the food hub to specialty crop producers and buyers.
- Specialty crop buyers, including school district food service directors, produce managers, grocery marketing directors, chefs, and restaurateurs, worked with project staff to refine operations and marketing plans. These professionals provided feedback on marketing materials, met in person to plan purchasing, and took time to discuss pricing plans and purchasing habits.

- Specialty crop producers, in addition to their business relationship with the food hub, contributed to the project by: letting the hub use cold storage space at their locations; providing potential customer contacts; responding to project surveys; providing production planning advice; allowing their farms to be photographed for marketing purposes; and leading tours of their farms for potential customers.
- University of California Cooperative Extension (UCCE) helped facilitate the Capay Valley Farm Tour and offered a full-day workshop on food safety following the 2016 Farmer Convergence.
- Several organizations contributed in-kind to the Farmers Convergences, including the Community Alliance with Family Farmers (CAFF), CA FarmLink, FarmsReach, the USDA Farm Service Agency, Anderson Valley Food Shed, CropMobster, the Grange Farm School, and KivaZip.

Goals and Outcomes Achieved

Activities carried out by project staff have been detailed in preceding responses. All of those activities were implemented to achieve the performance goals and measurable outcomes.

The anticipated long-term outcome of the project is to sustain the operations of the food hub to continue to enhance the competitiveness of specialty crops by providing local producers with expanded access to local institutional and retail markets. In close collaboration with the Advisory Council, NCO has actively addressed food hub sustainability following the grant period by researching and assessing a range of ownership models and structures. The preliminary plan is to create a specialty crop farmer cooperative with annual fees, democratic control of budget and operation, and multiple levels of membership depending on each farm's size and usage of food hub services. Although the plan has yet to be finalized, it has been well-received by the Advisory Council and other farmers that have been engaged in the discussion.

Goal/Outcome 1. Increase access to local retail and institutional markets for local specialty crop producers resulting in an average per-farmer increase of 10% in specialty crop sales and an average per-farmer decrease of 15% in transportation costs related to distribution of specialty crops.
During the final months of the project, staff surveyed 23 participating specialty crop producers about their experience. Asked how many times they had sold through the food hub, 14 producers (61%) reported that they had sold 2 to 5 times, while 9 producers (39%) sold more than 5 times during the grant period. Producers were asked to report farm business costs (e.g., transporting produce to markets, marketing, and post-production costs) that were impacted by their participation in the food hub. Of 21 producers, all but 2 reported decreased costs in at least one expense area. The extent of the decrease in costs varied widely, ranging from 1% to 100%. (Note that, while 21 producers reported cost decreases, not all provided an amount of decrease.) Producers were also asked to report any gains in farm income resulting from their participation, and the source of their increased income (e.g., increased sales, higher sales prices, more sales of surplus and seconds). Of 23 producers, all but 4 reported increases in their income that ranged from 0.1% to 60%. Producers were next asked to report changes in the amount of time they spent on their farm business, as well as the types of activities (e.g., marketing, transportation, direct sales) for which the time spent changed. In all, 16 of the 23 producers (70%) reported reduced time spent in at least one activity. For example, the most active producers were able to reduce their drive to market by an average 80 miles one way and were also able to access new, more distant markets without increasing their travel time.

Goal/Outcome 2. Increase in purchase of local specialty crops by institutional/retail buyers, with at least 20 institutional/retail buyers of local specialty crops and an average increase of 10% in the quantity of local specialty crops purchased by local institutional/retail buyers by the end of the project.

At the full launch date in May 2015, the food hub began with five farmers selling and eight buyers purchasing specialty crops intermittently. In June 2016, at the end of the project and just 14 months later, there were 9 orders twice a week, with specialty crops sourced from 11 different farmers purchased by 21 different buyers. From January 2015 through June 2016, the top 10 buyers and the top 5 producers accounted for 80% of food hub sales. The most active buyers regularly purchased twice weekly throughout the reporting period.

At the end of the project, staff surveyed 25 food hub buyers, including restaurants and markets, schools, and buying clubs. Asked how many times they had purchased through the food hub, 17 of 24 buyers (71%) reported that they had purchased more than 5 times. The top reason that buyers gave for buying through the food hub was customer demand (76%), although nearly half (48%) also identified the food hub's competitive pricing as a factor. Other factors included local farmers' increased ability to meet buyer requirements in terms of timeliness and availability (32%), quantity (32%), consistency (32%), and packaging (24%).

In specific response to the goals, 84% of the buyers reported that they were purchasing more local specialty crops. Reported increases ranged from 5% to 300%, with the most frequent response being 10%. In terms of variety, 20 buyers (80%) reported purchasing more types of local produce, and in terms of cost, 14 buyers (61%) reported paying either lower prices or the same amounts for local specialty crops purchased through the food hub, while 36% reported paying higher prices. Only one buyer ventured to estimate the percentage by which his costs decreased, which was 25%.

Using the food hub launch date of May 2015 as a baseline, progress can be seen by comparing the numbers of participating producers and buyers, as well as sales figures, over the course of the grant, as shown below.

Table 2. Baseline and end-of-project data

Indicator	May 2015	June 2016	Difference	Percent Change
Number of specialty crop producers selling through the Food Hub	5	47	+42	+840%
Number buyers purchasing through the Food Hub	8	30	+22	+275%
Number Food Hub orders	18	609	+591	+3,283%
Revenue generated by specialty crops sold through the Food Hub	$2,007	$103,915	+$101,908	+5,078%

NCO collected baseline data from both producers and buyers through focus groups, baseline surveys, and individual interviews. Baseline data collected at the beginning of the project were primarily qualitative in nature; most local specialty crop producers were either unable or unwilling to share specific details related to their income and expenditures. Rather, baseline data collected by the project focused on local specialty crop producers (e.g., where they are located, types of crops they produce, where their produce is sold, marketing strategies) and local specialty crop buyers. Intensive interviews with 16 producers revealed that: 13 were selling locally (within 100 miles); 7 wanted to sell wholesale; 7 would scale up and grow more if they were sure they could sell it; and their most successful crops were cucumbers, tomatoes, greens, squash, potatoes, and orchard fruit. Other quantitative outcome data has been cited previously in this report.

Working with local partners, NCO successfully created a local specialty crop aggregation, sales, and distribution hub, making it possible for producers to market and distribute their produce more efficiently and economically while retaining brand and location identity and supporting their economic vitality. By the end of the grant period, 47 specialty crop producers had sold produce through the food hub, and 30 buyers had purchased through the food hub, resulting in total sales of $103,915.

Beneficiaries

Project beneficiaries include specialty crop producers, specialty crop buyers, and community members. The 47 specialty crop producers that sold through the food hub benefited from the project in numerous ways:

- Increased farm income.
- Training on food handling safety, crop planning, marketing, and packaging for mainstream markets, etc., resulting in increased capacity to meet institutional and commercial buyer requirements.
- Through NCO, access to liability insurance coverage for specialty crops sold through the food hub.
- Reduced marketing, transportation, and distribution costs.
- Reduced challenges related to aggregation, packaging, marketing, and distribution.
- Ability to retain and market grower-identified products.
- Ability to focus effort on growing, rather than marketing and delivering their specialty crops.
- As a result of the Grown Local marketing campaign, increased community awareness of the availability and value of specialty crops.

The 30 business and institutional buyers that participated in the project benefited through:

- Increased access to products that were source-verified and grown using sustainable techniques.
- Increased capacity to satisfy customer demand for locally-sourced specialty crops.
- For locally-owned businesses, a market advantage because they became known as the best resource for purchasing local specialty crops.
- Stronger relationships with local specialty crop producers.

Additional benefits, beyond those that accrued to producers and buyers, included the following:

- Increased access to local specialty crops for local consumers.
- Increased community awareness of the availability of local specialty crops and their value.
- More food dollars kept in the community, thus increasing regional wealth through the multiplier effect, which calculates that every $1,000 in net farm income generates an additional $930 in the community.

By the end of the grant period, 47 specialty crop producers had sold produce through the food hub, and 30 buyers had purchased through the food hub.

Lessons Learned

Specific challenges and lessons learned are described below.

- Early in the grant process, NCO was challenged by the complicated maze of regulations around food safety and other regulations. NCO accessed technical support in understanding the regulatory and licensing requirements for food hub operation; understanding these requirements made it possible to provide producers and buyers with accurate information in securing needed certifications and ensuring regulatory compliance.

- On the opposite end of this scale, NCO learned that some requirements were less, rather than more, onerous than previously believed. At the outset of the project, school district food service directors were leery about procuring from local farmers because of the extensive food safety regulations that govern school meals. However, NCO learned from USDA Regional Representatives that schools do not have to follow the more stringent procurement procedures when purchasing in amounts of less than $150,000. NCO then offered technical assistance on compliance to food service directors, covering bids, contracts, forward contracts, and marketing, so that they could purchase through the food hub.
- A second lesson learned from working with schools was that, because of the tight constraints on the time they have for processing foods, they preferred to order specialty crops that would require minimal processing, such as cherry tomatoes, or foods that they would normally purchase elsewhere that required the same amount of time to process as locally-procured items, such as fruit.
- Input from the Advisory Council made it clear that most specialty crop producers operate on a small scale that precludes them from accepting wholesale prices, either because they have limited land area, meaning they cannot grow the size of their operation to make up for a reduced margin through increased volume, or because they have a limited resource base that does not allow them to save labor costs through mechanization. To address this challenge, NCO developed a food hub structure that allowed producers to set their own prices.
- Food hubs must learn to effectively communicate the value of the services they are providing, since it is not in their power to set market rules. In spite of producers' and buyers' theoretical support for the food hub, in practice some producers with long-term market relationships chose to sell directly rather than through the food hub. A related challenge continues to be the pressure on margins. The food hub uses a markup of 15%, although most research recommends markups of 20-30%. However, even at the 15% markup some buyers contacted producers directly to work out a better deal, and others have continued to purchase through mainstream distributors, even though the local specialty crops are of higher quality. On the other hand, several producers agreed to route their existing wholesale accounts through the food hub. This level of buy-in will continue to be key to the food hub's success. Project staff are continuing to reiterate and reinforce why the food hub is valuable to the local food system.
- NCO developed a marketing package around Grown Local branding. Producers and buyers that become Grown Local members sign agreements and gain the right to use the Grown Local logo and marketing materials at three different levels, depending on their purchase amounts. The agreements are structured with Grown Local brand sustainability in mind so that after the grant funding ends, retailers and farmers will pay an annual fee for continued access to the materials.
- Production planning turned out to be a hurdle. To address this challenge, project staff spent long hours working with producers to determine which crops they might be able to grow in larger quantities, and with the school district food service directors and market produce managers to review their invoices; track purchases, quantities, and costs; and identify foods that could be purchased locally at similar prices without adding to processing time.
- Lack of redundancy is a challenge to a small rural area, where the loss of just one farmer can result in shortages that reduce supply and inconvenience buyers. Continued outreach, to engage new producers, and support, to retain participating producers, are essential to produce quantities that meet the needs of local buyers.

- Most small-scale specialty crop producers do not maintain records on transportation or marketing costs, making it difficult to assess changes in these expenses.

In response to a request, NCO is compiling a description of the decentralized node design and operation, and will share it through the National Good Food Network.

Through the USDA Community Facilities Grants Program, NCO secured funding to buy a refrigerated delivery truck to provide the distribution support that is essential to operating the decentralized node food hub model.

At the beginning of the project, the Coordinator initiated contacts with other food hubs in the region. The initial contact developed into an informal Community of Practice with monthly conference calls to share challenges and solutions towards the development of regional market access. Recognizing the value of this network, in 2015 University of California, Davis took on facilitation of the group, which continues to meet every month.

Through a range of revisions, project goals were achieved, as discussed throughout this report.

Additional Information

See Attachments

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 6	Project Title: Creating Value-Added Demand for California Figs – Foodservice/Food Manufacturing Ingredient Education Program (California Fig Ingredient Program)	
Grant Recipient: California Fig Advisory Board	**Grant Agreement No.:** SCB13006	**Date Submitted:** December 2016
Recipient Contact: Karla Stockli	**Telephone:** (559) 243-8600	**Email:** kstockli@californiafigs.com

Project Summary
The initial purpose of this project was that there was an 88% increase of fig and fig ingredient imports into the United States over the base year of 2007-2008 resulting in a devastating effect on this United States specialty crop, threatening the economic viability of fig growers, processors, suppliers and workers. Due to this aggressive import pressure, the California fig industry requested funding to create a comprehensive ingredient education program to educate key target audiences about domestically grown- and produced-figs and fig ingredients and the importance of choosing figs from California.

In addition, 70% of the California fig production competes with imports in low value, commodity business segments. To remain viable, the industry needed to develop markets that recognize the value California figs and fig ingredients contribute to specialty foods instead of competing in the low-value commodity segments. The proposal objectives were to support the emergence of niche, high-value markets among multiple audiences by demonstrating the use of California figs and fig ingredients in product development and clearly differentiating why California figs are preferable to imports. California dried figs are a high-quality and versatile ingredient which provide a full range of possibilities in new products and menu items: enhancing flavors, lowering overall ingredient costs, adding nutrients of concern while reducing fat and sodium to meet demand for flavorful and good-for-you food. This program focused solely on promoting the specialty crop, California dried figs.

This project was important and timely to the California fig industry for several reasons. The initial investment provided the industry an opportunity to strategically build an ingredient development program for long-term sustainability and success. In this effort, the industry created a comprehensive ingredient education program to educate key target audiences about California grown- and produced-figs and fig ingredients. The program funding also provided the ability to conduct one-on-one appointments with 18 key targeted national account product developers resulting in new products for foodservice and retail using California fig ingredients as well as increased awareness to about 46,000 influential food professionals on the importance of California grown figs.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach
Activities that were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal were as follows:

- Partnership alignment. Contract negotiations and partnership alignment were completed.

- Survey. Conducted a pre- and post-program chef and food technologist attitudes and intent to use California fig and fig ingredients survey among food professionals to establish a benchmark and measure performance.
    - Results: Out of over 500 respondents: 74% represented product developers from foodservice volume ingredient categories, up 6% from benchmark; 49.94% indicated use of dried figs, up 10.73% from benchmark. In addition, the survey validated that product developer needs are perfectly aligned with the solutions California fig and fig ingredients provide to them: 1) nutrition: 37.89% were interested in dried figs for product development for nutrition, up 10.01% from benchmark; 2) functionality: 52.17% were interested in dried figs for product development because of functionality which is up 8.90% from benchmark; and 3) natural sweetener: 35.4% were interested in dried figs as a natural sweetener which is up 10.4% from benchmark. 67% of respondents also indicated an interest in learning more about California dried figs and fig ingredients for product development.
        - Conclusion: The California Fig Ingredient Program provided the opportunity to target and educate new potential users of California fig ingredients to shift usage and meet program objectives while setting the stage for continued future one-on-one product development appointments.

- New product concepts. Developed 10 new California fig and fig ingredient concepts to demonstrate the unique possibilities using California fig and fig ingredients in the specialty food categories. Including formulation from small-to-large scale for commercial use presentation styles for the Institute of Food Technology (IFT) Supplier Nights/Culinary School Curriculum Seminars and Product Development Meetings.
    - Results: The development of 10 new California fig and fig ingredient concepts allowed for the project team to customize meeting presentations for each appointment showcasing the concepts to best provide solutions to product developer needs.
        - Conclusion: These innovative product concepts provided the ability to demonstrate the solutions to product developer needs.

- Ingredient concept photography. Professional photography of 11 finished ingredient concepts was completed.
    - Results: Photography was taken of Fig Pepita Bar, Fig Powerball, Fig Chocolate Bar, Fig BBQ Sauce, Fig Steak Sauce, Fig Thai Curry Sauce, Fig Bread, Fig Biscotti, Fig Horchata, Fig Kombucha, and Fig Coffee. Photography has been used in meeting materials for the ingredient program which is designed to enhance the competitiveness of California Figs and re-gain market share from low-cost imports.
        - Conclusion: Professional photography brings the ingredient concepts to life and enhances meeting and presentation materials.

- Ingredient development meetings. Conducted 18 ingredient development appointments reaching 187 attendees in total for one-on-one customized presentations to demonstrate the unique use of California fig and fig ingredients in new products and educate each targeted account on the functionality of California fig ingredients to clean up labels (reduce sodium, refined sugars, imitation coloring and flavors) while increasing nutrition (fiber, potassium, calcium, antioxidants and more).

- Results: Out of 18 appointments, two companies are in the final stages while six are in the beginning stages of new product development using California fig ingredients.
  - Conclusion: Conducting the ingredient development appointments has provided the opportunity to enhance the viability of California fig ingredients and sustainability with potential of new products in higher value niche markets.

- Developed list of ingredient companies. Developed a potential targeted list of companies for product development meetings to conduct educational California fig ingredient seminars to demonstrate the unique uses of California fig and fig ingredients in new products.
  - Results: About 335 (67% of 500) key accounts are interested in learning more on California fig product ingredients.

- IFT Sectional Meetings/Culinary School Curriculum Seminars. Completed three IFT Supplier Nights (Minnesota, Illinois and New Jersey) and two Culinary School Curriculum Seminars (Johnson & Wales and Southwest Minnesota State).
  - Results: These events provided the opportunity to demonstrate unique ingredient versatility and functionality of California fig ingredients in new concepts to over 8,000 attendees (IFT Sectional Meetings) and 60 attendees (Culinary Schools).
    - Conclusion: These opportunities enhance the viability and sustainability of California figs and fig ingredients with increased awareness to identified target audience, adding new target accounts to existing database for future new product development appointments to regain market share from low-cost imports.

- Ingredient kit. Developed a California fig and fig ingredient kit (mission figs, fig pieces, fig nuggets, fig paste, fig powder, fig fiber and fig juice concentrate) for fulfillment from the Culinary School Curriculum Seminars, IFT Supplier Nights and Ingredient Development Meetings.
  - Results: Over 550 kits fulfilled to food professionals.

- Printed support materials and presentations. Developed materials and presentation for use during IFT Supplier Nights, Culinary School Curriculum Seminars and Ingredient Development meetings.
  - Results: California fig brand and look for ingredient education program.

- Food Arts partnership. Developed three recipes for the Annual Food Arts Chef event in Chicago, Illinois.
  - Results: Demonstrated the unique uses of California fig and fig ingredients in savory applications through sampling to approximately 1,500 influential food professionals and added attendees to a database for potential product development meetings in the future.
    - Conclusion: Ongoing outreach and fulfillment of the California fig ingredient kit and securing meetings.

- Figology Council. Established the ingredient and culinary council with four experts in the field of Research Chefs, Cereal Chemists, Food Technology and Chefs.
  - Results: These experts provide ingredient development expertise, collaboration and expert validation to the California fig program.

- Research Chefs Association (RCA) Conference and American Association of Cereal Chemists Conference (AACC). Exhibited innovative California fig ingredients to a combined total of nearly 3,000 attendees at these two leading food professional conferences.
    - Results: Demonstrated unique ingredient versatility and functionality of California fig ingredients (RCA: Fig Bar, Fig Powerball, Korean BBQ Sauce, Thai Dipping Sauce and Asian Steak Sauce; AACC: Fig Bar, Fig Powerball, Fig Chocolate Bar and Fig Bread) to targeted audience of cereal chemists and food scientists.
        - Conclusion: Through this participation, project staff were able enhance the viability of California fig ingredients and add over 3,000 key contacts to a database and contributed to the 335 ingredient meeting target list. In addition, project staff provided ingredient kits to interested attendees and schedule future meetings to develop new products using California fig ingredients.

- Natural Products East. Exhibited innovative California fig ingredients creating awareness and reaching 35,000 Research Chef and Food Technologist attendees with California fig messaging which was perfectly aligned with program objectives for natural, functional and nutritious.
    - Results: Demonstrated unique ingredient versatility and functionality of California fig ingredients: Fig Coffee, Gluten Free Fig Biscotti, Fig Energy Bar, Fig Powerball and Fig Meat Free Salami to targeted audience of research chefs in the health and better for you segment of food and retail goods.
        - Conclusion: Although the show provided the opportunity to demonstrate California figs and fig ingredients to a large audience and add key contacts to the ingredient meeting target list, project staff would not participate in the future because of the overall size of event and organizational flow which limits the ability to have valuable interaction with attendees.

- Efforts to disseminate project results. The California Fig Ingredient Education team (California Fig Advisory Board (CFAB) staff, Food Technologist and Food Agency Professional) met with California dried fig processors, growers and the CFAB during the program to provide periodic project updates and results. A complete report will be generated upon completion of the program.

The overall scope of the project did not benefit commodities other than California figs, a specialty crop.

The significant contributions and roles of project partners are as follows:

The Food Innovator on the project was a full-service company focused solely on the food ingredient industry and has used their expertise to build the foundation of the California Fig Ingredient Program. Their ability to fully understand the functional benefits and the applicable fig ingredients to use in product development resulted in concepts which demonstrated versatility and functionality to product developers contributing to the long term success of the program – from lowering ingredient costs, reduced baking time, cleaning up label through the replacement of refined sugars, imitation colors and flavors.

The Research Chef on the project used their expertise to elevate California figs and fig ingredients in niche specialty food categories instead of competing in low-value commodity markets that are impacted by low-cost imports. Recognized for their success as an award winning chef, they have contributed to program awareness and acceptability.

The Food Technologist on the project has provided food technology expertise and development of California fig products. Their experience developing markets for food ingredients has been key in the development of ingredient categories and concepts of California figs and fig ingredients in niche specialty food.

Goals and Outcomes Achieved

The activities described above were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal.

All goals for the reporting period were exceeded with the exception of the percent positively shift sales which is too early to determine. The results of the program are summarized below:

a. The first target goal was to positively shift usage and preference amount chef/culinary and food technology professional target audience by 5-10% during the program.
    a. Result: Positively shifted usage and preference among chef/culinary and food technology professionals by 10.73% during the program.

b. The second target goal was to increase new product and menu development by 16% over the same period prior year; resulting in 10-15 new products and menu items during the program.
    a. Result: Increased new products by 110% resulting in 21 new food products during the program. There was also a significant increase (51 in non-food category (cosmetics, pet food, etc.)) which previously was not tracked but appears to be opportunistic for future growth and further expansion from low-value commodity ingredient categories.

c. The third target goal was to positively shift sales from low-value to commodity segments to niche added value segments by 8-13% during the program.
    a. Result: Although there is a positive shift from low-value commodity segments to niche added-value food categories: such as snacks, energy bars, beverages and condiments; non-food categories: such as lipsticks, body care and pet foods, it is too preliminary to track the percent shift in sales at this time.

The baseline data gathered to date and the progress toward achieving set goals follows:

1. Survey. Conducted pre- and post-program surveys to understand current awareness perceptions of California figs and fig ingredients.
    a. Result: As previously stated, out of over 500 respondents: 74% represented product developers from foodservice volume ingredient categories; 49.94% indicated use of dried figs (up 10.73% from benchmark). In addition, the survey validated that product developer needs are perfectly aligned with the solutions California fig and fig ingredients provide to them: 1) nutrition: 37.89% were interested in dried figs for product development for nutrition, up 10.01% from benchmark; 2) functionality: 52.17% were interested in dried figs for product development because of functionality, up 8.90% from benchmark; 3) natural sweetener: 35.4% were interested in dried figs

as a natural sweetener which is up 10.4% from benchmark. 67% of respondents also indicated an interested in learning more about California dried figs and fig ingredients for product development.

i. Conclusion: The California Fig Ingredient Program provided the opportunity to target and educate new potential users of California fig ingredients to shift usage and meet program objectives while setting the stage for continued future one-on-one product development appointments.

2. New product and menu items containing California fig and fig ingredients will be measured pre and post-program through Mintel.
    a. Result: Increased new products by 110% resulting in 21 new food products during the program. There was also a significant increase (51 in non-food category (cosmetics, pet food, etc.)) which previously was not tracked but appears to be opportunistic for future growth and further expansion from low-value commodity ingredient categories.

3. Ingredient shipments to low-value commodity segments and niche added-value segments will be measured using data collected through the Fig Inspection Site and Annual Statistical Review.
    a. Result: As previously stated, although there is a positive shift from low value commodity segments to niche added-value food categories: such as snacks, energy bars, beverages and condiments; non-food categories: such as lipsticks, body care and pet foods, it is to preliminary to track the percent shift in sales at this time.

The major successful outcomes of the project follow:

a. Positively shifted usage and preference among chef/culinary and food technology professional target audiences by 10.73% during the program.
b. Increased new products by 110% resulting in 21 new food products during the period of the program.
c. Identified significant increase in non-food categories (51) which were previously not tracked with opportunity for future growth and continued expansion from low-value commodity segments.
d. Conducted 18 ingredient development appointments resulting in 12% in final product development stages while 34% are in the beginning stages of new product development using California fig ingredients.
e. Strategically developed an ingredient program and have set the stage for continued growth resulting in long-term sustainability and viability for this specialty crop.

Beneficiaries

The primary beneficiaries of this project are the entire California fig industry, including more than 100 farmers, marketers, farm managers, and processors. The industry's 700 full-time and 3,500 part-time employees will benefit by retaining employment during these economically challenging times. Also, the communities where they reside (Madera, Fresno, Merced, Kern, Imperial, and Yolo Counties), which experience unemployment rates ranging between 6.4 to 24%, exceeding the state unemployment average of 6.2%, will also benefit from the fig industry's economic activity. Consumers will benefit by purchasing a California grown nutritious fruit that will support better for you food choices to maintain a healthy lifestyle.

The number of beneficiaries affected by the project's accomplishments and potential economic impact of the project is estimated at 4,500.

Lessons Learned

The California fig industry is very pleased with the results of this project. They recognize the positive momentum created for commercial use of California grown figs and fig ingredients in new product development efforts for. Along the path of achieving this success and industry support, the CFAB has learned the importance of identifying contractors with skills and expertise to manage and execute objectives in the timeline established, allocating staff time to support program objectives effectively, and securing internal staffing support to assist with management and execution of the program. Moving forward, the CFAB will ensure that any grant implementation team is appropriately staffed to ensure the project's success. Recognizing these items in the future will ensure grant implementation is seamless and on track to complete within the established timelines.

Additional Information

See Attachment.

USDA Project No.: 7	Project Title: Baking Seminars for Food Professionals in Japan and South Korea	
Grant Recipient: American Pistachio Growers	**Grant Agreement No.:** SCB 13007	**Date Submitted:** December 2015
Recipient Contact: Peter Vlazakis	**Telephone:** (559) 475-0435	**Email:** pvlazakis@americanpistachios.org

Project Summary

Faced with rising production and increased competition from foreign suppliers, it was essential that American Pistachio Growers (APG) and California Dried Plum Board (CDPB) develop ties with food manufacturers in key export markets around the world. The purpose of this project was to conduct a series of baking seminars in Japan and South Korea as a way to educate food professionals on the technical benefits and added value of baking with pistachios and prunes. APG and CDPB partnered with the world-renowned Culinary Institute of America (CIA) to introduce participants to the health benefits, sustainable production practices and stellar food safety records of both industries. These markets were specifically chosen because of their high value and strong growth potential. Combined, the baking sector in both countries was valued at $36.7 billion dollars in 2012 according to statistics from Euromonitor, making it one of the most lucrative regions in the world for baked goods. These seminars highlighted differences in product quality and food safety to strengthen existing relationships and forge new ones, helping guarantee the continued purchase of U.S. products. Together, APG and CDPB sought to enhance demand for these specialty crops and help ensure the continued prosperity of the pistachio and dried plum industries in California.

Through market development projects such as this, APG and CDPB are able to create new economic opportunities for specialty crop producers. By cooperating, the organizations were able to leverage their combined assets in an effort to build demand for pistachios and prunes globally. The result helped offset production increases and stave off international competition, ensuring that California remains the key supplier of pistachios and prunes to both countries. The project targeted Japanese and South Korean bakers and food professionals, who play an integral role in purchasing both products as ingredients in markets that stand as global leaders in the production and consumption of baked goods.

A number of challenges threatening the viability of international markets for California pistachio and prune producers made this project important and timely. Increased yields and acreages will result in a doubling of pistachio supply between now and 2020, making it essential that APG find new uses for this important California specialty crop around the world. Increased usage as an ingredient in Japan and South Korea will help stimulate demand and offset the impending rise in pistachio production. At the same time, the seminars allowed CDPB to raise awareness of the benefits of using California-grown prunes in baked goods. Japan is the largest overseas market for prunes in the world and exports to South Korea have grown as a result of the United States-Korea Free Trade Agreement. However, stiff competition from lower priced foreign product is threatening the competitiveness of California prunes in each high-value market.

Increased demand will also allow the prune industry to secure and maintain higher market prices, which are a vital response to both the global short supply and to build a competitive long-term position as compared to higher-value crops produced by California growers. Value-added promotions such as this baking sector project help facilitate expanded utilization of prunes and create better price opportunities. By building demand among high volume users in the baking industries in both markets, APG and CDPG will be able to ensure the sustainability of both specialty crop industries for generations to come.

This project did not build on any previously funded Specialty Crop Block Grant Program project.

Project Approach

APG and the CDPB secured the services of Marketing Focus International (MFI) to start planning the baking seminars. Representatives from the CIA were contacted and an agreement was signed to begin work developing the recipes and curriculum that would be used at each event. At the same time, MFI began researching potential in-country consultants in Korea and Japan to help carry out the grant activities. After receiving proposals and evaluating them against the approved grant budget, APG/CDPB hired Sohn's Market Makers in Korea and Motix Co. and Office K2M in Japan to organize the seminars and recruit participants. These in-country consultants immediately began work to find and secure venues, hire local support staff (including chefs and translators) and develop recruitment lists. The CIA finished developing recipes for the seminars and produced high-resolution photography suitable for recipe books and other collateral materials. APG/CDPB used a graphic designer to design the recipe books and other collateral material for the seminars. Once finalized, these were sent to the in-country contractors for translation and printing. Finally, MFI began finalizing travel arrangements and recruitment for the seminars in South Korea and Japan. Invitations were sent out to key baking industry representatives in both countries and ads were placed in major industry publications to promote these events.

In April 2014, representatives from MFI and CIA traveled to South Korea and Japan to execute the series of baking seminars. They were joined by the Project Director (PD) from APG in South Korea and the PD from CDPB in Japan. Following their arrival in South Korea, the group traveled directly to Busan, site of the first seminar. After a preparation/training day with the in-country staff, the seminar was held on April 15th at the Yeonsan International Bakery Academy. In total, 58 bakers, hotel/resort chefs, and baking institute members attended the seminar. The following day, the group traveled to Seoul to begin preparations for the second Korean baking seminar. On April 18th, the second baking seminar was held at the Richemont Bakery Academy, where 88 attendees enjoyed presentations and technical baking demonstrations designed to encourage them to use California pistachios and prunes as an ingredient.

Next, the group traveled to Japan for three planned seminars. After a day of orientation and training with the in-country support staff, the first Tokyo seminar was held on April 22nd. Ninety-six bakers, chefs, industrial users, and media representatives attended the event, where they learned about how to incorporate California grown pistachios and prunes as an ingredient in their products. On April 23rd, 72 people participated in the second baking seminar, also held in Tokyo. Both events took place at the brand new Shoei Foods test kitchen facility in downtown Tokyo. These seminars were the first outside events hosted at this state of the art facility. Finally, the group traveled to Osaka for the third and final Japanese baking seminar. On April 25th, 70 attendees took part in the seminar held at the Iwase Este test kitchen.

Following the seminars, surveys were collected, responses were analyzed, and final results were shared with APG/CDPB. Overall, these seminars represented a significant accomplishment for APG/CDPB. They not only provided information about innovative ways to bake with pistachios and dried plums, but highlighted differences in product quality, food safety, health benefits, and production practices of the two industries. The seminars helped strengthen existing relationships with bakers who already use pistachios and dried plums, establish new relationships, and provided a valuable way of reaching key purchasers of ingredients in both South Korea and Japan.

As a result of the original baking seminar expenses coming in under budget, approval was given to use the unspent balance of funds for recipe contests in Japan and South Korea. Press releases were prepared and distributed to the major food publications which provided further exposure of California grown pistachios and prunes. Application materials were developed and the contests were promoted to members of the baking trade in both countries. In Korea, a total of 102 recipes (54 for pistachios, and 48 for prunes) were received, while in Japan, 65 pistachio recipes were submitted. (The CDPB did not participate in the recipe contest in Japan due to a conflicting contest held in late 2014.) The recipes were judged by leading instructors and authors in the bakery trade and ultimately, 6 prize winning recipes were selected in Korea, along with 5 in Japan. (Prizes were financed by APG and CDPB.) The results of the contests, along with winning recipes, were publicized in major trade publications in both markets. Furthermore, one winning recipe from South Korea was produced and sold commercially in a chain of bakeries.

This project did not benefit commodities other than specialty crops. All project activities focused on pistachios and plums.

The Vice President of Global Marketing for APG traveled to Korea and the Executive Director for the CDPB traveled to Japan to attend the seminars. A representative from MFI traveled to all five seminars in Japan and South Korea. They provided presentations to the attendees on the benefits of using California pistachios and prunes in baked goods, as well as the health and safety advantages of the products over foreign competition. Furthermore, the President of Shoei Foods, a leading importer and manufacturer in Japan, spoke at the Tokyo seminars, supporting the products and the project. The featured chef from the CIA prepared the final products for the attendees that were very well received. Ninety-seven percent of attendees rated the recipes produced for the seminars, in the good to excellent category. The in country partners, Sohn's Market Makers in Korea, Motix and Office K2M in Japan, made an excellent contribution in organizing the seminars and recruiting quality participants, with 98% of them rating their experience at the seminar in the good to excellent category.

Following completion of the seminars, MFI continued to work with Sohn's Market Makers, Motix, the APG and CDPB to plan, organize and execute a recipe contest. These principals promoted the contest, recruited participants, collected entries, selected judges and organized venues. Finalists were chosen, recipes prepared and the winners selected. Winning recipes were photographed and promoted via social media, press releases and magazine articles. Contestants recipes became the property of APG/CDPB and were included in the binders prepared for the bakery seminars.

Goals and Outcomes Achieved

A total of five baking seminars were held in Japan and South Korea including two in Tokyo, one in Osaka, one in Busan, and one in Seoul. They were held in four outstanding facilities which only enhanced the quality of the seminars. The seminars themselves specifically targeted two areas. One was to educate bakers, chefs and purchasing decision makers on the benefits of California pistachios and dried plums over foreign competition. Power Point presentations were made by APG and CDPB employees, as well as their 3rd party consultants, featuring these benefits, which included farming practices, health and food safety issues. Secondly, the recipes and curriculum developed for the project was clearly directed to the use of California pistachios and prunes as an added value ingredient in baked goods.

Two recipe contests were held as a follow-up activity to the baking seminars. Contestants were made up of participants of the bakery seminars and other members of the baking industry from both countries. The contests resulted in 167 total entries, including 102 in South Korea and 65 in Japan, which far exceeded expectations. The winning recipes were promoted in both countries, resulting in positive media attention for California pistachios and prunes. Furthermore, one winning recipe from South Korea reached commercialization and is being sold at a major department store.

No outcome measures for this project were long term. However, export statistics will continue to be monitored as a way of gauging increased use of pistachios and prunes among bakers in Japan and South Korea.

For the baking seminars, target recruitment was set at 75 attendees per seminar, or 375 total participants. Actual attendance exceeded expectations with 384 participants. Total attendance would have been higher, but attendance in Korea was limited by the size of each facility. In total, 355 completed surveys were received, reaching 95% of the original targeted attendance.

The goal of the survey was to have 95% positive responses, and this was achieved and exceeded, with 98% of participants rating their experience at the seminar in the good to excellent category. Secondly, participants were asked if they would use, or recommend, using California pistachios or prunes in their business and 93% responded positively. This result far exceeded the established goal of 80% positive responses.

For the recipe contest, a total of 167 recipes were received, with 102 being collected in South Korea and 65 in Japan. This participation rate exceeded expectations and is a testament to the strong interest for using pistachios and prunes among bakers. Eleven winning recipes were selected and one has reached commercial production.

For export increases, a baseline cumulative target was set at 10-20% in the year following the baking seminars as compared to a baseline. Actual shipment data showed that in 2014, exports of pistachio and prunes to South Korea and Japan totaled 17,358.3 metric tons, a 1.8% increase as compared to the five year historic average. While the export goal failed to reach the target, other factors outside of APG/CDPB control, such as a smaller than expected 2013 plum crop, may be partly to blame. When examined individually, pistachios showed a 21% increase, while prunes had a 4% decrease. However, prune market prices in South Korea showed significant improvements throughout 2015, increasing by 10% to reach $2,942 per ton. Furthermore, exports of pistachio kernels, which are preferred as ingredients by bakers, increased 46%, far exceeding the project goal. Overall, both APG and CDPB feel strongly that this project will have a continued impact on demand for pistachios and prunes in Japan and South Korea. Going forward, both organizations are planning to maintain and expand activities targeting the baking industry in both countries.

Beneficiaries

The primary beneficiaries of this project are the 900 pistachio growers and 900 prune plum growers in California. Pistachio producers spend nearly $409.1 million annually for products and services, which equates to more than $1.1 million in industry expenditures each day of the year. Their total economic impact was calculated at $672.3 million in 2011 and combined, growers and processors provide 5,280 jobs in the farming and non-farming sectors. In total, the industry generates more than $221.1 million in labor incomes for residents of the state. Furthermore, business taxes paid by the pistachio industry as a result of increased economic activity totaled $24 million in 2011.

The California prune industry is one of the oldest specialty crops in the state, tracing its roots back to the 1850s Gold Rush. It employs more than 4,000 full-time and seasonal workers and total acreage devoted to plum prune production now stands at 52,000. California leads the world in production producing 272 million pounds of prunes in 2012, roughly 48% of the world's supply.

Increased shipments to Japan and South Korea will indirectly benefit the 9,280 full-time and seasonal workers that both pistachio and prune plum industries employ. According to U.S. Census Bureau statistics, the economic value of the 21% growth in pistachio shipments as compared to the 5 year average equaled $7.8 million and while prune shipments decreased by 4%, higher prices translated to only a $19,391 decrease in value. Cumulatively, this increase fell just short of the projected $8 million sales increase outlined in the grant proposal.

Lessons Learned

The planned baking seminars provided a very aggressive timetable. Originally, seminars were planned in three different cities in Japan, but preparation and travel time did not allow these to be executed as planned. However, the change to having two seminars in Tokyo and one in Osaka proved to be very positive. APG/CDPB were able to secure the new teaching/test kitchen of Shoei Foods, a major food manufacturer and distributor in Japan. This modern, brand-new facility accommodated 168 participants in central Tokyo for the two seminars. APG and CDPB were the first outside organizations to use the facility. A tribute to the respect Shoei has for APG and CDPB.

At the Richemont Bakery facility in Seoul, Korea, 88 participants attended the seminars. This was a little more than the facility could handle, due to companies sending several employees that were not registered for the seminar. However, it again represented the excitement generated for California prunes and pistachios as an ingredient.

Overall, the aggressive attendance and survey targets were exceeded, thanks to the hard work of all concerned with the organization and execution of the seminars.

The recipe contest was an excellent follow-up to the baking seminars, and provided increased interest from bakers and others in the food business. Furthermore, APG/CDPB were able to secure additional media coverage through press releases and hard work from the very effective in-country partners.

No unexpected outcomes or results came about as a result of the implementation of this project.

While largely successful, this project did fail to achieve a few of the stated project goals or outcome measures. While overall seminar attendance exceeded goals, the number of surveys received fell just short of expectations. In total, 355 completed surveys were received, reaching 95% of the original targeted attendance. Looking back, it was unrealistic to expect a 100% survey response rate and in the future, this target will be lowered to match the actual results of this grant. In addition, the cumulative export increase goal of 10-20% was also not achieved. While this was in part due to factors outside of APG/CDPB control, more specific export targets (individual vs. cumulative) may have led to a different result. For future grants, export goals will be provided for each individual product and target increases will be lowered to match real world results from this project. When examined individually, pistachio exports to Japan and South Korea showed a 21% increase, far exceeding the project goal. Prune market prices in South Korea showed significant improvement in the year following this project, increasing by 10% to reach $2,942 per ton. Furthermore, exports of pistachio kernels, which are preferred as ingredients by bakers, increased an impressive 46%.

Additional Information

Additional information has been attached to this report:

1. Japan Baking Seminars Activity Report
2. Korean Baking Seminars Activity Report
3. Compiled Survey Results
4. Korean Baking Recipe Contest Summary Report
5. Japanese Recipe Contest Photos
6. Korean Winning Recipe Commercialization (Pista-Prune Macaroons)

USDA Project No.: 8	Project Title: Building the Dried Plum Market with Younger Consumers with Dried Plum Granola	
Grant Recipient: Sunsweet Growers	**Grant Agreement No.:** SCB13008	**Date Submitted:** December 2016
Recipient Contact: Stephanie Harralson	**Telephone:** (530) 822-2876	**Email:** sharralson@sunsweet.com

Project Summary

Sunsweet's 250+ prune grower members face growing operating costs and economic competition and pressure from other commodities, such as nuts and fresh fruit that can yield a higher return per ton. In addition, household penetration of prunes is low at only 8%, with a core consumer age of 55+. In order to maintain a viable commodity, it is important to support a premium positioning and continually introduce prunes to a new consumer base. The current project aimed to introduce prunes into granola, a category that grew 12% in 2012 and appeals to a younger audience than the traditional prune consumer. In addition, the granola consumer shares a similar interest in healthy snacking, resulting in an openness to prunes as an ingredient. The goal was to create a new market for prunes by introducing a granola, providing increased value per ton to prune growers.

The project is very important, as California has experienced a 30% decline in prune acreage over the past five years, as the result of competing crops that provide a higher price per ton, and the increased cost of prune cultivation. Sunsweet developed a proprietary method to dice pitted prunes. This innovation lead to the ability to market prunes as a value added ingredient, which enhances the nutritional value of other foods by adding fiber and potassium, both nutrients that are considered shortfall by the United States Department of Agriculture.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The Sunsweet team, along with a designer, designed and developed packaging. The initial design was completed early in the project. However, there were delays in the formulation of the product. It was difficult getting a granola that was different enough to compete in the category. Because of the growth of granola, there came to be a proliferation of competitive items. It was very important to the team to deliver on taste and nutrition. At the finalization of the project, a granola with nuts and prunes in a cluster form created a very unique and delicious snack. The packaging was updated to reflect the final product. A stand-alone product website was created with collaboration from an advertising consultant (Consultant) and a public relations firm (PR Firm). The outcome was a very user friendly website that communicates the product clearly and in an appealing way. In addition, the PR Firm created a fun quiz to help drive consumers to the site to discover their favorite flavor and learn more about the product.

Sunsweet worked with the Consultant and the PR Firm to develop the marketing and public relations programs to launch the product. The Consultant developed a media plan designed to have the greatest reach with the target consumer, in the markets where the product was being carried. The PR Firm aimed to reach influencers who could help communicate the message. It also helped to develop an "influencer kit" which can be used in the future for expansion of the product to other markets. The term influencer is used to describe a health professional, such as a registered dietitian (RD), who has knowledge of a healthy diet and can help relay information to the public or media about prunes. The RDs typically are provided with educational materials, and are at their discretion to communication in their own fashion.

The marketing and advertising plan developed for the launch will serve as a model for continued expansion of the product.

Only specialty crop commodities benefitted from the project. All grant work, activities, and funds only benefitted California specialty crops. Sunsweet represents over 250 prune growers and 70% of U.S. prune sales. This project was sponsored by the California Dried Plum Board, which notes benefits to all California prune growers by attracting younger consumers to prunes, and creating a new eating occasion for prunes.

There were three main contributors to this project. A designer provided design on packaging. Much of their contribution was through in-kind or matching funds, where they provided strategic advice on positioning and ways to differentiate from competition in the market. The Consultant worked with Sunsweet to develop an efficient media plan that included television and social media advertising. They also managed production of a TV spot that highlighted the new product. They produced advertising assets for the social media program that will continue to be used over the next two years. The PR Firm designed a public relations program to help launch the product. This included a combination of outreach to health professionals, retail store registered dietitians, and influencer kit and television news segments featuring the product. The Sunsweet marketing team managed the project, overseeing planning and implementation. In addition, Sunsweet marketing reported progress to the board members and to growers.

Goals and Outcomes Achieved

A website was built to help communicate the product. Traffic to the website in June 2016 was 5,579 unique visitors and 7,768 page views. This was driven by both public relations and advertising which attracted consumers to the website. Sunsweet will continue advertising the product and conducting public relations activity over the next two years, which should help maintain or growth the website traffic. Advertising and public relations also helped drive awareness of the product and generate sales. In addition, being able to demonstrate strong support for the product helped us get authorizations in stores. Total public relations impressions totaled 4.6 million. Expectations are to continue to receive coverage, since results from public relations are often long-term. Total media impressions was 13 million driven by television and Facebook. The creative assets that were used for the advertising will continue to be used over the next two years.

Sunsweet will continue to gain distribution in stores. The sales team is still in the process of presenting the product to retailers, and expects to have strong sales in the upcoming season which is an important time for prunes, as store traffic increases during fall and winter holidays. In addition, the project team will be continuing to invest in supporting the product with advertising.

The website traffic being over 5,000 unique visits in June 2016 was a significant accomplishment and met the goal that was set forth. In addition, it’s an important tool for educating the consumer about the product, providing engaging content.

Target distribution was 19,000 stores with national distribution in year 3. Due to the delays in the project, this has not been achieved yet. The current store count is 5,500. Over the next year, Sunsweet expects expansion based on the performance of the product.
Total revenue for the year is $300,000 which is short of the target but expected to grow, considering shipment to retailers did not start until March 2016. The marketing activities also helped the base prune sales, which have grown over the past year by $2.4 million.

As stated above, website traffic is currently at 5,000 per month from a baseline of zero. The product is available in 5,500 stores in several states and will continue to expand. Sales of the product total $300,000.

The major success of this project is the introduction of a unique product in the dried fruit aisle that generates increased household penetration of prunes. The prunes in the product are value-added because they are diced and processed in a proprietary way, so it creates a new opportunity for including prunes in the product. Due to it being quite different from the regular prune products, it will introduce a new consumer to prunes. The number of stores carrying and revenue generated from the item will continue to grow based on the continued support of this item.

Beneficiaries

The beneficiaries of this project are the 250 California prune growers who form the Sunsweet organization. The project adds value to the prune crop by creating a value added usage in the granola product category, which has an upward trend. In addition, it helps communicate a usage for diced prunes as an inclusion in healthy snacks, to other food manufacturers who may be interested in developing new products using prune ingredients. Prune growers in California face higher operation costs and competition for acreage from other crops. By introducing this type of product, it increases the value of prunes and the return to the growers, allowing prunes to be a viable crop choice for California farmers.

The project benefits the 250 California prune growers. This project along with the development of other value added products, helped increase return per tonnage by 178% vs. 2013.

Lessons Learned

The key lesson learned in this project was the need to make sure the new product would be able to compete in the market place versus the many competitors. This resulted in the finalization and positioning of the product taking longer than expected. The launch and marketing support was delayed, however the final product is something that will stand out in the market and successfully introduce new users to prunes.

During the development of the product, it was interesting to see the explosion of other “hybrid” snacks that combine dried fruit with granola or nuts, and that are merchandised throughout the store in produce, dried fruit, snack bars and other sections. The project team felt that the final product is on trend with these other healthy snack options, and fits well into the changing habits of consumers looking for convenient options that provide nutrition and satiety. Through this project Sunsweet learned the value of integrating both public relations and advertising so that there is valuable content for people as they learn about a new product or learn about prunes as a nutrition source. Digital advertising offers a new and efficient way to communicate a message and the project team has seen it through the result in sales, when supported by other traditional advertising methods.

Additional Information

Please visit www.sunsweetfruitandnutclusters.com, and see attached documents.

USDA Project No.: 9	**Project Title:** Building a Farm Trail: Developing Effective Agritourism Associations to Enhance Rural Tourism and Promote Specialty Crops	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13009	**Date Submitted:** December 2016
Recipient Contact: Shermain Hardesty	**Telephone:** (530) 752-0467	**Email:** shermain@primal.ucd.avis.edu

Project Summary

Due to lack of economies of scale, small-scale specialty crop growers, need to add value to their products to remain economically viable. These growers often seek to diversify with farm stands, U-Pick, tasting rooms, festivals or other agritourism activities to stay in business or provide employment for families. Individual growers often have difficulty attracting visitors to their operations. Local, county-based and regional "farm trails," organized and promoted by grower-based agritourism associations, have proven useful in attracting visitors and adding value to a region's crops by providing a variety of activities and products unified by a recognized brand. Establishing agritourism associations and marketing collaboratively requires skills and partnerships that are new to most specialty crop growers. This project brought together experienced farm trail organizers and marketing and tourism professionals who provide technical assistance and marketing resources to assist newly-established groups of growers in building sustainable and effective farm trail organizations. Because California's local and county-based agritourism associations have few opportunities to learn from each other or to work together for mutual benefit, this project provided such opportunities through workshops, a statewide agritourism summit, a guide to farm and wine trail development, and online resources.

Public interest in food production is growing, creating demand for agritourism. Specialty crop growers' interest in connecting with the public through on-farm direct marketing and agritourism is increasing. This project offered important skill-development, marketing and networking opportunities to assist small-scale specialty crop growers in successfully taking advantage of these recent trends and partnering with others in their communities to develop rural tourism.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

Objective one was to provide technical assistance to 60 specialty crop growers to develop and promote three agritourism associations, three farm trail maps, and three collaborative events. Project staff were able to achieve the following: Three Northern California marketing and economic development professionals were hired through this project as consultants to work as a team with three newly-established agritourism associations, the Sacramento River Delta Agritourism Association, Capay Valley Grown, and North Yuba Grown. Seventy-three specialty crop growers, who are members of the three associations, participated in the year one activities of the project. Members of the three associations met each other and the three consultants at an initial workshop in November 2013. At this workshop, the agritourism associations shared their challenges and plans, and the consultants presented beginning lessons in farm trail development and agritourism marketing.

The project manager, collaborators and consultants participated in a tour of each association's region, visiting with several members of each association at their operations. Each of the three tours concluded with a stakeholders/members meeting in which the consultants facilitated a group discussion helping association members to define their geographic region, their membership, and a representative committee to be responsible for selecting a graphic designer and working with that designer to create a farm trail map. The three tours and meetings were held in February, 2014. Each of the three agritourism associations selected a graphic designer, gathered members' information, drafted text, selected images and worked with the graphic designer to create a farm trail map brochure for their association. The three map brochures were completed, and 20,000 copies of each map brochure were printed, by August 2014. All of the map brochures are available for download on the project webpage: http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/

Members of the three stakeholder agritourism associations distributed the map brochures widely in their communities and through their tourism partners, generating increased tourism interest and community pride in each region. The three consultants and the project manager attended multiple committee and board meetings of the three agritourism associations and provided guidance to the groups in planning collaborative tourism events, drafting economic sustainability plans and in planning effective marketing for their associations. Each of the three agritourism associations selected a website designer with the help of the consultants, and worked with that selected designer to recreate the group's website. Each newly designed website included the group's farm trail map, member information, information about the region and a calendar of events. The websites were all completed and published by February 2015. The Sacramento River Delta Grown website is: http://sacriverdeltagrown.org/. The Capay Valley Grown website is: http://capayvalleygrown.net/. The North and Yuba Grown website is: http://www.northyubagrown.org/. All of the websites have been maintained and are regularly updated by the group members.

The project manager coordinated and facilitated the contracting with each of the consultants and designers for this project. All three groups planned, organized, promoted and operated a collaborative event as proposed. The goal was for 500 members of the public to attend each of the three events. Sacramento River Delta Grown had 300, rather than the goal of 500, attendees at their Passport Weekend event in August 2014. North Yuba Grown collaborated with other community organizations to hold the North Yuba Harvest Festival in September 2014, which had 700 attendees, exceeding the goal of 500. Capay Valley Grown organized an Open Farm Day event in October 2014, with an estimated attendance of 250 people visiting at least one of the nineteen farms open that day. Each of the groups repeated its collaborative event in 2015 and all have made plans for similar events in 2016. The project manager and collaborators organized and conducted a second workshop for all three stakeholder agritourism associations in November 2014. The groups discussed challenges and successes with each other, and learned from leaders of the Apple Hill Growers' Association and from project consultants. The 2nd workshop agenda and 2nd workshop notes are online at: http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/.

Objective two involved statewide agritourism collaboration, and sharing of lessons learned and best practices. Project staff and collaborators organized, promoted and facilitated the California Statewide Agritourism Summit, held on April 8, 2015. The Summit was attended by approximately 150 members of the California agritourism community who listened to presentations about specialty crop agritourism associations' successes and challenges and held small-group sharing and planning sessions. The summit agenda and notes from summit group discussions are posted on the University of California (UC) Small Farm Program website at http://sfp.ucdavis.edu/events/Statewide_Agritourism_Summit_2015/ All summit attendees received an evaluation form to measure their increase in knowledge.

The Project Manager identified thirty representative California specialty crop producers based agritourism associations. The Project Manager contacted leaders from all 30 associations and requested telephone interviews. Leaders from 20 of the associations responded and agreed to interviews. The Project Manager conducted interviews with leaders of 20 specialty crop agritourism associations about their activities, membership, management, growth, challenges, needs and plans, and transcribed the responses. The Project Manager also requested materials from each of the interviewees for the resource library to be published online.

The Project Manager compiled the interviews and information from presentations by association leaders at project workshops into a guide, published online in November 2015. The guide, Marketing Regional Farms and Wineries: A guide for California Agricultural Marketing Groups, was distributed by email to leaders of all 30 identified agritourism associations. The link to the published guide was distributed widely to the California agritourism community through email announcements and in several issues of the UC Small Farm Program's AgTour Connections email newsletter. The guide and related resources provided by the groups interviewed are posted on the project webpage, http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/

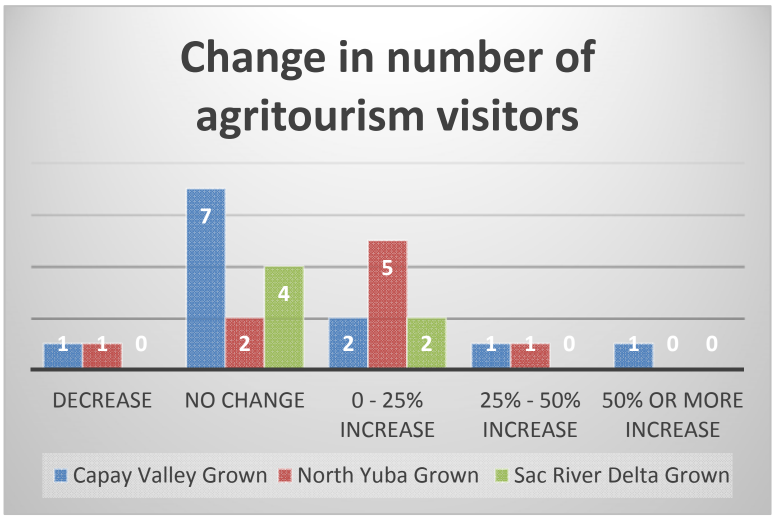
The Project Manger requested response in December 2015, using an online survey, from leaders of 30 specialty crop producer based agritourism associations about increased collaboration, use of project materials and improvements in association marketing and management skills resulting from use of these materials. The survey was also shared with other specialty crop producer groups in the early stages of organizing collaborative marketing associations and with other subscribers to the AgTour Connections email newsletter. Response to the online survey was lower than expected, but those who responded had shared and discussed the guide with their association leaders, and said it was helpful.

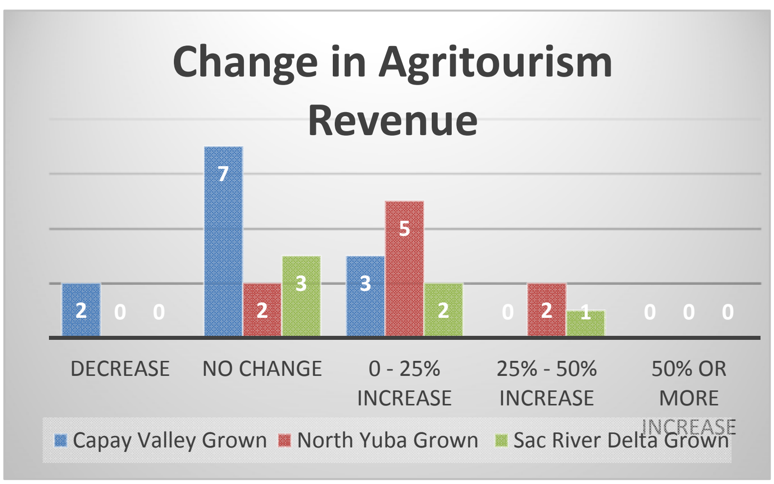
Each stakeholder group was informed that only producers of specialty crops were eligible to participate in the project. The Project Manager checked the crop list of each participating producer to ensure that each produced specialty crops; therefore, tracking mechanisms were in place to ensure that SCBGP funds were used to solely enhance the competitiveness of specialty crops. To ensure that only specialty crop producers received Specialty Crop Block Grant Program funds to travel to the Statewide Summit, the application for travel funding included a question about what crops each applicant grew. The Project Manager checked responses against the list of approved specialty crops before approving any travel reimbursement, and only approved that for specialty crop growers.

Collaborators shared extensive expertise and connections in the process of selecting graphic and web designers and printers and in distribution of the map brochures. Each of the contracted consultants shared detailed information regarding marketing, group dynamics and economic development. Collaborators provided meeting facilities and assisted specialty crop growers in promoting their activities. Collaborator/members of each of the three participating stakeholder groups were actively involved in the process of creating farm trail maps and sustainable organizations in their communities, organizing and promoting collaborative events, in planning for website redesigns. Collaborators provided additional sponsorship for the Statewide Agritourism Summit. Collaborators Extension played an active role in planning, promoting and facilitating the Summit.

Goals and Outcomes Achieved

Measurement of Goal 1: Increased number of agritourism customers:
The goal of at least 500 customers attending each collaborative farm trail of festival event organized by the three stakeholder associations was not met. Approximately 300 people attended the Sacramento River Delta Grown "Passport Weekend" event, and approximately 700 people attended the "North Yuba Harvest Festival" event. After analysis of raffle entry forms and reports from 7 of the 19 Capay Valley Grown farms that were open for the "Capay Valley Open Farm Day" on October 5, 2014, project team estimated that approximately 250 people participated in visiting association member farms as part of that event.





To further measure achievement of Goal 1, and to measure achievement of Goal 2, and increased revenue to agritourism operators, project team has conducted an online survey of the 73 specialty crop growers who participated as members of the three stakeholder associations. The survey was conducted in March 2015, soon after the three new websites went live. It asked about increased number of agritourism visitors/customers as compared with the previous year (2014), and also about changes in specialty crop revenue as compared with the previous year. Twenty seven responses were received, for a response rate of 40 percent. Expected measurable outcome for Goal 2 was not achieved, which was an average increase in agritourism revenue of 50% during project year one over the previous year, as shown in the included charts reporting the responses to the survey. The Project Manager and a marketing consultant met with each group to discuss the results of this survey and to plan for improvements in the marketing program to generate more revenue for association specialty crop members in the coming year.

Measurement of Goal 3: Increased tourism revenue to the communities surrounding the three stakeholder agritourism associations: The change in Transient Occupancy Taxes (TOT) received was obtained in March 2015 from each county tax collector in the regions of the stakeholder groups. In each region, the amount of tax increased from Fiscal Year 2013 to Fiscal Year 2014, indicating that tourism in general increased during this time period in each region. However, as the area included in the jurisdiction reported for each county was the entire unincorporated area of the county, and because the latest figures available were for 2014, project staff are not able to claim realistically that the efforts of this project had a measurable impact on the increase in tourism to the region. The measurement of TOT income to the county does not seem to be a good metric for measurement of increased tourism revenue to communities surrounding the stakeholder groups. The Project Manager asked about more appropriate measurement tools for each community from members of the stakeholder groups during the evaluation and planning discussion.

Measurement of Goal 4: Increased effectiveness of agritourism associations' collaborative marketing:
A pre- and post- self-knowledge assessment of agritourism summit attendees about farm trail development and marketing was coordinated by the Project Manager at the Statewide Agritourism Summit. 150 people attended the statewide summit. Thirty-seven percent of the 30 surveyed agritourism associations reported use of project-created materials, but none reported improved association management or marketing skills at the time of the survey. Seventy-four summit attendees completed and returned the evaluation, 97 percent reported increased knowledge about farm trail development, marketing and networking opportunities. Summit attendees were asked: Please circle your level of awareness about the following on a scale of 1 to 5, with 1 representing having no or little awareness, and 5 being extremely knowledgeable.

Results: "Successful regional agritourism (farm trail) associations"
- Pre Survey: mean response = 2.86
- Post Survey: mean response = 4.08

"Opportunities for agritourism marketing and promotion"
- Pre Survey: mean response = 2.9
- Post Survey: mean response = 4.12

Marketing Regional Farms and Wineries: A guide for California Agricultural Marketing Groups was published online and shared with the leaders of 30 specialty-crop agritourism associations for response. The response from agritourism associations about the use and usefulness of the online guide to farm and wine trail development is as follows: Leaders from 11 of the 30 identified specialty crop agritourism associations reported reading the guide, sharing it with their boards of directors, and finding useful information with the potential for improved management and marketing by their organizations. In the year following its publication, the project manager shared the "Marketing Regional Farms and Wineries" guide at workshops and meetings with multiple groups of growers in the process of starting or strengthening their collaborative marketing. Leaders of these groups commented that the lessons shared in the guide were helpful in setting up effective management and marketing practices. In addition, the guide has been downloaded at least 180 times from links shared in regular email newsletters to California agritourism operators and an unknown number of times directly from the UC Small Farm Program website."

Major accomplishments of this project include 73 specialty crop growers are members of the three stakeholder agritourism associations that are now sustainable, have effective websites, editable farm trail map brochures, a financial sustainability plan and improved marketing skills. These growers, through their associations, have increased potential for agritourism income as an outcome of this project. As an outcome of the California Statewide Agritourism Summit, attendees from nine California regions have plans to stay in touch and work together to improve agritourism collaboration in their regions. Members and leaders of more than 30 specialty crop grower-based agritourism associations, and an unknown number of not-yet formed groups of growers in California have increased access to experienced advice and resources shared by contributors to the online farm trail marketing guide produced through this project.

Beneficiaries

Seventy-three specialty crop growers who are members of three agritourism associations, North Yuba Grown, Sacramento River Delta Agritourism Association, and Capay Valley Grown, benefited from this project by increased agritourism marketing and association management skills and increased agritourism visitors and agritourism revenue, with the potential for further increases.

Approximately 500 specialty crop growers who are members of approximately 25 agritourism associations will potentially increase revenue from on-farm sales and tourism activities due to their associations' participation in the Statewide Agritourism Summit, resource-sharing, collaborative marketing education and networking activities organized by this project in Year two.

Approximately 2,000 California specialty crop growers who offer agritourism activities will potentially increase their agritourism income by using materials produced by this project to develop farm trails and collaborative marketing efforts.

Rural communities benefited from the marketing of specialty crop agritourism in their communities by increased tourism income to agritourism and other community businesses and through increased job creation and increased tax revenues for all impacted businesses. The agricultural community benefited from the increased public understanding and support of specialty crop production by urban visitors generated by this project. The California specialty crop industry benefited from the combined marketing and educational efforts of more skilled collaborative regional agritourism associations by increased sale of California specialty crops to Californians.

Lessons Learned

Collaborative work can take longer than expected due to the multiple demands of production and marketing for the growers' core operations and the additional demands of new collaborative projects. Lesson learned: Allow more time for activities that require growers to gather information, edit documents, and meet together for decision-making and other collaborative work.

Small committees can work effectively together for the benefit of the larger group, but the larger group must agree on the committee makeup. When planning and organizing on behalf of the larger association, a small committee of three to five members can meet, share the tasks, communicate and make decisions well. However, the trust of the membership of the larger association is essential for the work of the committee to be accepted. It is best to select the working committee at a larger group meeting where all have a chance to provide input and help select the committee.

Agritourism development in a community is a long-term effort. Do not be discouraged by a lack of quantifiable results in the first year. However, small marketing efforts and activities by individuals and groups can grow over time and develop into significant revenue-producing and ongoing benefits for communities and for specialty crop growers who participate.

In this age of overwhelming communication, it is very hard to get people to respond to an on-line survey. If at all possible, either offer an incentive for participation or try another method of asking for response, such as a telephone call or a paper form mailed or handed out at a workshop or meeting.

TOT changes may not be the best measure of changes in agritourism income to a small local area or group of producers for at least two reasons: 1) Often it can be hard to obtain this information for a small enough area to be effective in measuring localized changes. 2) Much of agritourism income is from local and reginal day-travelers, and does not include any overnight stay, so would not be measured by TOT.
The project staff could try to survey the agritourism operators about their agritourism income; however, based on past experience, they are very reluctant to disclose their income in surveys. Instead of measuring agritourism income, project staff could measure the economic benefit to the community surrounding an agritourism association by conducting a survey of visitors to the agritourism operations. This would involve asking these visitors to share how much they spent for food, gas, lodging and other expenses in the surrounding community during their trip.

Additional Information

The Project Manager published a post on the UC ANR Green Blog in September 2014 announcing the completion of the three stakeholder associations' new farm trail maps:
http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=15229

The Project Manager gave a presentation about the project at the National Extension Tourism Conference held in Galveston, Texas in October, 2015 which involved no expenditure of project funds:
http://extensiontourism.net/files/2015/11/leff_building_farm_trail_net2015.pdf

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 10	**Project Title:** Bay Area Urban Agriculture Marketing Association	
Grant Recipient: Alameda County Deputy Sheriffs' Activities League	**Grant Agreement No.:** SCB13010	**Date Submitted:** December 2015
Recipient Contact: Hilary Bass	**Telephone:** (510) 225-5954	**Email:** hbass@acgov.org

Project Summary

This project addressed critical elements and needs of local food systems and economies in underserved and low-income communities located in the San Francisco Bay Area. Dig Deep Farms (DDF) is an urban farm and community-supported agriculture operation serving Ashland, Cherryland and other underserved areas of Alameda County. Ashland and Cherryland specifically are communities that are part of unincorporated Alameda County, situated between the city of San Leandro and the city of Hayward. In 2010, the population was 36,653, the majority Latino, African American and Asian. The median family income in Ashland in 2010 was $54,358 and in Cherryland $50,233, compared to $85,014 in Alameda County. The percent of persons below the poverty level (2006-2010) was 15.8% in Ashland and 21.0% in Cherryland, rates far higher than surrounding communities and Alameda County. Only Oakland has a higher poverty rate. For persons over the age of 16, about 33% are no longer in the labor force; unemployment is over 10% in four of eight census tracts in Ashland and Cherryland.

The food environment of Ashland and Cherryland is very poor. Most census tracts in Ashland and Cherryland have only small corner stores or liquor stores with few or no fresh fruits and vegetables. Six out of eight census tracts in Ashland and Cherryland appear to meet the U.S. Department of Agriculture (USDA) criteria as food deserts.

The significance of the project was to move urban farm production and distribution of fresh, healthy fruits and vegetables to the next level. The intent of the project was for the Alameda County Deputy Sheriffs' Activity League (DSAL) to organize the Bay Area Urban Agriculture Marketing Association (BAUAMA) to work in cooperation with peers in the East Bay and South Bay to better serve the communities with healthy specialty crops, job opportunities, and ultimately hope. The project increased demand for and access to California specialty crops through education, added retail channels, and innovative marketing.

This project set out to enhance the marketability and competitiveness of specialty crops through local market development, California grown participation, economic opportunities through local market development, and farmer to consumer connections through direct marketing opportunities.

DSAL set out to link urban farms in the BAUAMA to increase access to specialty crops in local underserved communities. The BAUAMA aggregated, expanded product supply and diversity, improved packing and distribution, and built long-term sales and competitiveness with training and technical assistance in specific market channels.

This project also intended to achieve a nutrition objective that complements market enhancement with cooking and nutrition education through cooking demonstrations at DDF farm stands by staff.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The following activities were performed:

- Hired and oriented the BAUAMA Coordinator, and when she left, DSAL staff brought on another person to take her place.
- Both coordinators built relationships with partner farms that DSAL has been able to sustain throughout the duration of the grant and will continue to work with.
- Staff collected information about the eating and shopping behaviors of people in the community (Attachment 1), which showed that people wanted to purchase fresh produce, but in a convenient and affordable manner. This supported DSAL's plan for opening farm stands and doing cooking demonstrations at the stands, as well as working on increasing the Community Supported Agriculture (CSA) programs. Staff did not collect additional surveys because there was so much anecdotal information from the CSA and farm stand customers via daily phone calls, delivery conversations and farm stand interactions. All of DSAL's customers continuously drive the modifications, changes and improvements to the planting plan and aggregation of other produce plan.
- DSAL staff hosted Cooking Matters at the farm stand sites for 6 cooking demonstrations where they prepared different dishes to show the people how to use specific specialty crops that were in season. DDF staff continued these demonstrations on a monthly basis to introduce new recipes and strategies for cooking with specialty crops that many people seemed unsure about. Some examples of produce highlighted are: Brussel sprouts, collards, mustard greens, okra, spinach, squash, swiss chard and tomatoes.
- Staff met with the farm partners to determine what the farms produce and how much could be purchased from them on a regular basis for distribution at the farm stands and CSAs. This has also resulted in contract growing agreements where staff pre-purchased strawberries from a partner knowing they would be needed for raw product sales as well as conversion into consumer packaged product (jam).
- Staff tracked sales monthly throughout the grant period and have seen an overall increase, as well as a reduction in cost of goods to consumers.
- Supplemental Nutrition Assistance Program (SNAP) enrollments were taken care of by the Social Services partner. Staff sold the produce directly in front of Social Services buildings because the majority of the people coming out were SNAP clients.
- The BAUAMA Coordinator met/communicated with partners weekly about orders and needs
- Based on the increase in sales within the CSA program and the farm stands, staff conclude an increase in consumption of specialty crops.

The specialty crops that are grown and aggregated are all intended to be sold through current distribution channels. Only specialty crops were grown for this project and all activities focused on specialty crops. Project staff tracked all project expenditures in relation to products promoted by the project, traded by BAUAMA partners, and used in nutrition activities. In order to enhance the competitiveness of the specialty crops grown, staff created weekly newsletters to go into the CSA bags that highlight a different specialty crop each week and included a recipe. Staff did the same at the farm stands, but would also conduct demonstrations when possible to show people how to prepare that item.

Project partners include:

- Alameda County General Services Agency: provided the land and lease agreements for the large farm parcel and the food hub.
- Alameda County Environmental Health Department: provided necessary permits for the farm stands and reviewed plans along the way for the food hub development to ensure it was up to code.
- Alameda County Civic and Economic Development Department: worked with DDF to find new selling opportunities for DDF.
- Alameda County Social Services Agency: engaged on the DDF Advisory Committee as well as a major partner in the farm stand operation. They have stepped into a major partnership role as a funder and supporter of developing farm stands within the community, specifically in front of SSA offices. The goal for them is similar to DSAL's in that they want to increase access to locally-grown specialty crops for SNAP clients as well as support job creation in the green economy. DSAL's partnership with them has resulted in hiring 2 new staff members to run the farm stands and the development of 5 total stands throughout Alameda County in neighborhoods that are lacking in immediate access to locally-grown specialty crops.
- Alameda County Sheriff's Office: Provides staff oversight for all of DDF under the non-profit DSAL. Additionally, they are supportive of partnership development for the purpose of adding new land space for DDF to grow more produce. Their support is often one of the more encouraging factors for new partners since they carry such a great reputation.
- Oakland Builders Alliance: contributing all of the labor to build out the food hub
- Tri-Valley Regional Occupational Program: training people in culinary and food related skills while incarcerated so they are able to intern/work with DDF upon their release.
- Soulciety: providing paid youth interns to DDF to learn skills for their future while helping get work done on the farm
- La Clinica de la Raza: referring youth patients to purchase food from DDF stands as part of their preventative health plan.
- Tiburcio Vasquez Health Center: referring adult patients to purchase food from DDF stands as part of their preventative health plan
- Highland Hospital: purchasing CSA bags from DDF as part of their preventative health plan for high risk patients
- Alameda County Small Business Development Center: serving as a member on the DDF Advisory Committee.
- Inner City Advisors (ICA): serving on the DDF Advisory Committee
- Fire Department: Continues to provide land space to DDF for farming next to one of their stations in the heart of the Ashland community. They value the purpose of the program and provide water and space for free.
- Pacific Apparel: Donates a part of their property and water to DDF. There is a greenhouse and 11 raised beds on this site and will soon have a community events area where people can share food and eat healthy specialty crops directly from the garden.
- Capay Valley Farm Shop: This was the first food hub visited and the developers gave great feedback on what worked for them when building out their aggregation process. They included detailed information on software systems used for billing and selling product including offering free software tutorials.

Goals and Outcomes Achieved

Outcome 1:
Goal: The BAUAMA farms will increase sales volume.
Performance Measure: Annual revenue from sales.
Benchmark: Previous year annual sales
Target: Increase in sales revenue by at least 10%.
Progress: Staff delivered steady groupings of bags to high-risk pregnant women being served at Tiburcio Vasquez Health Clinic and additional patients at Highland Hospital. These Food Rx projects are great wins for both DDF and the patients being served through the health centers. The baseline of produce revenue for October of 2013 to March of 2014 was a total of $208,303.96, with $121,751.91 of that being from grant (non-SCBGP) reimbursement (58%). Jumping forward to October of 2014 to March of 2015, the total was $321,281.26, with $98,905.32 of that being from grant (non-SCBGP) reimbursement (30%). This demonstrates an increase of 154% in total sales and an increase of 257% in actual revenue coming from direct sales of produce rather than grants/contracts.

Outcome 2:
Goal: BAUAMA will increase the volume of product received and the volume of product distributed to BAUAMA partners
Performance Measure: Pounds of produce received/distributed
Benchmark: Previous year pounds of product received/distributed
Target: Increase pounds of product received/distributed by 5% over the one-year project period.
Progress: DSAL didn't use pounds as a measurement tool due to the difficulty of tracking (many items come by the bunch rather than pound). What made for a consistent tool was the cost of raw goods. Staff used this as the baseline to see how much DSAL was spending on partner farms to aggregate for redistribution through the CSA bags and produce stands. Staff estimates that DSAL received/distributed over 45,000 pounds for 2013 and over 58,000 pounds for 2014. DSAL's baseline of cost of goods (purchasing specialty crops from BAUAMA partners) for October of 2013 to March of 2014 was a total of $137,240.11, with $38,455.52 of that for produce purchases directly. October of 2014 to March of 2015, the total was $106,399.26, with $25,747.17 of that for produce purchases directly. This demonstrates a 33% decrease in raw goods purchased, however it does show more specialty crops produced through DSAL. Although DSAL still purchases from BAUAMA partners, staff were able to increase productivity at DDF and decrease spending, in turn providing more specialty crops to consumers at better prices (see Attachment 2 for harvest list).

Outcome 3:
Goal: Urban residents will report increased access to and consumption of local produce as a direct and indirect result of sales and marketing activities of BAUAMA farms and the Cooking Matters classes/DDF cooking demonstrations.
Performance Measure: Survey of urban residents
Benchmark: Number of urban residents who report access to and consumption of local produce in first month of project
Target: 2,500 urban residents will report increased access to and consumption of local produce as a result of project sales and marketing activities and Cooking Matters classes/DDF cooking demonstrations, as estimated by population survey methods
Progress: Staff did not conduct a formal survey of people but based on the number of visits and sales at the produce stands (approximately 200 people per day, 5 days per week since October 2014) combined with the

frequent interactions with customers in the CSA program, DSAL has dramatically increased access to and consumption of local produce. By observation and verbal remarks to project staff, it is more than apparent that people are appreciative of having locally-grown produce in such close proximity to them and where they can use their EBT benefits to purchase it. The cooking demonstrations drive great conversations about recipes, cooking tips and ideas for spinning family traditions into new healthy options. Staff may still conduct the survey in the future, but based on what was understood from the customers and the past survey, DSAL was able to grow, purchase and sell specialty crops that they enjoyed.

Outcome 4:
Goal: Low-income residents will be enrolled for SNAP benefits.
Performance Measure: SNAP enrollment. Project partners will be trained to conduct SNAP outreach by local food banks, and will conduct pre-screening and screening activities at farm events, including regular produce stands and special events.
Benchmark: Number of low-income residents in Ashland and Cherryland enrolled in SNAP in the first month of the project
Target: 1,500 low-income residents will be enrolled in SNAP as a result of the project. (this target was selected by the original writer of the proposal)
Progress: Staff did not participate in a push to sign more people up for SNAP benefits, but did conduct major outreach within and around the SSA buildings to ensure that those enrolled in SNAP were aware of the farm stands and to inform them that they could use their benefits to purchase the produce. Staff experienced an increase in SNAP customers at the stands. Participating BAUMA partners would pass along the information of where to sign up for benefits and some would carry EBT machines at their farmers market.

Five farm stands were created to service at-risk areas, three of which being in front of SSA offices where people receive SNAP benefits. DSAL increased sales at the farm stands each month since they were started. Staff handed out flyers informing the community when and where the markets were located, and which days would have cooking demos. Staff localized issues and problems concerning volume of produce needed to create a sustainable program and tools needed to fulfill the project objectives. DSAL learned that education is very important when serving at-risk communities that need guidance when understanding health, nutrition, and turning produce into healthy meals. After collecting information, DSAL staff realized the initial goals were set too high for servicing the community. The logistics of picking up the produce was a huge cost burden for staff and the farmer. Creating drop sites and picking up from farmers markets, where the farmers are already going, is the new system of aggregating product from farms.

During this time DSAL only sold specialty crops. No subsidized crops are currently being sold at the farm stands or in the weekly produce bags. The cooking demonstrations exposed people to dishes and recipes that they would not normally make themselves. Staff chose creative culturally appropriate dishes to share with the community to encourage people to buy specialty crops. Due to the partnership with SSA, DSAL was able to sell product at a lower rate to increase affordability of product.

Staff have continued to have cooking demonstrations at the farm stand locations when possible. The community enjoys the recipes that the DSAL team put together and are more interested in purchasing those specific ingredients after sampling the item. Even on days when staff are unable to do the demonstration, there are always new specialty crop recipes available for customers to take home.

In addition to the accomplishments listed above, DSAL staff participated in the Sheriff's Office re-entry model which is referred to as Operation My Home Town (OMHT). This model consists of the Youth & Family Services Bureau (YFSB) therapists meeting inmates inside Santa Rita Jail, case managing them inside as they complete programs and services pre-release, picking them up upon release and continuing to case manage them until they are stable back in the community. Some of the OMHT clients are good fits to intern within the DDF operation. The interns work on the farm or at the farm stand for four weeks and get paid a stipend from a non-SCBGP funding source. Once their four weeks are up, they are either hired on with DDF or connected to other employment opportunities by their case manager. One of the OMHT interns did an outstanding job on the farm stand and the team decided to hire her on as their assistant.

As for long term project goals, the only thing that still remains is the actual building of the food hub, which has taken longer than anticipated, though staff are fairly certain that it will actually be completed and open in January or February 2016.

DSAL believes that all goals have been achieved except for doing an official survey of local residents. Staff were able to acquire narrative feedback in so many different ways, that they ultimately opted against doing one.

Beneficiaries

The main beneficiaries of this project are the 2,500 plus resident of Ashland and Cherryland who now have access to and consume specialty crops through this program. The secondary beneficiaries are the specialty crop farmers who sold produce through this project. DSAL staff have found that there are a wide range of county departments, local non-profits and residents that all benefit in some way from DDF. The SSA for example, was eager to alter the way in which they offered people social benefits, like general assistance and food stamps/SNAP. SSA contracted with DDF to create 3 new positions for CalWorks clients to manage the farm stands that are placed in front of the SSA offices, where people coming out can use their benefits to purchase fresh, locally-grown specialty crops. This creates several wins for SSA as well as increasing the scope of what DDF can do.

Similarly for Tiburcio Vasquez, Highland Hospital and La Clinica, doctors and clinicians are looking for real ways to impact the health outcomes of their patients knowing that access to, and consumption of, specialty crops would play a significant role in preventing serious issues. DDF's CSA program that delivers to people's doorsteps offers a way to reduce barriers to accessing the food, and the clinician's prescription to eat the food increases the odds of people actually consuming it. The food Rx model works well for those partners as well as increasing DDF's customer base.

One of the local farmer partners, Avalos Farms, was contracted by DSAL to grow a large quantity of strawberries for DDF. DDF staff then distributed the strawberries through farm stands and CSA bags. This benefited the DDF customers, as well as Avalos Farms.

For County Supervisors who grapple with the many challenges of the unincorporated area, particularly related to employment, the re-entry population, crime and blight, DDF offers tangible solutions for them to support. DSAL not only created jobs and internships for the re-entry population through the OMHT re-entry system, but also is beautifying previously blighted properties with farms

It is hard to specifically quantify the exact number of beneficiaries of the project as the ripple effect is impossible to really know. However, here are some ideas of how the impact could be occurring:

- 60+ CSA customers weekly, which have families/friends/co-workers with whom they share food and recipes with.
- About 150-200 farm stand customers a day, 5 days a week, totaling over 750 customers a week, which staff also assume have families/friends/co-workers with whom they share food and recipes with.
- There are 8 DDF employees who are employed because of this program. These employees all have dependents of one kind or another whose lives depend on this income.
- The local farmers that DSAL purchases produce from to aggregate with DDF produce are all small farmers. Regular purchases of their produce help to sustain them and their families. This represents an additional 6-12 people who get to have jobs in the farming and logistics arena, plus the families they represent.
- There are somewhere between 20-40 youth interns that come to DDF to learn work skills throughout each year. These youth not only gain tremendously from their personal experiences working hard on DDF, but they leave there and discuss that experience with their peers, who may not have otherwise been on that positive track. Additionally, it is more likely that these youth will find permanent employment in the future as a result of having experience working on DDF, which will result in greater economic and social benefits and quite possibly the next round of specialty crop farmers.
- The same general story is true for the OMHT interns coming straight out of Santa Rita Jail. There are approximately 15 interns per year and their rate of re-offending is less than 13%, which is greatly improved from the more normal rate of 60-80%.
- When the food hub opens, that will represent additional cohorts of youth and adults learning skills, getting certificates, working as interns, getting hired in DDF and elsewhere as well as starting their own specialty crop businesses.

Lessons Learned

One lesson to learn from this experience is that even when there is money in place, people ready to work, plans laid out and expected timelines, it doesn't always go according to plan. Staff have had to be nimble, adjust, redirect efforts, work around barriers, and everything in between. Staff had to realize that they can't do everything themselves. Letting the SSA partner agency take responsibility for increasing SNAP sign-ups was essential to getting other goals achieved.

As a result of ongoing efforts to build a food economy as a public safety initiative, DSAL was able to receive a Byrne Criminal Justice Innovation Award from the Department of Justice. They understood the value of blending economic development with public safety and wanted to further support that work. As a result, DSAL has additional partners working to plan and execute a strategy for getting to know local residents and supporting them in increasing specialty crop awareness as well as having some use their skills to start new specialty crop businesses in the area.

What was also realized as the project developed was that in an effort to become more sustainable, DSAL needed to grow more produce and purchase less from partners as a way to reduce costs to customers. Though DSAL still purchases from BAUAMA partners, staff were ultimately able to increase productivity and decrease spending, providing quality specialty crops to area residents at a price within their budget.

Additional Information

Attachment 1 Community Survey
Attachment 2 Master Harvest List

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 11	**Project Title:** Sustaining California's Flower Farmers through Sustainability Certification	
Grant Recipient: California Cut Flower Commission	**Grant Agreement No.:** SCB13011	**Date Submitted:** December 2016
Recipient Contact: Kasey Cronquist	**Telephone:** (805) 696-5000	**Email:** kcronquist@ccfc.org

Project Summary

Over the past two decades, South America's (SA) flower industry has not only taken over the majority of the U.S. fresh cut flower market, now representing approximately 80% of all flowers sold in the U.S., but they have spent millions on the development of their image as a sustainable flower growing region. In fact, every existing sustainability certification program for flower production was created for marketing purposes, helping the SA flower industry, importers and retailers to compensate for any reputational issues that countries like Colombia and Ecuador might face in the U.S.

Unwilling to associate the high standards and requirements of growing flowers in California with SA, many of California's flower farmers have steered clear of sustainability labeling, unwilling to certify under the same programs benefiting the SA floral industry. However, based on retailer and consumer interest in wanting agricultural producers to use sustainable farming practices, and consumer interest in buying California-grown agricultural crops, the California Cut Flower Commission (CCFC) decided to develop a certification program for the sustainable production of cut flowers in California.

This project addressed several timely and important issues for the California cut flower industry. First, over the last several years there has been a growing interest by consumers for local, American grown products. A recent study commissioned by CCFC found that flowers flown in from SA have a 3-16 times higher transportation footprint than California grown flowers, a noteworthy distinction that is currently not measured by any of today's consumer facing floral certifications. Second, retailers are increasingly requesting that farms be certified sustainable by a third party. Last, regulators in California appreciate working with industries that have third party audit programs already in place that measure environmental impact.

Therefore, it was timely and important to develop and implement a sustainability certification for California flower farmers that more accurately reflects the sustainable growing practices and ensures they are California-grown. The certification program was based on the comprehensive and rigorous self-assessment workbook for the sustainable production of California cut flowers and greens developed by CCFC in 2014.

This project built upon a2010 Specialty Crop Block Grant Program Project 48: *California Cut Flower Industry Sustainability Study*. Some of the grant funds were used to:

1) Carry out a survey of California flower farmers to determine:
    a. What sustainable practices were being used
    b. What percentage of flower farmers were using them
    c. Align practices with existing certification programs available to California flower farmers
2) Evaluate certification programs for cut flowers to determine their adequacy to measure sustainability performance of California flower farmers

3) Calculate the transportation footprint of flowers from SA to 10 different U.S. retail destinations and compare it to that of shipping California flowers to the same destinations.

Based on the outcomes of the above work, CCFC concluded that a sustainable certification program designed for California flower production conditions would add value to California cut flowers and differentiate them in the marketplace from flowers imported from SA and other overseas countries. This work led to the project described in this report.

Project Approach

- A project stakeholder committee of six flower farmers was formed to work with an agricultural consulting firm (Firm) to develop the certification program and oversee program launch and implementation.
- The project stakeholder committee, and Firm, created practice-based sustainable flower production standards via webinars.
- The project stakeholder committee, and Firm, assigned points to each farming practice standard to be awarded to flower farmers using the practice.
- The Firm submitted the flower production farming practice standards and point system to a third party certifier which arranged for the practice standards and point system to be scientifically peer reviewed.
- Flower practice standards were revised based on a peer review and submitted to the third party certifier for accreditation which was granted in December 2014.
- The Firm developed certification and auditing protocols according to the third party certifier specifications.
- The Firm established criteria to achieve certification according to the third party certifier specifications.
- The Firm developed and launched the internet-based certification sustainable management information system (SMIS) that provides the following functionality:
  1) Flower farmers use it to record the farming practice standards they are using and those they are not,
  2) Flower farmers tally points awarded for practices being used and produce a certification report indicating whether they have qualified,
  3) Auditor creates a report based on the flower farmer's practice assessment to use during the audit of the flower farm that verifies the farming practice standards are being adhered to;
- CCFC established the program name, BloomCheck, a logo, and messaging for a retail and consumer facing certification program marketing campaign.
- CCFC launched the certification program to flower farmers by announcing it at key meetings, e-newsletters, and emails.
- The Firm created the following documents for flower farmers to use to help prepare for their audits: BloomCheck Companion Document, BloomCheck Management Plan Guide, BloomCheck Pesticide Do Not Use, BloomCheck Certification Manual.
- The Firm created a four-part video series to be used to introduce flower farmers to the BloomCheck program and how to prepare for an audit.
- Two webinars were held to introduce flower farmers to the certification and auditing protocols.
- The third party certifier certified four flower farms during 2015.
- CCFC collected flower and greens total annual sales data from CCFC flower farmer members for 2012 and U.S. flower sales to establish a benchmark.

The only commodity that benefited from this project is California grown cut flowers.

Goals and Outcomes Achieved

The goal of the project was to increase U.S. market share and farm-gate value of California grown cut flowers through the implementation of a third party certification program based on sustainable flower production practices. The performance measure is the increase in market share and farm-gate value of California grown cut flowers.

The benchmark was the total annual sales of flowers in 2012, or $231,499,806, which was two years before the certification program was developed and launched. This benchmark will be compared to annual sales figures of certified flowers in 2017, two years after the launch of the certification program. The goal is to increase market share by 5% or $18.5 million in farmgate value for California flower farmers.

The activities completed during the project toward achieving this goal and outcome were the design, development and implementation of the third party certification program for the sustainable production of cut flowers in California, and the benchmarking of non-certified flower sales in 2012.

The outcome measures for this project are long-term. CCFC successfully developed and launched the BloomCheck program, certified four flower farms in 2015, and one in 2016.

The one goal that was not achieved was certifying 20 flower farms in 2015. Five flower farms have been certified to date. CCFC was unsuccessful in certifying more flower farmers because of a delay in the completion of the certification program. Developing a rigorous and thorough certification program is a challenging and time-consuming process. As a result, the timeline for launching the program was pushed back.

Beneficiaries

The completion of the BloomCheck certification program will benefit all 225 cut flower farmers remaining in California, who collectively supply approximately 18% of the cut flowers sold in the U.S. The program is available to all cut flower farmers in California, and CCFC's goal is to expand far beyond the farms currently involved in the program's development. Four flower farms achieved BloomCheck certification in 2015 and one in 2016.

This project will affect all 225 cut flower farmers in California who collectively represent more than $278 million in total cut flower sales in the US. By developing a sustainability certification program, CCFC expects market share of California-grown cut flowers to increase by 5% by 2017, or $18.5 million based on 2011 farm-gate values.

Lessons Learned

First, developing a rigorous and thorough certification program is a challenging and time-consuming process. As a result, there was a delay in the completion of the certification program which delayed the timeline for launching the program. The overall delay resulted in fewer farms being certified during the life of the grant than was predicted at the beginning.

Second, growers who have never participated in a sustainable farming certification program often do not have standard operating procedures in place and record keeping systems that are necessary for an auditor to verify that the sustainable farming practice standards are being adhered to. This situation was observed on some of the flower farms audited for BloomCheck in 2015. This is a situation remedied through good grower outreach and education detailing the requirements for certification and audits, and also through the flower farmer's first year experience of the certification program.

Finally, an insight gained by the Firm from not only developing BloomCheck, but also in designing and implementing other programs, is that the probability of a third party sustainable farming certification being successful is greatly increased by the presence of a group or organization that the target grower community is a part of, and not related to the certifier. This encourages growers to participate in the certification program and also helps them prepare for the audits. CCFC can and will fill this role, which greatly improves the likelihood that BloomCheck will be successful and grow.

There were no unexpected outcomes or results during the life of the project.

A lesson learned for those new to the process of developing a sustainable farming certification program would be to allow more time for the development and subsequent accreditation of a certification program. Another lesson learned for those new to implementing a sustainable farming certification program is to provide education and outreach to the population of growers who might participate to ensure they will be successful in their first audit.

Additional Information

The following documents are provided as additional information:
1) BloomCheck Certification Manual
2) BloomCheck Companion Document
3) BloomCheck Management Plan Guide
4) BloomCheck Do Not Use List by Pesticide Trade names

USDA Project No.: 12	**Project Title:** California Food for California Kids	
Grant Recipient: Center for Ecoliteracy	**Grant Agreement No.:** SCB13012	**Date Submitted:** December 2015
Recipient Contact: Chris Smith	**Telephone:** (510) 845-4595	**Email:** chris@ecoliteracy.org

Project Summary

More than 1 billion meals are served annually in California public schools, making local school districts a significant and largely under-tapped market for specialty crop growers. The Center for Ecoliteracy (CEL) created a targeted implementation and marketing program to increase the use of specialty crops in school meals by providing nutrition service directors and district personnel with the recipes and technical expertise they need to procure, prepare, and serve more California fruits and vegetables. This project also designed and launched a communications strategy to build enthusiasm for locally grown specialty crops in school meals with students, parents, staff, and school communities.

With new U.S. Department of Agriculture (USDA) regulations requiring the use of more fresh fruits and vegetables in school meals, this grant provided a timely opportunity to support the efforts of the USDA mandate, encouraging more California-grown specialty crops to be purchased, prepared, and served in meals for students.

The economic impact to specialty crop producers has the potential to be significant: a one percent reallocation of the California school meal budget to California specialty crop producers equals $5.6–7.8 million per year. According to the California Department of Education, California schools produced 1,078,870,492 meals during the 2013-2014 academic school year.

By providing nutrition service directors across the state with the resources, motivation, and professional development to serve more California-grown food in school meals, the project also benefited school districts, and ultimately the students themselves. The California Thursdays program could also positively impact student health and achievement by increasing the amount of fresh, local specialty crops in school meals and their enthusiasm for eating it.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

CEL achieved its project objectives through a two-track process. Track 1 addressed the supply side of the school food market for specialty crops by targeting decision-makers in the school food system and providing the necessary tools and assistance for success. Track 2 addressed the demand side of the school food market by targeting parents and students statewide with new promotional materials and platforms advocating for more California-grown specialty crops in school meals and showcasing specialty crops.

TRACK 1

Created and Disseminated a Food Service Providers' Toolkit:
CEL created and disseminated a Food Service Providers' Toolkit comprised of practical resources for nutrition services professionals, including (a) recipes featuring at least 51% California specialty crops; (b) flavor profile resources and displays; and (c) Rice Bowl Strategy posters which 54% contained and highlighted California specialty crops. CEL worked diligently to ensure that recipe analysis was performed and tracking tools were employed to manage funds dedicated to California specialty crops. The toolkit provided practical and realistic examples that enabled food service directors to plan, procure, and serve a California-sourced reimbursable meal at least one day per month beginning in October 2014, and to commit to a goal of implementing weekly California-sourced offerings within one year.

The toolkit was disseminated on a flash drive to all participants who attended CEL's statewide conferences. In addition, CEL established a Listserve as part of its web-based extension activities so that participating districts could share ideas, techniques, tools, recipes, and strategies for successful programs.

Recruited and Developed a Network of Committed Food Service Providers:
CEL recruited school districts that demonstrated the highest readiness factors and motivation to serve California-sourced specialty crops while representing the widest range of district sizes and geographic diversity. Each district representative committed to:

- Attend and participate fully in a statewide conference in August 2014;
- Serve a California-sourced reimbursable meal featuring specialty crops at least one Thursday per month beginning in October 2014; and
- Establish a goal of implementing weekly California Thursdays offerings within one year.

The network involved 15 school districts (surpassing the stated goal of 10 school districts) that collectively serve over 190 million meals per year and represent both large and small districts as well as a range of urban, rural, and suburban districts. The purchasing power of these districts increased the likelihood of news coverage by showing the potential economic impact of increasing the procurement of California produce. The range of districts provided a wide assortment of model solutions and recommendations for future school districts to emulate while demonstrating the ability to build awareness among a variety of school communities.

Conducted Two State-wide Conferences to promote California Specialty Crops for Professionals:
CEL hosted a daylong workshop and two-day exhibit at the California Nutrition Services Association (CSNA) annual conference on November 14 -16, 2013, attracting 149 workshop participants attending from 49 school districts in 20 counties. CEL was encouraged by the interest and dedicated additional resources to increase the capacity of the workshop. Among the 1,200 people who attended the conference, 80% of those attendees are estimated to have visited the exhibit where they learned more about CEL's activities to promote California specialty crops. The main objective of these conferences was to enhance California specialty crops and to create awareness to food professionals that there is a need for more specialty crops in California school meals.

On August 7, 2014, CEL conducted a second statewide conference dedicated to launching the implementation of "California Thursdays," an implementation and marketing program, with a pre-qualified statewide network of nutrition service directors from among the pool of 2013 attendees (see "*Network of Committed Food Service Providers*" above). By identifying experienced innovators and early adopters, CEL was able to provide a focused conference that included professional development, technical assistance, training, and practical resources, which enabled the program to achieve significant results in districts throughout the state.

Disseminated Best Practice Stories & Best Practice Press Releases:
CEL worked with school districts to develop and disseminate four best practice stories featuring innovative nutrition services directors from across the state, including Fort Bragg, Oakland, Riverside, and Ventura Unified School Districts, (a) at the first statewide conference; (b) through tailored press releases to local media markets; (c) via CEL's social media and website; and (d) amplified by allied organizations.

Conducted Surveys and Implemented Program Evaluation:
CEL worked with Resource Development Associates to design an improved survey instrument. The baseline survey was conducted on August 7, 2014, at the launch of the California Thursdays campaign. The follow-up survey and evaluation were implemented after each district served a freshly prepared school meal featuring fresh California-grown fruits and vegetables in October of 2014. Results of the evaluation are included in the evaluation section below.

TRACK 2

Market Research:
CEL identified and engaged a nationally recognized advertising agency, barrettSF, as well as an award-winning communications firm, Brown Miller Communications (BMC), to develop the creative strategy, produce key assets, conduct market research, and provide technical expertise for the statewide launch of the marketing campaign. BMC conducted focus group research in three California regions: (1) Greater San Francisco Bay Area; (2) Riverside County; and (3) San Diego County. In addition to conducting the focus groups, BMC presented the results of the study at the statewide conference in August 2014. The participants in the focus group were parents of children in public schools, in one session one parent had a child in a private school. There was a mix of professional and stay-at-home parents, as well as a mix of income levels. The purpose of the focus groups was to understand parents' perceptions and attitudes about their children's school meals program and the impact of serving more California fruits and vegetables. The study revealed the following attitudes:

1. Parents care about the food their children receive at school;
2. The parents prefer California-grown specialty crops and products, and connect health and achievement with school meals;
3. Parents believe that freshly prepared food is healthier than processed food; and
4. The parents are anxious for change.

The focus group participants were unanimous in wanting their schools to create meals using California-grown specialty crops and products. Among the reasons cited were:

- California grows a wide variety of fruits and vegetables.
- It would be good for children to have more choices of fresh produce in season.
- One mother confided that she tries to teach her children what is healthy, but the school should provide that through example. The mother said that if schools served healthier meals with more fresh fruits and vegetables, it would make a mother's job easier.

- Mothers in Riverside liked supporting their farmers and local economy, reducing the carbon footprint, and improving the meals' nutritional value.
- Bay Area mothers agreed that fresher ingredients provide more nutrition and better appearance; one commented "origin is only part of the equation." Another said, "A lot can happen between the farm and the kitchen."

CEL's Rethinking School Lunch Program Manager, arranged and conducted market research with students and teachers by conducting peer-to-peer taste tests and surveys to elementary and high school students. The taste test results consistently show favorable responses to freshly prepared food made with California-grown fruits and vegetables. These findings support the belief that freshly prepared foods with California-grown ingredients are desirable, and challenges general assumptions proffered in the media that students do not eat fruits and vegetables.

Website and Social Media:
Following the August 2014 statewide conference with 15 members of the network, results began to exceed the projected plan. Several school districts immediately began implementing meals featuring fresh California specialty crops under the "California Thursdays" banner. In September 2014, CEL launched a California Thursdays webpage (www.ecoliteracy.org/california-thursdays) to reflect early news and earned media coverage, and to begin promoting the program ahead of the public launch. CEL increased activity in its social media campaigns on Facebook and Twitter. The website, CEL tracked the activity to ensure that funds were spent on core website design and html coding with the project funds, including the introduction, video, recipes, infographic, and success stories for the California Thursday specialty crop program only. Any additional aspects of the website were paid by other non-grant funds.

CEL identified and engaged Plumbline Studios to design and implement the standalone California Thursdays website. The website launched in October 2014 and provided resources in Track 1 and Track 2 to promote California specialty crops and to assist new school districts in joining the expanding network.

California Thursdays Campaign:
The California Thursdays campaign was launched on August 7, 2014. The 15 participating school districts in the statewide network committed to serving a school lunch meal featuring California-specialty crops on Thursday, October 23, 2014, and to promote the event in the media.

BMC provided hands-on training to address media inquiries with the goal of helping districts to direct the press to achieve successful interviews and news stories that promote increasing California specialty crops in school meals. Participating school districts were provided with key objectives, facts, and a rationale for the initiative.

Within two weeks of the conference, on August 21, 2014, Oceanside Unified School District utilized skills and talking points from the conference, resulting in a feature news story in the *San Diego Union-Tribune* about Oceanside's California Thursdays program. In addition, Oakland Unified School District Youth Radio began filming a video that was aired on the "PBS News Hour" on September 15, 2014.

On October 23, 2014, the 15 California Thursdays school districts participated in a simultaneous statewide event by serving a California-sourced reimbursable meal featuring specialty crops. This was an unprecedented event and drew significant media attention, including: two national features (PBS News Hour television and Public Radio International (PRI)'s Marketplace radio); 37 local television, radio, and print features; and 65 web-based outlet features with a total of more than 240 million impressions.

Video Spot:
CEL engaged Monstro Design to create an animated video to describe and promote the California Thursdays program. The resulting video can be found on the California Thursdays website and has received favorable responses from food service professionals and the general public alike for its ability to present the value of bringing fresh California specialty crops to school meals in a visually appealing and succinct manner.

CEL implemented detailed specialty crop tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes; and (2) clear guidelines which emphasized and made specialty crops the main ingredient in regards to marketing and promotional materials. CEL implemented detailed tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes to ensure more than 51% specialty crops were in the recipe; and (2) clear guidelines regarding marketing and promotional materials, along with costs were charged for specialty crops only.

<u>Network of California Thursdays School Districts</u> – The network of California Thursdays school districts included Alvord, Coachella Valley, Conejo Valley, Elk Grove, Hemet, La Honda–Pescadero, Lodi, Los Angeles, Monterey Peninsula, Oakland, Oceanside, Riverside, San Diego, San Francisco, and Turlock Unified School Districts. Each of these districts committed to attending the statewide conference, serving a California-sourced reimbursable meal at least one Thursday per month beginning in October 2014, and serving one California-sourced reimbursable meal once per week within one year. In addition, food service directors agreed to participate in our surveys, identify the challenges and solutions of the program, and communicate with and support other members of the network. To increase awareness in the public for the program, each food service director was trained to work with the media and provided with marketing materials.

<u>Marketing Campaign Partners</u> – Brown Miller Communications (BMC) provided expertise in developing and executing a focus group study in three regions of California. They subsequently reported these findings to the network of participating school districts. BMC developed training materials for handling media inquiries and presented this training in August 2014 at the statewide conference and implementation launch. BMC created and disseminated press releases and media alerts both statewide and locally, created an on-line media room with information about California Thursdays and each district's meal program featuring specialty crops, and prepared the groundwork for earned media coverage for each of the participating districts scheduled to launch the event on Thursday, October 23, 2014. Additionally, BMC followed up with media contacts on that day. As a result of BMC's expertise and the unprecedented nature of this effort, exceeded the expectations for spreading the word about California Thursdays.

<u>Communications Production Partners</u> – Monstro Design developed the concept production on the California Thursdays video. Plumbline studios provided strategic, creative, engineering, tracking, and Google Adwords services for the California Thursdays website.

<u>Assessment Partners</u> – Resource Development Associates provided expertise in making adjustments to the survey instrument that was used to measure outcomes. The survey instrument was adapted to

capture (1) preparedness to incorporate California specialty crops into the school lunch program; and (2) increased desire to include more fresh California specialty crops in school meals.

Goals and Outcomes Achieved

CEL surveyed nutrition service directors at 15 school districts implementing California Thursdays immediately following the training and rollout of the California Thursdays communications campaign, then again four months post implementation. Accomplishments and barriers were captured in the surveys as well as reporting on non-school district groups (included PTA or other parents' groups, specialty crop producers and suppliers) engaged in increasing the availability of California specialty crops in school lunches.

Additionally, CEL surveyed nutrition service directors who participated in this project about the overall impact on the use of California specialty crops to understand (1) changes in the usage of California specialty crops in school lunches; (2) changes in systems-level readiness for increasing the use of California specialty crops; (3) additional training and technical assistance needs to increase the use of specialty crops in the school lunch program; and (4) sustainability of the California Thursdays program.

CEL's California Thursdays program has made progress towards its long-term objective of influencing demand for California specialty crops in school meals. Through the development of collateral materials featuring California fresh specialty crops and associated professional development opportunities, the program has increased in the capacity as well as the motivation for districts to make use of California specialty crops in school lunches. The campaign has also helped to spread awareness of this work and its importance beyond the school district nutrition departments themselves throughout the districts. Increased demand for California fresh fruits and vegetables among these other stakeholders bolsters the ability for produce growers to supply them as well. These efforts will support increasing demand for these fresh California specialty crops, which will in turn stimulate the supply.

By providing training and resources to nutrition service directors, this program has facilitated an increase in their abilities, level of motivation, and readiness to procure, prepare, and serve more California specialty crops in their districts' school meals. Specific expected measurable outcomes are demonstrated by results from surveys of nutrition service directors about their districts' school meal programs as mentioned below.

With regards to the stated goal of increasing the use of California specialty crops in school lunches, 13 of 15 districts (86.7%) participating in the four-month post-implementation follow-up survey responded "Yes" when asked whether they have "increased the use of California specialty crops in [their] school lunch program[s] this academic year compared to last year." Among those respondents who offered estimates as to how much this use increased, amounts ranged between 10% and 30%.

In addition, a comparison of the responses given to the follow-up survey with those given to the baseline survey shows an increase in the level of readiness following the roll-out of this program, as well. When respondents to the baseline survey were asked to rate how prepared their districts were to incorporate the use of fresh fruits and vegetables into school lunch programs, the average score among all respondents was 4.23 on a scale of 1-5 (with 1 being "Not at all" and 5 being "Extremely"). Four months later, respondents to the follow-up survey reported an average score of 4.63, an increase of 9.4%.

The follow-up survey was also used to poll respondents about what strengths and/or challenges were encountered while incorporating more California specialty crops into school lunch programs and to seek recommendations about new resources that may be helpful in the future. This data will be useful in determining how to further sustain the program's goals and achieve better outcomes. The most frequently listed strengths of the program in facilitating the use of California specialty crops in school lunches were: support from directors (three respondents), district policy (three respondents), and new vendor relationships (three respondents). The most frequently listed challenges faced in facilitating the use of California fresh fruits and vegetables in school lunches were: cost (seven respondents); and product availability (four respondents). The most frequently requested resources were: assistance sourcing specialty crops (four respondents), such as a database of vendors that could be shared among districts; and assistance with staff training and equipment for processing specialty crops (two respondents each).

Finally, the follow-up survey sought to measure progress toward the campaign's goal of "non-school district groups (included PTA or other parents' groups) engaged in increasing the availability of California specialty crops in school lunches." All 15 districts (100%) indicated that they had shared the California Thursdays materials with at least one such group, with the average number being 4.5 of the 7 types of groups listed. These groups included PTA or other parents' groups (9 out of 15 districts responding to the survey, or 60%); Afterschool Providers (6 out of 15, or 40%); Faculty and Staff (14 out of 15, or 93.3%); School District Administration (14 out of 15, or 93.3%); School Board (10 out of 15, or 66.7%); Students or School Club (10 out of 15, or 66.7%); and "Other" (4 out of 15, or 26.7%).

Baseline data collected in the aforementioned baseline survey of nutrition service directors included self-reported preparedness and motivation scores (on a scale of 1-5, with 1 being "Not at all" and 5 being "Extremely") of directors and districts in incorporating California specialty crops in school lunch programs and in implementing California Thursdays on a monthly basis. Changes in these indicators seen in the four-month post-implementation follow-up survey are given in the following table:

		Nutrition Directors		School Districts	
		Preparedness	Motivation	Preparedness	Motivation
Incorporating California specialty crops into school lunch programs	Baseline Survey Average	4.32	4.86	4.23	4.29
	Follow-up Survey Average	4.50	4.49	4.63	4.94
	Percent Change	+4.2%	+1.5%	+9.4%	+15.2%
Implement/continue California Thursdays on a monthly basis	Baseline Survey Average	3.52	4.77	3.48	4.02
	Follow-up Survey Average	4.44	4.94	4.56	4.88
	Percent Change	+26.0%	+3.5%	31.2%	+21.1%

Between the baseline and follow-up surveys, the average score for district preparedness to implement or continue California Thursdays increased 31.2%, from 3.48 to 4.56 (out of 5). Nutrition Directors also increased their preparedness to implement or continue the program by 26%. Both of these scores represent significant positive outcomes for the project objectives.

Beneficiaries

The school districts participating in the California Thursdays network served 1,327,604 California Thursdays meals between October 23, 2014 and December 31, 2014, which further benefited the students who consumed freshly prepared meals made with California fresh fruits and vegetables as well as the producers from whom the districts procured the additional California specialty crops.

The media coverage for the California Thursdays statewide rollout on October 23, 2014 served to increase public awareness about California-grown fruits and vegetables and thereby benefit a range of specialty crop stakeholders.

Thirteen school districts responding to the follow-up survey reported having "increased the use of California specialty crops in your school lunch program this academic school year compared to last year." California Thursdays supported these districts through the dissemination of its materials to the district Nutrition Services Departments, who in turn shared them with other district staff. Increased staff capacity for using fresh fruits and vegetables increases the likelihood they will be used and creates economic incentives for producers. Together these districts accounted for 1,077,789 enrolled students in the 2014-2015 school year, representing 17.3% of the state total. In a telephone survey of participating districts conducted by CEL, 11 districts reported data about the number of California Thursdays meals served between the October rollout and the end of the 2014 calendar year, which totaled 1,327,604 meals.

Nutrition service directors responding to the follow-up survey were asked to indicate with whom they had shared California Thursdays materials. All 16 respondents indicated that they had shared the materials beyond their district meal program personnel. Direct beneficiaries include: PTA or other parents' groups (9 out of 16 districts responding to the survey, or 56.3%); Afterschool Providers (6 out of 16, or 37.5%); Faculty and Staff (15 out of 16, or 93.8%); School District Administrators (14 out of 16, or 87.5%); School Board (10 out of 16, or 62.5%); Students or School Club (10 out of 16, or 62.5%); and "Other" (4 out of 16, or 25%). Responses listed in the "Other" category included "posted a blurb on CEL website," "media," "city agencies," "local hospitals," "community members, and community developers."

Lessons Learned

One of the biggest lessons learned as a result of completing this project is that the success of the program and subsequent growth of interest in participating, is that it also introduces organizational capacity issues. It is now a challenge to manage with current resources. CEL was able to recruit more active members within the network than planned. Since the conclusion of the first statewide event, more than double the number of school districts have asked to join the network of districts serving more California specialty crops. CEL is experiencing the challenge of meeting the increased demand in new members. It requires more attention and coordination than the current resources can manage effectively. CEL is investigating all options to accommodate the high volume interest in demand. CEL expected 10 school districts to commit to participating in the pilot network and was surprised by the interest from more nutrition service directors in joining the project. For phase 1, the project team accepted a total of 15 districts into the projects active network. Shortly after the conclusion of the grant period, interest throughout the state of California increased significantly, and the expanded network nearly tripled, currently including 42 districts.

Another significant lesson learned is that the individualized systems used by school districts do not lend themselves to easily-obtainable metrics and collective assessment. Collecting and analyzing aggregate procurement data is a challenge. Each district has its own approach to tracking purchases, and most are not set up to track provenance in an ongoing manner. That is in part because distributors and most food purveyors themselves have not traditionally provided source information to their customers. In addition, weights and measures vary significantly within a particular fruit or vegetable in its various forms. However, a few indications at the conclusion of this project lead the project team to believe that distributors are beginning to recognize the value of providing more information about the origins of their products as Nutrition Services Directors demand that information in order to participate in the program and support California specialty crops.

Contrary to what media coverage often suggests, during this grant period, students proved that they were enthusiastic about consuming more California specialty crops in their school meals. During the October 2014 statewide rollout events, nutrition service directors enlisted student-led groups to actively participate in activities like peer-to-peer surveys, tasting stations, event promotion, and garden clubs. In addition, they reported that students enthusiastically chose the California Thursdays lunch option that day (containing increased amounts of specialty crops) over less healthy yet familiar foods. This shows early signs that with an effective marketing and student-tested recipes featuring specialty crops, it is possible to spark a shift in student attitudes and behaviors toward healthy meals as “cool”, “more delicious”, and “more local”.

The intention to engage in a general market research telephone poll was revealed to be an unnecessary effort because of pre-existing studies. Philanthropic professionals, most notably from Pew Charitable Trust, affirmed the results CEL discovered around the consistently high polling support among parents of all backgrounds and affiliations for the general proposition of improving school meals. Marketing professionals made clear that early and generalized market research would be unlikely to provide a useful baseline, and recommended a more targeted effort in the form of a scheduled set of focus groups with parents.

Recruiting, hiring, and managing an external social media writer proved to require more resources than anticipated. CEL determined that it would be more cost effective and easier to manage the social media efforts with in-house staff.

One significant challenge involved clarifying the tracking mechanisms in order to ensure grant funds are expended to solely enhance the competitiveness of California specialty crops, rather than more broadly to fresh California-sourced food. Nutrition service directors are required to meet complex USDA menu pattern and meal reimbursement regulations for school meals, which dictate percentages of foods in different categories. Analyzing the recipes to ensure that they meet the requirements became an unexpected project effort. The key lesson learned in this process was to develop tracking mechanisms and analysis that would comply with grant requirements while working within the USDA School Food Service requirements. The project team ensured that this projects purpose was to solely enhance specialty crops. CEL implemented detailed tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes to ensure more than 51% specialty crops were in the recipe; and (2) clear guidelines regarding marketing and promotional materials, along with costs were charged for specialty crops only.

One of the key lessons learned was to simplify the project message and deliverables by focusing tightly on solely enhancing the competitiveness of California specialty crops. The marketing materials featured bright, beautiful images of the specialty crops alone. The effect of this constraint actually resulted in more efficient use of the project team's time and simultaneously increased the attractiveness of the message. School districts were able and eager to use the striking images in the school nutritional marketing efforts. Responses indicate that students and parents liked them, too.

Another significant challenge involved the time required to secure a top-tier advertising agency to provide creative direction for the marketing campaign, which shifted from the end of 2013 to the early part of 2014. The change was due in part to the calendar cycles of work flow at the end of the year and in part to the time required to secure subsidized services from major agencies for a nonprofit campaign. A major agency was secured ultimately, but CEL needed to shift some of the campaign effort to a smaller agency to meet the schedule and deliverables.

Additional Information

Please find the three informational pieces mentioned below available at this link
http://www.hightail.com/download/ZWJYS3doZ1BJMHVVbDhUQw

(1) A sample pre-approved poster within the projects series of specialty-crop posters;

(2) A screen shot of the California Thursdays website when it was launched in fall of 2014; and

(3) An infographic (available in 2014 on the website) showing the original network of 15 participating school districts.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 13	Project Title: Making the California Women, Infants and Children (WIC) Program Work for California Farmers and WIC Program Participants	
Grant Recipient: University of California, Davis	**Grant Agreement No.:** SCB13013	**Date Submitted:** December 2016
Recipient Contact: Richard J. Sexton	**Telephone:** (530) 752-4428	**Email:** rich@primal.ucdavis.edu

Project Summary

The Women, Infants and Children (WIC) Program Farmers' Market Nutrition Program permits eligible families to receive $20 in vouchers to purchase fresh fruits and vegetables at WIC-approved Farmers' Markets. Just under three million was expended in this program in 2010 in California. However, in 2014 over $87.5 million is expended annually through the California WIC Program for participants to purchase fresh, frozen, or canned fruits and vegetables using cash-value vouchers (CVV) – hereafter the Fruit and Vegetable Checks (FVC). Presently only a small fraction of these FVCs ($73,000 in 2014) are redeemed though farmers' markets, resulting in great loss in potential revenue to California's specialty crop producers.

While approximately 380 farmers' markets throughout California are authorized to redeem vouchers for the more limited Farmers' Market Nutrition Program, only 36 farmers' markets, concentrated in Southern California (Los Angeles and San Diego counties), are authorized to accept the CVVs given to eligible WIC participants. Expanding the number of direct marketers and farmers' markets authorized to sell to the larger WIC population is a fundamental goal of the project and is an essential step to increasing the share going to California farmers of the more than $87.5 million expended annually on fruits and vegetables through the California WIC program. Moreover, farmers who engage in direct marketing receive the full value of FVC redemptions whereas markups by market intermediaries decrease the farm share for FVCs redeemed at commercial retailers. For example, the farm shares for fresh fruits and vegetables sold at retail in 2013 were 35% and 27%, respectively. Thus, a farmer may receive only $2.70 to $3.50 in value when a $10 FVC is redeemed at a traditional food retailer, instead of the full $10 at a farmers' market.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Data Analysis: As part of this project, the UC Davis researchers obtained data detailing every WIC Program voucher redeemed in California for several recent years, enabling project staff to derive the first comprehensive information on WIC program expenditures at farmers' markets. For most months, total FVC redemptions in California have varied between $6 – 8 million, while the farmers' market share of FVC redemptions fluctuated around 0.05% of this total for most months, with some seasonal increases during the summer. The farmers' market share rose substantially, to above 0.15% in the summer of 2014, before declining quickly again in the fall/winter. Focusing specifically on 2014, the most recent year for which complete redemption data is available, just over $73,000 in FVCs was redeemed at farmers' markets, approximately 0.08% of total FVC redemptions in California.

The statewide figures do not paint a complete picture given that authorized farmers' markets are relatively concentrated geographically, and thus most participants in California lack access to a farmers' market that is authorized for FVC checks. The project team compared redemptions of FVCs at farmers' markets relative to other authorized vendors for California counties that have at least one farmers' market authorized to accept FVCs. The average share of FVC redemptions at farmers' markets in counties with at least one authorized market is 0.11%, compared to 0.08% statewide, but large differences in redemption rates are revealed across counties. In Fresno County, only one farmers' market is authorized and redeems 0.10% of FVCs. In contrast, both Placer and Santa Cruz counties each have one farmers' market authorized to redeem FVCs, which account for only 0.01% and 0.02% of FVC redemptions in the county, respectively. Thus, increasing the number of farmers' markets authorized to redeem FVC is only one small component to increasing the share of FVC redemptions at farmers' markets.

Geographic Information System (GIS) Analysis: All farmers' markets authorized by the California WIC Agency were geocoded and mapped to ascertain the level of participant access as well as to facilitate farmers' market manager survey sampling stratification. A sample of the maps generated from this analysis are included as Attachment 1.

Farmers' Market Manager Survey: Market manager surveys were conducted via phone between October and December 2014. Twenty of the 48 markets selected for survey chose to participate, a response rate of approximately 42%. Survey instruments were tailored for Farmers' Market Nutrition Program (FMNP) only and FMNP and FVC markets. Each of the surveys contained four sections including: i) basic market and manager characteristics, ii) perception of the authorization procedure, iii) perceived demand for FMNP and/or FVC authorization by farmers and participants, and iv) perceived costs for or barriers to FMNP and/or FVC authorization by farmers.

For this summary, the focus was on the responses from the managers whose markets are authorized to accept both FMNP and FVC vouchers in order to isolate responses that compare the two programs. Comparing responses across the two sections clearly indicates that market managers perceive the FVC program's authorization process as more difficult than its FMNP counterpart. For example, 80% of market managers strongly agree or agree that receiving FVC authorization is difficult, compared to only 10% giving a similar response when asked about the FMNP. Market managers also perceive that farmers' cost and/or difficulties associated with obtaining reimbursement from California WIC are more substantial for the FVC Program, when compared to the FMNP. Training employees how to properly redeem FVC is also regarded as more challenging than vouchers for the FMNP.

Examining these concerns in more detail, although the authorization procedures for the FMNP and FVC programs are somewhat similar, the FVC program's process does impose more of a burden on farmers and markets. For both programs, the California WIC program must authorize both the market and the individual farmer vendors in that market. Each must also be certified by the California Department of Food and Agriculture. In addition, farmers' market managers and farmers seeking authorization must attend in-person or interactive training sessions given by California WIC staff. Different training sessions are required for each program, and the FVC authorization requires additional training compared to FMNP and reauthorization every three years.

As to the reimbursement process for FMNP vouchers compared to FVCs, authorized farmers can deposit FMNP checks into their bank accounts and checks can be deposited any time on or before December 31st of each year. FVCs, however, must be redeemed through a dedicated online portal, a process that requires specific training, and the timeline to submit FVCs for payment is much tighter. Vendors have only 45 days from the "first day of use" indicated on the check to redeem it. Given that FVCs are issued to participants on a monthly basis and expire every 30 days, i.e., the participant has 30 days to redeem it, the farmer may in some cases have as few as 15 days to submit checks for reimbursement.

Another interesting facet of the market manager survey was the differences in perception by the managers regarding the economic potential of the FMNP and FVC programs at their markets. As noted, the annual value of FVC dwarfs that for FMNP. Managers, however, mostly agreed (80%) with the proposition that FVC checks were too low to justify authorization and that there was a lack of FVC customers (70%) at their market compared to 70% and 10% agreement on the same questions regarding FMNP.

Authorized Farmer Survey: To ascertain authorized farmers' opinions on the WIC farmers' market redemption programs, a survey instrument was designed and targeted to all farmers authorized to redeem FVCs, 149 in total at the time that the survey was designed. Surveys in both English and Spanish were mailed to all FVC-authorized farmers in January 2015. After initial contact and one follow-up, 61 completed responses were returned, a response rate of 41%.

Given that all farmers were authorized to accept FMNP and FVC vouchers, farmers were asked to provide opinions on both aspects of the WIC program in three broad categories: i) ease of administration, ii) participant demand, and iii) advertising and promotion.

Farmer survey responses confirm that the authorization process is significantly more challenging for FVCs compared to the FMNP program. Forty-three percent of respondents indicated (strongly agree or agree) that the FVC authorization process and administrative activities surrounding redemption are difficult. When asked the same question regarding the FMNP program, only 26% of respondents offered a similar opinion. Comparably, when asked whether accepting FVC (FMNP) vouchers was too confusing/difficult to justify the effort, 35% (12% strongly agreed) agreed with the statement. Based on farmer responses, it appears that the most significant challenge with FVC program is the reimbursement process. Fifty one percent of farmers say that receiving reimbursement for FVCs is too confusing and/or difficult to justify the effort, compared to only 27% of respondents strongly agreeing or agreeing with the same statement relating to the FMNP.

When asked about participant demand, participating farmers were evenly split on whether there were too few FVC customers to justify the effort, but more disagreed than agreed with the proposition that the dollar value of the FVC was insufficient to justify participation in the program. In general, farmers were less pessimistic than market managers about the economic value of participating in the FVC program.

In the area of promotion and advertising to communicate with WIC participants, 25% of farmers indicate they believe that the amount of advertising surrounding FVC and FMNP redemption is not sufficient. Yet, 59% (70% of farmers) indicate that they individually promote that they accept FVC (FMNP) vouchers.

Participant Survey: Despite repeated attempts to work with the clinic agency in charge on the development and administration of a participant survey, ultimately they were unwilling to facilitate this process. The information that was received from the market manager and farmer surveys, coupled with the additional analysis of the redemption data detailed in the subsequent paragraphs provided sufficient information that the integrity of the project is not compromised.

A potential benefit to WIC participants from redeeming their FVC at farmers' markets is greater ease in fully utilizing the full dollar value of the voucher. Results from the farmer survey indicate that 40% of authorized farmers provide participants with more fruits and/or vegetables than the dollar value of their voucher. To test if FVCs redeemed at farmers' markets are more fully utilized than when redeemed at other authorized WIC vendors, participant-level data was analyzed from June 2014 thru February 2015. These data indicate the vendor at which the FVC was redeemed and the dollar value that the vendor requested for reimbursement.

California WIC divides vendors into peer groups including: i) farmers' markets, ii) above-50 (A-50) vendors who derive more than 50% of their food sales from WIC redemptions, iii) full line grocers delineated by number of cash registers to proxy for size, and iv) non-full line grocers. A regression model was estimated to determine how the participant's choice of vendor type influenced the probability that the voucher would be fully utilized.

Regression estimates indicate for both the $6 and $10 FVC at farmers' markets, the reference category in the regression, have the highest probability of WIC participants fully utilizing their FVCs. The coefficient estimates for all of the other peer groups are negative and statistically significant at the 1% level. Further, chi-square tests for coefficient equality indicate that the coefficient estimates for each peer group are statistically different from the farmers' market estimate (reference category). The marginal effects provide probability estimates when data are evaluated at their means. Thus, for the $6 FVC, the probability that a participant will fully utilize the FVC value at a farmers' market is 99.1%, compared to a probability of only 66.8% if the FVC is redeemed at a full-line grocer with 6 - 9 cash registers. For both FVCs redeemed by participants, the highest probability of full utilization occurs when a participant redeems at a farmers' market.

California WIC redemption data also show that participants who do visit farmers' markets to redeem FVC generally don't return. Project staff considered the six month period from June 2014 through November 2014 and tracked where participants redeemed their $8 FVC. The period from June to November was isolated, as this is the season when the most farmers' markets are operating, have the greatest amount of specialty crops for sale, and are months when the most FVC are redeemed at farmers' markets. Among 2,524 participants who redeemed an FVC at a farmers' market during the six month window, 76% did not return to that market or another farmers' market during that time period. In contrast, at more traditional food retailers, the overwhelming majority of participants return to the same vendor to redeem WIC benefits, including fresh-fruits and vegetables, at least twice during a six-month period.

Of the remaining 24%, 426 participants (13%) redeemed FVCs at farmers' markets twice during the six month window. Only 11% (344 participants) redeemed FVCs at farmers' markets more than three times. Because participants are entering and exiting the WIC program on a continuous basis, project staff wanted to confirm that attrition was not being driven by participant exit from the WIC program. Thus the focus was on the 2,524 participants who only visited a farmers' market once and asked whether or not they were redeeming FVCs at other WIC authorized vendors during the six month period. The vast majority (97% or 2,451) remained in the WIC program and redeemed FVCs at other WIC-authorized vendors (i.e., not farmers' markets), meaning that for most the failure to continue patronage at a farmers' market was not due to exit from the program.

Dissemination of Results: A manuscript received a favorable first review in Renewable Agriculture and Food Systems. Although it is expected that the paper will be accepted for publication, a response has not been received to the revision of the Journal. Once published, the manuscript will be sent to all those market managers and farmers who, as part of the survey process, indicated they were interested in the results.

The overall scope of the project did not benefit commodities other than specialty crops.

The project had three "partners". The principal investigator (PI) on the project was involved in all facets. In particular, the PI was involved in the market manager and farmer survey design and sample stratification, advising all data analysis, and took a major role in drafting dissemination materials. The project scientist at UC Davis and collaborator on the project, was responsible for all coding and data analysis, coordinating graduate student researcher (GSR) help in survey dissemination and data entry, and conducted all GIS work. Finally, one GSR was employed on this grant. That individual was responsible for conducting the market manager surveys via phone and for mailing and entering the responses associated with the farmer survey.

Goals and Outcomes Achieved

Data: The data necessary to determine purchase shares and trends for farmers' market for redemptions as well as the attrition measures and FVC utilization analysis described in the previous section was collected on an ongoing basis from the California Department of Public Health WIC Program spanning October 2009 – February 2015.

Surveys: In order to execute the surveys both had to be developed and submitted to the UC Davis institutional review board for approval. Once this was complete, the market manager surveys were conducted via phone interview, while the farmer surveys were packaged and mailed (provided in both English and Spanish). Upon receipt of completed surveys, handwritten responses were entered into a machine-readable format (excel) so analysis could later be performed.

All of the goals associated with the project were accomplished with the exception of conducting the WIC participant survey. While project staff had been communicating on an ongoing basis with WIC Agency personnel regarding this task/goal, the Agency remained concerned about the workload that this could potentially add to local vendor liaisons in the Los Angeles area where there is the highest concentration of authorized farmers' markets, and thereby the largest WIC participant population that would have experience with this aspect of the program. Fortunately, the information that was garnered from the market manager survey regarding participant behavior can fill in the gaps created by not surveying participants directly.

The major goal of this project was to identify the barriers that have historically prevented the FVC program from succeeding and expanding. The baseline data on redemptions is provided earlier in this report in the "Project Approach" section. What follows are the challenges/impediments that were identified.

Despite the potential of the FVC program to increase the revenue of participating farmers and to provide fresh, locally grown specialty crops to WIC participants, analysis of the current redemptions of FVCs at farmers' markets and survey responses from participating farmers and market managers indicate that significant barriers stand in the way of the program's success in California. One factor is the limited number of markets authorized to date to accept FVCs. An issue in this regard is that no supplemental federal funds are provided to state WIC Agencies to facilitate the redemption of FVCs at farmers' markets. Thus, the costs of training, authorization, and monitoring markets must be paid from the general Agency administration budget.

With markets available to only a small subset of WIC participants, it is difficult for the California WIC agency to provide widespread information to participants of their opportunity to redeem benefits at farmers' markets without causing confusion among participants who lack access. Moreover, state agencies are precluded under food and nutrition service (FNS) regulations from taking actions that appear to favor one type of vendor relative to another. Publicizing the availability of redemption of FVCs in areas with participating farmers' markets could be construed as a violation of this regulation. Thus, even when participants have access to an authorized farmers' markets, they may be unaware of such markets' existence and that they are able to redeem their FVCs at those locations.

However, as results of analysis of the redemption data demonstrated, redemptions are only marginally higher in counties with one or more participating markets than the statewide average, indicating the presence of other barriers to participation. Market managers indicate that most WIC-eligible customers at their markets are not interested in redeeming their FVCs at farmers' markets (80% of market managers surveyed say "uninterested" or "very uninterested").

Another challenge may be overcoming market manager perceptions of the benefits associated with WIC authorization. Only 20% of market managers considered the FVC program important to bringing new customers to the market or increasing the sales at the market generated by existing customers. It is unlikely that market managers holding such views will actively pursue FVC authorization. As noted, however, research does suggest that participation in WIC fruit and vegetable programs does increase overall participation at farmers' markets.

Another major challenge in terms of increasing redemptions of FVC at farmers' markets is apparent dissatisfaction of WIC participants who shopped at farmers' markets with the experience, as indicated by a 76% attrition rate. One factor likely contributing to participant dissatisfaction is that under current federal regulations WIC participants must use their FVCs at a single farmer vendor. WIC regulations do not allow participants to visit a central point-of-sale location at the market and get smaller dollar-value denomination scrip or tokens to then use at different vendors at the market. Thus, depending on the market and on the farmer vendor, participants may have limited product choices (e.g., apples or grapes, but not both), further discouraging participation.

In addition to identifying the challenges, summarized above, pathways were developed for the California WIC agency and market managers and farmers to make the program more successful.

Various factors have limited market managers' interest in having their markets authorized, farmer vendors have found little benefit in their own authorization, given limited sales and a high administrative burden from participation, and most participants who have tried the program have apparently not been satisfied, given the high attrition rate revealed here. Such dissatisfaction limits the potential for the program to expand via "word-of-mouth" endorsements.

Suggestions center on achieving a "critical mass" of farmers' markets authorized to accept FVCs such that participant access is expanded, and also obtaining a greater rate FVC redemptions at authorized markets. A comprehensive strategy is necessary to solve the simultaneity of "chicken or the egg" problem of disinterest among farmers and markets because demand is so low, and lack of information and interest for participants because few markets are participating.

Additional dedicated resources from either the federal or state level are needed to support development and expansion of the farmers' market portion of the WIC Program. Program administrators currently face a tradeoff between allocating scarce budgetary resources to expansion of the farmers' market program or to other program objectives. Until the program reaches a threshold level of adoption among farmers markets wherein the state agencies can effectively publicize the farmers' market option to participants, most participants, market managers, and farmer vendors will likely remain uninformed and/or uninterested.

Because WIC participants must visit WIC clinics to pick up their vouchers, the clinic can be a source of information about farmers' markets. Responses from market managers and farmers indicate that the acceptance of WIC FVC is being advertised at participating markets and in most instances at each individual farmer stall. Yet the vast percentage of program participants likely remains unaware of the farmers' market option, even when it is accessible to them. Thus, it is imperative that information also be disseminated at the clinic level, or more broadly at the agency level, in order to make participants aware of availability of farmers' market as a choice for redemption of their FVC.

The California WIC agency has recently made some significant changes that have streamlined the authorization process, and thereby expanded the number of markets authorized and vendors approved to accept FVCs. These changes and others may merit widespread adoption among state agencies. In cases where individual farmers at an FVC-authorized market are not authorized, the market manager can now accept and redeem FVCs on behalf of the farmer who sells WIC-eligible food items to a WIC participant. Allowing market managers to act as an intermediary expands the farmers from whom participants can choose to redeem their FVCs and likely expands their product choices as well. This also alleviates some of the administrative burden and cost associated with the program from farmers' perspectives, as they no longer have to undergo training and ongoing re-authorization on an individual basis.

Ultimately, these efforts all need to happen in concert in order to generate the largest possible impact for California WIC participants and California farmers. Although the challenge is great, so too are the prospective benefits for both California farmers and WIC participants.

Beneficiaries

The beneficiaries include California farmers who are direct marketing their WIC authorized food items at WIC authorized farmers' markets, as well as California WIC participants who will have increased access to fresh, locally grown specialty crops.

While participants are receiving FVCs at no cost, and thereby don't receive pecuniary benefits, they do stand to benefit from increased food access. WIC participants who shop at farmers' markets are able to obtain fresh, locally grown specialty crops and possibly expand the purchasing power of their FVC checks. Contrary to common perception, farmers' markets are price competitive with supermarkets for fresh fruits and vegetables sold in season. Moreover, participants may be better able to fully redeem their FVCs when shopping at farmers' markets compared to traditional retail outlets where transactions costs may present a barrier to full redemption.

Expanding the number of markets authorized to accept FVCs may also help address concerns surrounding participant access to healthy foods. Farmers' markets have the potential to expand participant healthy specialty crop options in food-desert areas. Further, research suggests that ease of access significantly affects consumers' choice to shop at farmers' markets and this will likely be a more significant factor for low-income WIC participants who are more constrained in terms of their access to transportation.

In addition to a direct expansion of sales, increased WIC FVC redemptions at farmers' markets can potentially expand the consumer base of farmers' markets. In fact studies show that the FMNP has increased participant awareness and use of farmers' markets and that farmers who participated in the FMNP program reported increased market sales. Expansion of FVC redemptions at farmers markets could have even greater influence on participants' propensity to patronize farmers' markets than the FMNP research suggests, given that FVC checks are part of a participant's regular monthly benefits and the annual aggregate dollar amount is much larger. Moreover, farmers who engage in direct marketing receive the full value of FVC redemptions whereas markups by market intermediaries decrease the farm share for FVCs redeemed at commercial retailers. For example, the farm shares for fresh fruits and vegetables sold at retail in 2013 were 35% and 27%, respectively. Thus, a farmer may receive only $2.70 to $3.50 in value when a $10 FVC is redeemed at a traditional food retailer, instead of the full $10 at a farmers' market.

The results from this work have been accepted for publication in Renewable Agriculture and Food Systems and will be in press in 2017. Thus, the conclusions and recommendations from this project are now widely available to researchers, WIC agency personnel, and farmers' market managers throughout the U.S. This is a highly visible outlet for these findings and an avenue by which decision makers in this arena will have access to this information. During the project and publication process, the Principal Investigators worked closely with California WIC agency staff that is responsible for the farmers' market program in California. It is impossible to predict with any accuracy the number of beneficiaries from this research. Potential beneficiaries include (i) researchers with an interest in food-assistance programs, (ii) officials at state WIC agencies who operate farmers' market programs or seek to implement such programs, (iii) farmers market managers who serve WIC participants or seek to serve them, (iv) WIC participants who would like to redeem fruit and vegetable vouchers at farmers markets in order to receive high-quality produce, and, potentially, more favorable prices, and (v) farmers market vendors who could increase revenues if their markets were authorized to accept WIC vouchers.

Lessons Learned

Overall the project went smoothly and was a positive experience. Significant staff and administrative personnel turn over during the performance period of the grant made it challenging to collect data from the WIC program regarding participant purchase decisions.

Despite repeated attempts to work with the chosen agency on the development and administration of a participant survey, ultimately they were unwilling to facilitate this process. The information received from the market manager and farmer surveys, coupled with the additional analysis of the redemption data detailed in the subsequent paragraphs provided sufficient information that the integrity of the project was not compromised.

Even though the participant survey was not completed as planned, project staff secured and analyzed redemption data that could fill in the majority of the gaps in knowledge of the WIC participant experience at farmers' market. Secure more data than you believe is required to complete the project.

Additional Information

See Attachment 1

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 14	Project Title: Recovering Returns on Sonoma Valley AVA Winegrapes	
Grant Recipient: Sonoma Valley Vintners Association	**Grant Agreement No.:** SCB13014	**Date Submitted:** December 2015
Recipient Contact: Maureen Cottingham	**Telephone:** (707) 935-0803 x4	**Email:** maureen@sonomavalleywine.com

Project Summary
Sonoma Valley Vintners Association (SVVA) represents nearly all growers/vintners in the American Viticultural Areas (AVAs) of Sonoma Valley (SV) in Sonoma County. The economy hurt returns as consumers switched to non-AVA labeled wines; the average winegrape prices for SV dropped 6.19% since 2009 due to lower wine prices. Research showed consumers pay more if they see value; a 2009 Wine Opinions study showed SV wines are well valued in the wine community but a need existed to promote Sonoma Valley wines to consumers and the trade. This project helped create economic opportunities for specialty crop producers through market development activities that focused on local, regional, or international markets. The goal was to grow consumer acceptance of premiums for SV AVA labeled wines, helping recover recent wine and grape price declines. The aim was not to increase consumption, or total sales at the expense of other growers, but to boost the demand and premium for SV AVA labeled wines and shift volume back from bulk and other lower value sales through website redesign, social media and email campaigns, and print and online ads.

This project was important and timely for the winegrape growers of Sonoma Valley; if the downward wine price trend was not reversed, winegrape growers would continue to see declining grape prices. Sonoma is an expensive area to grow grapes and bottle wine compared to many regions of the state and SV growers depend on a strong premium to remain financially viable as California specialty crop producers.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach
Website – The website was redesigned to increase consumer/trade engagement and interaction with the Sonoma Valley brand to optimize distribution and viral sharing of new and existing assets. The integration of the new CMS system, new content and the kick-off of the Extended Family drove more Sonoma Valley wine enthusiasts to the SonomaValleyWine.com which ultimately educated the consumer on the product and in the long term creates ambassadors and customers for life. While the program goal was to reach 45,000 unique visits per month, and an average of 15,000 visits per month was reached, this was not a fail. The improved website and engagement programs and content continue to increase the amount of time each consumer spends on the website in general and specifically on each page which ultimately drives more traffic to the individual grape growers and vintners.

Social Media – The implementation of the social media programs was another success overall. The development of content for the social media outlets to continuously tell the story of the premium product and provide an outlet for Sonoma Valley grape growers to gain exposure will ultimately elevate their prestige in the marketplace and allow them to charge more for their product. The goal for social media was to increase measurable engagement throughout all social media channels. The goals for social media were re-assessed and revised mid-project for more realistic goals. At the end of the project, results were Facebook increased by 85%, Instagram by nearly 20,000%, Pinterest by 64% and Twitter by 58%.

Email – An email campaign to promote purchases as well as brand advocacy that nurtured relationships with wine lovers was successfully developed. The Blackboard, the title of the email that engaged the wine enthusiasts, garnered over 42,000 subscribers. A very important, yet time consuming, piece was developing the content featured in these newsletters to keep consumers engaged and interested wine drinkers to subscribe. This program was hugely successful and continues to be the most successful way for the Sonoma Valley brand to tell its story to those that will purchase the end product.

Advertising – A very successful advertising campaign ran in nationally known publications that reinforced the brand message, encouraged readers to subscribe to the email blast for current information and follow the social media channels for daily updates. This program positioned Sonoma Valley labeled wine in front of the target audience on a national level.

This project only benefitted specialty crops. The project directly and exclusively promoted of winegrapes produced by the winegrowers in the Sonoma Valley.

Goals and Outcomes Achieved

Implemented the strategic plan for Facebook, Twitter, Instagram, Pinterest and YouTube integration of digital assets and consumer engagement that focused on increasing awareness and fan base and to support seasonal campaigns, which highlighted the grape to glass stories, personalities of Sonoma Valley winegrowers, chef inspired food and wine pairings, and contests to win trips to Sonoma Valley. For the web specifically, Extended Family was built, which is a core element of the social media campaign that allowed users to interact with the loyalty program and web application. The function of the program was for users to register, post photos of Sonoma Valley wineries and receive points for participation. The user registration was built to dovetail with the CRM (customer relationship management) system in place, and the point system was built around activity such as registering (subscribing for the database), posting a photo, sharing the photo on Facebook, Twitter, Instagram and Pinterest and referring friends (driving the subscription numbers). The web application was also built to provide tracking and reporting on users' activities tying back to the goals originally set within the road map of the social media plan. The email campaign was launched with rich content tying in and highlighting stories of the vintners, winegrowers and wine region within Sonoma Valley. The email campaign, The Blackboard, lives within the blog section of the website: www.SonomaValleyWine.com. The content was delivered through several media styles – video (posted via YouTube.com), photo slides, as well as stories.

The ultimate outcome was to increase in the average price/ton from $2,300.88 to $2,372.21 for Sonoma Valley wine grapes by 2017. As of February 2015, the average price/ton increased slightly to $2,314/ton which is the second highest return. The price per ton has increased by just under 1% in less than one year of effort.

- Website: Started in April 2014 with google analytics as the primary tracking method; unique visitors started at 1,342 with an increase of 10% (15,863) as an average per month by February 2015.
- Social Media: The following information was collected at the end of the project:
    - Instagram: 20,000% increase in fans

- Facebook: 85% increase in fans
- Pinterest: 64% increase in fans
- Twitter: 58% increase in fans

- Email Campaign started with subscriber base starting at 22,000 subscribers in the database; at the end of February 2015, the Email Campaign had over 42,000 subscribers.
- Member wineries were surveyed in October 2013 to develop baseline information for visitors to wineries within Sonoma Valley. Member wineries were surveyed again in February 2015 to show an overall increase of 25% in tasting room visitation.

Objective	Start	Proposed	Actual - Feb 2015
Increase the average price/ton by 3.1%	$2,300.88/ton	2,372.21/ton	$2,314/ton (increase of 1%)
Increase unique visitors to 45,000/mon	1,342	45,000	15,863 (increase of 10%)
Increase Instagram followers to 3,000	26	3,000	5,250
Increase Facebook followers to 15,000	3,004	15,000	15,000
Increase Pinterest Followers to 2,500	300	2,500	2,500
Increase Twitter Followers to 5,000	1,026	5,000	2,500
Increase email subscriber base to 100,000	22,000	100,000	42,000
Increase Tasting Room Visitation by 25%	802,500	1,010,000	1,010,000(25% increase in visitation)

Beneficiaries

Primary beneficiaries are the winegrape growers and vintners (most of which are also growers) in the now five Sonoma Valley AVAs – Bennett Valley, Sonoma Mountain, Los Carneros, Moon Mountain District and Sonoma Valley.

Primary beneficiaries are 140 winegrape growers and 110 vintners (most of which are also growers) in the Sonoma Valley AVAs. The Sonoma Valley is a wine-tourism destination; according to the Valley Profile provided by the Sonoma County Economic Development Board, 65% of the jobs in Sonoma Valley are related to the wine industry. For every bottle of wine produced in Sonoma there is an economic impact generated in the valley, county and state. The wine and grape industry is responsible for more than 28,000 jobs in Sonoma from manufacturing, agriculture, tourism, transportation, research, restaurants and retail (source: Valley Profile by Sonoma County Economic Development Board). The impacts are both direct and indirect, from job creation and tourism to tax generation and agricultural growth; the wine industry benefits multiple business sectors across the entire Sonoma Valley/Sonoma County economy. According to the Sonoma County Tourism Board, wine-related tourism welcomes more than one million visitors to the Sonoma Valley each year, generating more than $1.36 billion annually in tourism spending. Sonoma Valley winemakers support a broad network of related industries through significant investments, long-term jobs and market opportunities in Sonoma Valley communities; accordingly every dollar spent in the Sonoma wine economy stimulates more jobs, more revenue and more taxes. The large and growing economic impact of Sonoma Valley's wine and grape industry will continue to spread across many sectors of the economy as the demand for higher value wine increases. The project objective to recover winegrape prices by 3.1% by December 2017 will increase the total winegrape value in the Sonoma Valley by over $10 million per year, a direct benefit to growers.

Lessons Learned

Several unexpected outcomes as a result of implementing this project:

1. The Sonoma Valley AVA organization became a leader amongst other AVA groups in Sonoma County and outside of the region. Other AVA groups asked project staff to speak to their membership on the method of developing social media and online campaigns.
2. Relationships with Food & Wine magazine, a leading publication in the country in the food and wine world, were created. Those relationships continue to drive the value of the specialty crop as the perception with the consumer group continues to grow with the continued support received from the publication and key editorial staff. These relationships have also been noticed by other publications such as Sunset magazine and the Williams-Sonoma brand team, and continue to open doors for the marketing of the specialty crop and will in the future drive up the value of the product.

While increases in social media and website goals were realized, the goals were not completely achieved. Lessons learned throughout the process and when identifying metrics for social media and a website are:

1. The biggest lesson learned is that it takes an incredible amount of staff support and time to manage all contractors to ensure all programs and efforts are integrated. For example, social media should be aware of what web is doing and vice versa to gain as much benefit as possible.
2. When determining metrics, remember that results of marketing web and social exposure are measured, and the method of capturing those results are always increasing and improving. However, that doesn't mean results will be higher.
3. Any budget that has to do with social media should be increased by double. Social media is now a pay to play. In addition to advertising within the different channels, it is expensive in terms of time and talent to flip content and reallocate for each outlet. It can be very effective, though expensive.
4. Project staff found investing in content development will had the biggest return on investment. Consideration should be given to the outlets when developing stories and design materials.

Additional Information

Links to web presence:
Website – www.SonomaValleyWine.com
Consumer E-Blast - http://sonomavalleywine.com/the-blackboard/#.VhREVd9Viko
Facebook - https://www.facebook.com/SonomaValleyWine?ref=hl
Twitter - https://twitter.com/SVGrapesWine
Instagram - https://instagram.com/sonomavalleywine/
Pinterest - https://www.pinterest.com/sonomavalley/

Extended Family is available on the Sonoma Valley Wine website: www.SonomaValleyWine.com

USDA Project No.: 15	Project Title: Food System Multipliers for Specialty Crops in the Sacramento Region	
Grant Recipient: Sacramento Area Council of Governments	**Grant Agreement No.:** SCB13015	**Date Submitted:** December 2016
Recipient Contact: David Shabazian	**Telephone:** (916) 340-6231	**Email:** dshabazian@sacog.org

Project Summary

The economic benefits of specialty crops are often overlooked by policy makers, economic development practitioners and others due to a lack of data and tools and poor understanding of how growing specialty crops creates jobs and incomes both on and off the farm. Without such supporting data and tools, much of the economic development and planning practice in the Sacramento region to date has focused on converting agricultural land into other uses. And the few data available to document agriculture's economic output have tended to look just at the farm, not the larger food system, and did not distinguish the unique economic contribution of specialty crops.

In response, this Food System Multipliers for Specialty Crops in the Sacramento Region project not only documents the direct contribution of specialty crop farms to the Sacramento regional economy, it goes even farther to illustrate the ways in which the economic impacts of specialty crops then ripple throughout the larger regional economy through a multiplier effect. In doing so, the project has completed a set of tools and data to also test future conditions in specialty crop agriculture, helping facilitate the development of effective strategies, investments, and policies supporting specialty crop production.

Prior to this study, this suite of data and tools did not exist for Sacramento region specialty crop agriculture. In short, the project has provided the means to analyze the economic value of specialty crop agriculture from field to table, helping reinforce political and financial commitment to previously overlooked specialty crop industries.

The project is both highly important and timely. Like many other regions, greater Sacramento has faced enormous pressure to urbanize, especially in the last several decades. Indeed, in the thirty years between 1988 and 2008, the six-county region lost an estimated 250,000 acres of farmland and open space. Without an agricultural perspective and adequate tools for research and policy making, the effects of these changes have not been fully understood and, in many cases, not appropriately addressed.

Yet after decades of planning and policy focusing primarily on urbanization, the role of specialty crop agriculture is witnessing a renaissance in the region. In 2008 the Sacramento Area Council of Governments (SACOG) launched the Rural-Urban Connections Strategy (RUCS) to bring to the forefront how the Sacramento region can leverage, preserve and better manage its rural assets to create new economic value. As this and many other vital efforts have taken hold, the region stands in need of a corresponding and appropriate set of tools to consider specialty crop agriculture on par with other economic uses.

The project could not be timelier in that the region's economic development entities have now come full circle to recognize specialty crop agriculture and its contribution to the regional economy, yet lack the tools and data to develop effective strategies and policies supporting investment in specialty crop production and infrastructure. This project responds to that gap, helping position the region to better capitalize on the recent resurgence of support for specialty crop agriculture in metropolitan Sacramento. This work focused on specialty crops in the Sacramento region also may help enhance the marketability and competiveness of specialty crops for all California producers by serving as a case study for similar issues in the state.

The project built on work funded by 2011 Specialty Crop Block Grant Program Project 39: *Food Bank as Food Hub: Building a Local Food Systam*, which delved into the economics of infrastructure to support specialty crops produced for the local market. That project's food hub assessment calculated the number of jobs created at a single food hub facility, but due to the unavailability of sufficient tools did not develop the connection from the facility to increased production levels on supplying specialty crop farms, and to further the economic activity generated by the food hub. Likewise, the case study component of the project noted the substantial increase in economic returns from local specialty crop production, but did not then link this increased farm output to the larger specialty crop cluster. The work of 2011 SCBGP Project 39 helped lay the foundation for this project by exploring individual elements of the specialty crop value chain. This Food System Multipliers for Specialty Crops in the Sacramento Region project enhanced that previously completed work by connecting the specialty crop farm to a larger specialty crop cluster, to show the full economic contribution of specialty crop production.

Project Approach

The project's work plan consisted of three primary tasks: data collection, specialty crop stakeholder outreach, and model development to produce economic impact multipliers. First, the project undertook an unprecedented data collection effort, including over 100 interviews with local specialty crop farmers, processors and distributors. The project team also delved into numerous supplemental data sources to complement the primary data collection. The team held a series of survey workshops with specialty crop producers, processors and distributors in developing the primary multiplier data, which formed the cornerstone of the outreach component of the project. The project also conducted outreach with policy makers and the economic development community to better demonstrate how they too are specialty crop stakeholders. Finally, the team incorporated the data collection and outreach findings into a set of integrated modeling tools to produce a series of multipliers for current and various future conditions in the specialty crop cluster. The project's final deliverables (included in attachments) discuss in much greater detail the substantial work performed to complete these tasks. The Specialty Crop Cluster Assessment: Sacramento Region deliverable delves into the economic data collection to connect specialty crop production to core specialty crop processing, support and distribution industries. The technical Food System Multiplier for Special Crops in the Sacramento Region deliverable describes outreach with local specialty crop growers through the project survey instrument, and then defines the modeling activities leading to the project's final multipliers. The project's Executive Summary deliverable is meant to complement these two technical deliverables with a less technical, more policy-oriented explanation of project work and findings.

The project provides an in-depth portrayal of the specialty crop value chain that was previously unavailable within the region, producing a series of significant results. The results begin with economic indicators for specialty crop farms, the foundation of the larger impact of the specialty crop agricultural system. Overall, there are nearly 11,000 (full time equivalent) jobs on specialty crop farms in the Sacramento region that produce food worth $1.5 billion each year. The economic impact of this regional specialty crop production has soared to record levels in the past several years—between 2008 (the beginning of the recent national recession) and 2014 (the latest year with data), the value of the regional specialty crop production doubled, far outpacing the regional economy as a whole. This outcome leads to more wealth and economic opportunity within the region, as well as more jobs. While most sectors of the economy have still not returned to their pre-recession employment levels, specialty crop farmers in the region have added around 800 jobs. Indeed, specialty crop production has been a leading driver in the region's recovery from the recent recession.

While the look at specialty crop farms shows significant findings on the growing economic importance of specialty crops to the Sacramento regional economy, the project's multiplier analysis shows how this is just the first step in a much larger specialty crop food system. The full specialty crop cluster in the Sacramento region consists of 17,200 jobs and $1.2 billion in annual value add. The multiplier model then estimates over 31,000 jobs created by specialty crop businesses, $2.4 billion in value add contribution each year to the regional economy, and almost $6 billion in total output value. From an economic multiplier perspective, this translates into an employment multiplier of 1.82 (every job in specialty crops generates another 0.82 jobs in other areas of the regional economy), and a value added multiplier of 1.90 (each dollar of the specialty crop cluster's direct contribution to gross regional product also generates $0.90 in additional value added across other industries).

Major accomplishments in the project include the successful development of a highly technical specialty crop modeling toolkit that provides an unprecedented level of data and economic findings tailored to a lay and policy-oriented audience. Secondly, the project has accomplished its outreach goals with specialty crop stakeholders, including growers themselves, but also new groups such as policy makers and economic development professionals who now better understand how specialty crops are an economic driver in the region. Furthermore, the project has been able to demonstrate how specialty crop jobs are widely spread throughout the region, so that all jurisdictions—both rural and urban—gain economically from this vital cluster.

Next, the project has made major findings concerning default methods to measure specialty crop agriculture that apply not only to this study, but to economic impact analysis in general. The project finds that the default 'IMpact analysis for PLANning' (IMPLAN) model, which is the most widely used economic model to estimate multiplier effects, does not accurately characterize expenditure patterns for specialty crop industries in the Sacramento region. In particular, an in-depth evaluation of the data underlying the IMPLAN model identified that key parameters for specialty crop agriculture are based on national benchmark data provided by the Bureau of Economic Analysis (BEA). As such, the default IMPLAN model multipliers are not representative of specialty crop agriculture in the Sacramento region. Instead, this project drew on a customized model based on surveys and supplemental local data to produce multipliers that more accurately represent the region's specialty crop system. For example, the project team found the base default multipliers underrepresented the actual contribution of specialty crops in the Sacramento region by upwards of 20 percent, depending on the measure. This undercounting translates into thousands of specialty crop jobs and hundreds of millions of dollars not accounted for using the default data. This finding affects not only prior analyses conducted on the Sacramento regional economy, but likely any other application of the default model to measure specialty crop agriculture in the region, California, or nationally. Finally, the project discovered several limitations in creating custom sectors in the base IMPLAN model which also would affect other economic impact analyses. This highly technical finding is explained fully in the project's technical appendices.

In short, the project has produced a surfeit of data, indicators and findings that more accurately describe the larger economic contribution of specialty crops in the Sacramento region. The project also produced recommendations for future work that would use standard economic impact models. Finally, the project recommends future work to expand the analysis of the specialty crop food system to include wholesale, retail, and consumption activities.

The project's scope clearly limited analysis and project work exclusively to specialty crops. To include only specialty crops for data analysis, the project developed and then implemented a methodology combining standard industry classification coding with the project's customized model to focus solely on specialty crop industries. First, the project organized incoming data by relevant North American Industry Classification System (NAICS) codes. NAICS is the standard grouping scheme used by federal statistical agencies to categorize business establishments and collect statistical data related to the economy. The first step project staff took was to group those NAICS codes at the most detailed level that were exclusively specialty crop, and remove all NAICS codes with no specialty crop activity. While this step helped organize the vast majority of the 1,100 industry codes, several industries remained that included both specialty and non-specialty crop activity (for example, farm labor contractors are organized in NAICS into a single industry that includes business services provided to specialty crop producers, but also other crop production). To isolate the specialty crop component of these industries the project team used the primary and supplemental data developed over the course of the project to model and thus isolate only specialty crop activity for analysis. The appendices to this project's deliverables include a further explanation of this technical methodology. The result was that specialty crop, and only specialty crop economic activity was included in the project, so that funds were used to solely enhance the competitiveness of specialty crops. While this result is important not only in meeting the requirements of the grant program, but also supporting specialty crop production, the project team believes it is important to note that total agricultural production was not studied therefore total industry impacts are still likely being underreported due to the aforementioned limitations of the IMPLAN model.

The regional partners made essential contributions to the success of this project. Partners in the economic development community (such as Valley Vision, Sacramento Metropolitan Chamber of Commerce, and Greater Sacramento Area Economic Council) provided a key bridge to expand upon outreach activities. In turn, this project also provided a bridge back to economic development practitioners, showcasing specialty crops as a regional economic driver and providing the data and indicators to substantiate. The Los Rios Center of Excellence provided a highly detailed Economic Modeling Specialists International (EMSI) dataset on the six-county SACOG region covering the period of 2008 to 2014 which was invaluable in showing the growth of specialty crop industries through time.

Next, through survey workshops the region's specialty crop growers, processors and distributors provided the primary data that was vital to present this more accurate portrayal of the regional specialty crop cluster. This contribution of local specialty crop proprietors was the essential element that underpinned the economic model. Finally, the project team also worked with researchers at UC Davis who shared both survey instrument and aggregate data, which helped this work more efficiently hone in on segments of the specialty crop cluster not covered in other data sources. Likewise, elements of the UC Davis survey instrument were incorporated into the data collection survey, which saved development time which could then be spent on other project work.

Goals and Outcomes Achieved

This project has been an essential element in SACOG's RUCS program to provide data and tools and build capacity so that rural and agricultural issues are treated on par with urban and other economic activities. To move toward implementation of this goal, one of the measurable outcomes was of a total of 100 specialty crop establishments participating in the project. The project exceeded that goal, working with 116 specialty crop growers, processors, distributors or support groups to acquire detailed primary data on the connections in the region's specialty crop cluster (these 116 groups have each participated multiple times, leading to a total of 307 direct project communications with specialty crop businesses). As part of this outreach, the team has also developed and conducted a survey to serve as a benchmark on the regulatory role in specialty crop economic output. The team also surveyed local jurisdictions at three points in the project through presentations to local elected officials representing both rural and urban jurisdictions.

Further outreach efforts build out the work to meet the performance goals and expected outcomes. The project team has worked with diverse organizations such as UC Davis, Valley Vision, GSAEC (Greater Sacramento Area Economic Council), the Metro Chamber, and the Los Rios Center for Excellence to explain the role of specialty crops as a driver of the Sacramento regional economy. Examples of the audiences of these presentations include participants at the National Good Food Network conference held in Atlanta, Georgia (400 participants), a regional workforce convening around the food system (50 participants) and local elected officials in the six-county Sacramento region (15 participants).

This project has been a critical component of SACOG's long term effort to support and enhance specialty crop viability in the Sacramento region as an economic development strategy that embraces agricultural heritage and capitalizes on food system capacity. SACOG will continue to disseminate, share, and work with specialty crop farmers, stakeholders, investors, economic development practitioners, and policymakers to leverage these new tools, data, and capacity in support of the region's specialty crop agriculture sector.

The goals for this project included final calibration and validation of the economic model; model documentation and scenario results; final deliverables describing project outcomes in non-technical language; and, presenting project findings to the various stakeholder groups developed through this project. First, the project completed an integrated toolkit that quantifies the economic impact of specialty crops from farm to table. Next, the project produced three deliverables to summarize the toolkit methodology, data collection, and findings. The first two of these deliverables are more technical in nature, describing the specialty crop cluster of production, processing, distribution, and support, and also the multiplier effect of the cluster. A final executive summary deliverable synthesizes project results using non-technical language. Finally, as discussed above in the performance goals section, project staff have worked to share these important results with a broad group of stakeholders. Key to the project communication strategy has been engagement with the region's economic development community, as the project has provided highly detailed and previously unavailable data and tools to document the economic impact of specialty crop agriculture.

Prior to this project there was no economic multiplier specific to specialty crop agriculture in the Sacramento region. Yet the project went much further through its primary data collection to more accurately describe specialty crop industries and their multiplier compared to default modeling techniques and data. For example, the project found the multiplier for the region's fruit farming to be 20 percent higher than default model outputs that use base input data. Other examples of how the project more accurately describes specialty crop multipliers compared to default base data include tree nut farming (25 percent higher), vegetable farming (21 percent), nurseries (5 percent), olive oil mills (17 percent), tomato canning (5 percent), and produce shippers (4 percent). In all, the project developed over 20 custom specialty crop industry multipliers. Together, these specialty crop industries show the full economic impact of specialty crop agriculture and provide the baseline data for the project—over 31,000 jobs, $2.4 billion in annual value add, and $5.8 billion in total output value each year to the Sacramento regional economy. In multiplier terms, this translates into an employment multiplier of 1.82 (every job in specialty crops generates another 0.82 jobs in other areas of the regional economy) and a value add multiplier of 1.90 (each dollar of the specialty crop cluster's unique contribution to gross regional product also generates $0.90 in additional value added across other industries).

The data developed as part of the project has also helped show progress toward achieving targets of supporting sustained economic growth and job opportunities in the region's specialty crop cluster. In addition to employment gain, the value of regional specialty crop production has also grown despite the recession, as specialty crop production grew by over 100 percent in total value between 2008 and 2014. Even when adjusted for inflation, this remarkable growth far outstripped the larger regional economy. Indeed, specialty crops accounted for 95 percent of the growth in total agricultural production value in the Sacramento region during the study period. Looking forward, SACOG will continue to track employment and value indicators to measure progress in supporting the specialty crop cluster.

The first successful outcome of the project is the completion of a single integrated economic model that measures the larger economic impact of specialty crop production. This analytical framework and tool did not exist prior for specialty crops in the Sacramento region. The tool has national significance since the IMPLAN model was dissected and re-specified to more accurately describe the economic contribution of specialty crops in the region, with an increase in multiplier estimates upwards of 20 percent over default model data depending on the industry. Overall the project's custom model estimates over 31,000 specialty crop jobs in the Sacramento region. These jobs lead to nearly $6 billion in sales each year in the regional economy. The work also shows how employment and output value in these specialty crop industries has been growing the last several years, a finding even more notable in that this period coincides with a major economic recession. Finally, the project has been successful in its outreach, surpassing the goal of engaging 100 specialty crop stakeholders directly through the workshop survey instrument, with another estimated 500 stakeholders engaged through project outreach efforts.

Beneficiaries

This project and resulting tools benefit specialty crop farmers, processors, distributors and others participating in specialty crop markets given the significant improvements to the IMPLAN model and its ability to better represent the economic and employment activity related to specialty crop production. The tools developed through this project demonstrate a valuable asset to public and private stakeholders by providing the needed data to first highlight the overlooked and significant economic contribution of specialty crops to the Sacramento regional economy, and then facilitate the development of effective policies and strategies that support specialty crop agriculture. The first of beneficiaries consist of the region's 1,200 business establishments that grow, process, distribute and provide support functions for specialty crop production. Through this project these businesses have updated data to better showcase the important impact of their activity in supporting further jobs and economic growth in the larger economy. This information is also of use for the region's economic development and policy makers. By better demonstrating the economic impact of specialty crop lands and related food industries, there can be more incentive by these stakeholders to invest in specialty crop production and food chain infrastructure, in turn enhancing the marketability and competiveness of specialty crops. In particular, the region's larger economic development entities benefit from this updated work. Three key project partners that benefit from the project and embody the renewed focus on specialty crop agriculture include the Greater Sacramento Area Economic Council, the Sacramento Metropolitan Chamber of Commerce, and Valley Vision. Additionally, through SACOG's Board of Directors the study spreads the data and outreach efforts to local elected officials and economic development departments, providing the tools and updated analytics to help inform data-driven decision making. this project and resulting tools benefit farmers and others participating in specialty crop markets given the significant improvements to the IMPLAN model and its ability to better represent the economic and employment activity related to specialty crop production.

The work affects nearly 1,000 specialty crop growers, processors and distributors, 1,200 business establishments, and 31,000 related employees in the specialty crop cluster. The region's six agriculture commissioner offices, five farm bureaus and five farm advisors all benefit from the study with improved data and analytics. Yet unlike prior agency work, this project has expanded the focus of specialty crop agriculture from the farm to the full value chain. As such, the study also benefits the local economic development practices of the 22 cities and six counties within the Sacramento region.

The economic impact of the project has been stated above—better demonstrating the economic contribution of the over 30,000 jobs created by regional specialty crops. In addition to describing current conditions, the project also provides a series of scenarios to forecast future economic conditions in the cluster. For example, the study estimates the increase in jobs, value add and taxes by attracting a peach processing facility in the region. The project's integrated tools show how more economic activity that currently flows out of the Sacramento region could stay in the area if this hypothetical scenario is implemented, with a net increase of 600 jobs and $146 million in total output value. Notably, these 600 additional jobs consist of employment opportunities across the region, be it on the farm, at the processing facility or in the community in general. This one scenario can be expanded upon in future work to show even further job creation and economic growth opportunity from investments in the regional specialty crop food system.

Lessons Learned

Overall this project has been critical in SACOG's efforts to support data-driven decision making and investments benefiting the regional specialty crop food system. The first lesson learned is that expanding the focus of the impact of specialty crop production from just the farm to the larger multiplier effect greatly increased the interest, relevance, and number of partners participating in the project. Through this project, the project team have been able to demonstrate the job and economic value of specialty crops to both rural and urban communities in the Sacramento region, in turn helping raise the regional understanding of the economic contribution of specialty crops to be on par with other segments of the regional economy. Securing the interest and buy-in of the larger economic development entities improved project outreach efforts, allowing the project team to also tap into the larger network of these agencies. Likewise, the team reached out to local associations and farm bureaus before implementing survey workshops to build credibility in the specialty crop grower community. While this effort did help, the team did find it challenging to collect the detailed primary data from local specialty crop proprietors needed to underpin the study's customized model. This finding is not surprising given the time commitment and sensitive nature of financial data compiled through the data collection. It is important to note the resources expended by the project to secure the necessary specialty crop grower response. To mitigate this challenge and assist in the data collection effort, the project team engaged in two important tasks that ultimately improved efficiency. First, the project worked with researchers at the

University of California, Davis to access recently completed survey data on specialty crop growers in the four counties of Sacramento, Yolo, Yuba and Sutter. Next, the team worked with partners at the community college system to access an aggregated data set providing a time series of specialty crop industries back to 2008. These activities highlight not only the outreach value of building partnerships but also the potential to leverage partner resources and research for a more efficient use of project resources.

One negative result for the project was the finding that the base IMPLAN model data for the Sacramento region does not accurately describe the economic impact of specialty crops. To combat this shortcoming in the standard model data, the team shifted final calibration and the project's scenarios to the project consultants. This shift led to a more efficient and effective use of project resources. On a related note, through the project's final deliverables the project team worked hard to develop language, graphics and summaries that describe the mountain of highly technical methodologies and results in a non-technical framing, which continued to be a challenge for the project. Improvements were made in this area, though future work can continue to refine the key takeaways and findings for a broader audience.

The key unexpected outcome, as mentioned above, is that the base data used in the default IMPLAN model for the Sacramento region does not accurately describe the role of specialty crops in the regional economy. This finding is surprising in that the IMPLAN model is the most widely used economic multiplier model across sectors and industries. An in-depth evaluation of the data underlying the IMPLAN model identified that key parameters for default data come from national benchmark data coming from the BEA. While IMPLAN utilizes detailed county-level data to define the output values associated with given industries, the model estimates total value added based on the national benchmark data, not localized data. As such, the model's trade flows are imposed on the specialty crop agriculture sector in the Sacramento region, while the survey of specialty crop businesses found that these national averages are significantly different than actual practices. To overcome this issue the project team has created custom specialty crop sectors in the project's model that draw on local primary and supplemental data. However, future analyses using the IMPLAN base data should consider this issue. Overall, this unexpected outcome has state and national implications of how specialty crop agriculture impact analyses are conducted.

The goals and measurable outcomes laid out at the onset of the project have been met.

Additional Information

The project's three deliverable are attached as part of this final report. First, the Specialty Crop Cluster Assessment (Attachment 1): Sacramento Region defines the core specialty crop cluster of production, processing, support and covered distribution industries. Notably, this cluster definition does not include the economic activity of specialty crop food at the point of consumption, be it restaurants, grocery stores, or institutions. Also, the distribution activities covered in the cluster are limited to those industries with sufficient data. The companion Sacramento Region Specialty Crop Multiplier Study deliverable estimates a multiplier effect for this cluster definition. Each of these technical deliverables contain the methodology and appendices explaining the project's data collection and analysis efforts. To translate these technical findings for a more lay audience, the project team has also completed an Executive Summary (Attachment 2) that synthesizes project work into a more graphically oriented story framing. Finally, the project has produced an updated and customized modeling toolkit (Attachment 3).

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 16	**Project Title:** Inbound Marketing and Mobile Gardening Application	
Grant Recipient: California Association of Nurseries and Garden Centers	**Grant Agreement No.:** SCB13016	**Date Submitted:** December 2016
Recipient Contact: Chris Zanobini	**Telephone:** (916) 448-3900	**Email:** chris@agamsi.com

Project Summary
The purpose of this project was to reach a younger demographic of novice gardeners and non-gardeners in order to promote the benefits of gardening and develop a sustainable market for California nursery crops, as older more avid gardeners downsize and spend less on landscaping. While the benefits of gardening (creating wildlife habitat, growing your own food) were qualities that resonated with Millennials, as a group they did not have as much experience with or exposure to gardening first-hand. Retail trends show that today's consumers make most of their purchases online or via mobile devices. Due to the nature of the nursery business and the variability in product selection this is not an ideal business model. Therefore, this project aimed to attract and introduce gardening to a new set of consumers through the utilization of modern marketing techniques and mobile media.

The nursery industry was utilizing traditional "outbound" marketing messaging platforms such as television, radio and direct mail at a time when consumers purchasing behaviors were shifting. Consumers often researched plants and products before making a decision. An overwhelming number of consumers use the internet for this research, on PC's at home and an increasing number from mobile devices. In order for the nursery industry to engage with these potential gardeners, it was important to reach them where they already "lived," on mobile devices. Also, the timing of this project became even more pertinent due to the negative impact of the California drought on nursery crop sales through gardening limitations and uncertainty created by watering restrictions and public messaging to limit outdoor water use.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach
Before development began, social media research and data mining was completed to determine the campaign content that would best resonate with the target audience. A consultant analyzed over 1 million conversations related to gardening across online news sources, blogs, forums, and social media platforms, taking into account the keywords and hashtags used, whether the tone was positive or negative and how influential the author was. The survey revealed which topics were trending or emerging and informed the project selection.

The California Association of Nurseries and Garden Centers (CANGC) and the consultant were able to apply these results directly to the next phase of the project and developed the garden projects listed below with a focus on 'Do it yourself' (DIY) and options for gardening in small spaces. Each project was accompanied by a one to three minute video tutorial, materials list, and step-by-step instructions. Videos were conceptualized and shot to bring each garden project to life in order to capture the attention of users on social media and drive them to read more.

The content was tailored to offer the most relevant information for young, urban novice gardeners in California. Affordable DIY gardening projects such as *How to Make a Vertical Herb Garden* suit the needs of urban dwellers. Garden tips such as *Healthy Soil* and *Fertilizer Basics* offer useful information to address the concerns of younger novice gardeners. Some of this content, such as *Irrigation: When & How Much to Water*, highlighted water wise gardening practices which became increasingly important during California's fourth year of drought.

Projects included:

- Create a Small Space Butterfly Garden
- Plant Your Own Cocktail Herb Garden
- How to Plant a Small Space Vegetable Garden
- Convert Your Patio Garden to Drip Irrigation
- The Incredible Edible Patio
- How to Make a Vertical Herb Garden
- Make Your Own Container Water Garden
- Growing Citrus in Containers
- How to Host a Succulent Garden Party
- How to Maintain Your Garden Organically
- Houseplants that Clean the Air

New gardening projects and tips were conceptualized and developed in 2016. This new content aimed to encourage return visitors and keep the audience interested, each of the projects also had an accompanying video. These projects included:

- Creating a Hummingbird Habitat
- Recycling indoor water in the garden
- Growing edible flowers

Tips included:

- Vertical gardening
- Water wise plants for California
- Avoiding and controlling invasive plants

Social media platforms (Facebook, Pinterest, and YouTube) were established and the mobile application (app) development were completed in the first year of the project once the inbound marketing campaign had been developed. The mobile app, Plantable, was launched in June 2014, slightly behind the originally planned launch date of March 2014 due to a longer than anticipated development phase. Within that same year the competing mobile app, GrowIt! was also launched which focused on gardening socially, offering a similar platform to Plantable. This unforeseen competition offered a more advanced social engagement component, which, coupled with an overall smaller pool of app users provided unforeseen challenges to growing Plantable's mobile user audience. Despite using social media research and data mining to inform the campaign delivery mechanisms in order to promote California nursery crops and hit the target millennial demographic, initial media outreach did not return anticipated audience reach or engagement. Therefore, the project team began to place a greater focus on providing enticing and relevant content for the projects various media outlets.

CANGC partnered with CA GROWN to have a Plantable booth in the CA GROWN Pavilion at Sunset Magazine's Savor the Central Coast event in September 2014. An estimated 10,000 people attended this event where the project team promoted Plantable and the corresponding social platforms. The team also collaborated with the Sunset Magazine garden editor, and incorporate Plantable's project focused on installing drip irrigation systems to help consumers protect their plants and save water during California's historic and continuing drought into their gardening education program.

This project solely enhanced the competitiveness of California nursery crops.

Plantable's progress and launch was communicated to the CANGC Board on various conference calls, as well as to members in the CANGC newsletter. Partnerships with CA GROWN and Sunset Magazine helped to increase Plantable's exposure to new audiences on social media and at events. The consultant performed the data mining, set-up social platforms, met with industry, set-up a website and developed the iOS app and gardening content.

Goals and Outcomes Achieved

The primary expected measurable outcome of this project was increased sales at California retail nurseries. Creation of social media platforms for the California nursery industry increased the visibility of gardening, and offered a voice to communicate the benefits that plants provide. These platforms became increasingly important as people with limited knowledge of the critical benefits of gardening to both humans and wildlife, faced the challenges brought on when gardening during a drought with a for limited water use on landscape.

The garden projects developed for Plantable resonated with the target audience as intended, with an emphasis on young, mobile users in California. 59% of users were within the target age group of 25 – 54 and more than half of those users were under 44. Over half of the views were on a mobile device, demonstrating the projects overall success in reaching mobile users in spite of the app's setbacks. The top ten cities with the most visitors to the site were located in California. The insight gained from the initial research continues to inform CANGC's outreach strategy.

This project also assessed its reach to the public by measuring website and social media traffic as well as mobile app use. Visits to plantable.org increased significantly once social media platforms were established in April 2014, Facebook remained the top referral source. After the home page, the Projects page was the most visited followed by the 'Find a Nursery or Garden Center' locator. September 2014 saw the most visitors to the home page per month. While the mobile app was not as successful as hoped, there was however, a considerable spike in downloads when Plantable was promoted at Savor the Central Coast during the last weekend of September 2014. Facebook was the primary social platform utilized reaching 113 pages liked in the first three months. To date the Facebook page reached 215 likes. Since the YouTube channel was created in May 2014, there were 2,647 total views of the gardening project videos. Two of the most popular videos included, *How to Make a Vertical Herb Garden*, and *How to Make a Patio Water Garden*. As of this report, the Pinterest page had 269 followers and 140 likes and a steady growth. With no advertising budget, all reach on social channels was organic.

Progress was made toward reaching the long-term goal of introducing non-gardeners to the benefits of planting. Based on the anecdotal responses received on social media and in-person at events, millennials have been inspired to try gardening through fun, approachable projects that engaged them to learn more and set them up for success.

Engagement with potential gardeners was successful through social media, a key component of the proposal. Engagement on the mobile app which was anticipated to be a large driver of audience growth, did not materialize as planned. The multimedia content created hit the mark with younger and less experienced gardeners without a lot of space, time or money. To further the project, videos and photos were created in order to enhance the available content and bring garden projects to life to continue to spark an interest in gardening with Millennials. The project team successfully executed strategic outreach at partner events, increasing the reach to their more established audiences.

CANGC received plant sales data from retail nurseries during the year preceding the launch of Plantable.org (June 2013 – June 2014) and the year following the launch (July 2014 – July 2015). Based on retail sales data, the average total plant sales decreased by approximately 2%. While not achieving the goal of a 3.3% increase in nursery sales, this decline was indicative of California entering its fourth year of drought the year following the launch. The Governor's Executive Order mandating watering restrictions went into effect on April 1, 2015, at the beginning of the spring quarter, which impacted what was typically the industry's strongest quarter thanks to a spike in planting. Subsequently, the California nursery industry experienced stronger sales, thanks to more rain which lead to a lift on mandated restrictions and greater confidence in the availability of water for landscape. Without the efforts to market nursery crops to a younger demographic, it is expected that the decrease in sales would have been more significant.

The content created for Plantable was a major driver of audience growth and engagement and an asset for retail nurseries. The gardening projects inspired novice gardeners to consider incorporating plants into their lives and the videos drove users to learn more about the projects. The high resolution photos of each gardening project, plants and gardening equipment were also essential to promoting gardening visually.

Beneficiaries

The primary beneficiary of this project were California retail nurseries, wholesale nurseries also benefited indirectly. It was learned that smaller independent garden centers without the resources or budget for marketing, were most likely to share the gardening projects.

Based on feedback from CANGC members, this project benefited many of the 10,000 California nursery locations by reaching new customers.

Lessons Learned

One lesson learned was the importance of being able to adapt to unforeseen developments. The drought had not fully materialized when this project proposal was written; as a result, the project concepts were updated to reflect increased awareness and limitations on irrigation.

Another lesson learned was the need to incorporate a funding source for promotion for any future marketing projects. This project enabled the development of content and platforms for inbound marketing of gardening, but did not provide resources to promote these unknown resources to California consumers. For example, Facebook algorithms shifted since the beginning of this project to where pages now have to “pay to play”. Essentially organic reach is very limited for page posts, requiring regularly boosting posts with core content to guarantee engagement.

The Plantable mobile app was not as successful in the marketplace due to the launch of a similar app, GrowIt! with more social engagement components and an overall smaller pool of app users. At the time of this project proposal no gardening apps existed and the mobile app market had not yet peaked, so these challenges were unforeseen at the beginning of this project.

Additional Information

Please find links to the Plantable home page, a description of the mobile app and social media properties respectively.

1. http://www.plantable.org/
2. https://itunes.apple.com/us/app/plantable/id888430089?ls=1&mt=8
3. https://www.facebook.com/Plantableapp/
4. https://www.youtube.com/channel/UC9vMKnrUVEybARbFmvA0Wpw
5. http://www.pinterest.com/getplantable/

USDA Project No.: 17	**Project Title:** California Farm Academy Incubator Program Development	
Grant Recipient: Center for Land Based Learning	**Grant Agreement No.:** SCB13017	**Date Submitted:** December 2016
Recipient Contact: Mary Kimball	**Telephone:** (530) 795-1520	**Email:** mary@landbasedlearning.org

Project Summary

The purpose of this project was to fulfill a critical industry need to recruit, train and support new and replacement specialty crop growers. In addition, this project meshed with an incredible opportunity for California farmers to fill direct and niche markets and meet consumers' growing demand for fresh, affordable regionally grown produce.

The promotions of the food system, along with projections by the Sacramento Area Council of Governments that the region's population will double by 2050 point to both the need and opportunity for specialty crop growers to provide more food locally. Given that the average California farmer is near 60 years of age, it is clear that there is a need for new farmers to meet this increasing demand over the coming decades. The proposed California Farm Academy Incubator Program Development project increases the capacity of the Center for Land-Based Learning (CLBL) to support the farmers that go through their high quality training program. The expanded and strengthened California Farm Academy (CFA) Incubator program will provide additional land, staff, equipment and market opportunities to beginning farmers during their most vulnerable early years of farming as they develop their production and marketing skills.

This project would actively publicize and recruit qualified prospective specialty crop growers, and train new farmers with the necessary knowledge and skills in sustainable food production, and provide them with access to affordable land, equipment and ongoing technical assistance; identify and help develop additional regional markets for beginning growers, including researching branding opportunities; and assist new farmers in increasing their sales and distribution to a greater variety of local consumers.

The average California farmer is approximately 60 years old and it is clear that a need for new farmers to both revive the aging farmer population, and also grow and take advantage of the ever increasing demand for locally grown produce. There is a diverse demographic of prospective farmers who would like to farm but lack the resources, especially raising specialty crops and value-added products for local and regional markets. The California Farm Academy Incubator program provides the training and support that is needed to become full-fledged farmer and make farming goals into a reality. It is prospective farmers as such, who will help to revive an aging farmer population and strengthen the Sacramento regions food system.

The CFA was built upon the 2010 Specialty Crop Block Grant Program (SCBGP) Project 32: *Sacramento Valley Beginning Farmer Training and Incubator Program.* This project purpose was to educate, mentor and provide land opportunities for the next generation of specialty crop producers. In the 2010 SCBGP project, CFA established the specialty crop Training Program. The seven month program included classes, workshops and farm tours (theoretical component and guided on field sessions (experiential component)). Also the program provided the first steps which were necessary to an aspiring beginning farmer that would enter the farming industry. The current incubator project, through the support and services it provides, was the natural next step. The experiences from the 2010 SCBGP project were put into practice in the current incubator program. In encouraging the participants to run self-owned farm enterprises, the project team was able to put into practice the learnings from the 2010 project.

Project Approach

Work Plan Activities Accomplished:

Activities	Results/Accomplishments	Notes
Recruit, review crop plans and business plans of prospective incubator farmers (2014 and 2015 seasons)	Reviewed 38 prospective incubator farmers crop and business plans	Twenty training farm participants in 2014. Eighteen training farm participants in 2015.
Identify and lease (or receive in-kind) additional acreage for CFA Incubator farm	A total of 16 acres of land was leased to CFA for the incubator farm program.	
Complete and/or renew 2014 and 2015 incubator farmer licenses	The program has grown from four farmers in 2013 to 22 farmers in 2016. Leases have been signed with all of these farmers.	
Conduct market research and assessment	Fourteen produce buyers and five farmers interviewed for the research. Research results helped to develop and establish 36 market linkages that included farm stands, farmers markets, and chef/grocery stores	Research findings were presented at the CFA advisory board. Research report (Attachment #1).
Purchase supplies necessary for additional incubator site(s)	Sixty-five tractors leased (In-Kind Lease). Chisel plow, walk behind tractor (In-kind donated) and small tools purchased. Irrigation system put in place at all sites – One in Winters, one in Davis and four in West Sacramento.	
Report on incubator program successes and challenges at regional winter conferences	The incubator program concept presented at Eco Farm conference, California Small Farms conference, Farmers Veteran Coalition conference, Farmers Guild meeting and at the National Incubator Farm Training Farm Initiative (NIFTI) annual conference.	
Ongoing training, supervision and support of Incubator farmers	Advanced training workshops, monthly meetings, as well as individual check-ins with each incubator farmer to assess goals, and offer continued training was completed.	

Activities	Results/Accomplishments	Notes
Daily logistics, repairs, scheduling, trouble-shooting, and answering production questions	Daily logistics, repairs, and troubleshooting, by Program Manager greatly increased the effectiveness of the program, and the success of the farmers. For example, a Food Safety Plan was completed for the farm site as a model for incubator farmers.	
Market, sell, distribute specialty crops to local, regional and under-served markets	Marketing relationships developed by incubator farmers, as well as the CFA. Ten major buyers buying or committed to buying from incubator farmers.	Market research was useful in identifying buyers and markets
Present findings of Beginning Farmer Market Assessment	The Graduate Student Researcher presented the findings of the marketing study to the CFA Advisory Committee. This study, final report, and supporting documents were distributed to the incubator farmers and were extremely useful for them to approach new sales venues.	Research Report Completed (Attachment #1).
Assist Incubator farmers who are ready to transition to off-site farms, ag jobs or own farmland	Incubator farmers transitioning out of the program were met with individually in an exit interview in which additional areas of support were clearly defined. Farmers were encouraged to reach out to program staff for support, and staff continues to assist farmers when needed.	Exiting farmers have bought property, transitioned into farm management positions, and leased acreage nearby.
Identify and develop 2-3 of marketing and/or branding opportunities identified by Graduate Student Researcher	Developed relationships with major grocery stores, farmers markets, food banks, and restaurants.	Farmers have started to supply produce to grocery stores, 850 pounds total. Three farmers participated in a farmers market in 2016. 3,000 pounds supplied to food banks. Three farmers supplying produce to a farm shop.

Activities	Results/Accomplishments	Notes
Conduct incubator program evaluation and improvement	A comprehensive survey of all program participants was completed. Additionally, a program evaluation, final report, and a final meeting with each participant is accomplished each year, and improvements are made to the program.	The evaluation is an ongoing process and helps CLBL to guide program participants towards the right direction, such as areas which need improvement in production, right scales and types of markets necessary. Evaluation also helps the program in terms of how to do effective initial screening to identify participants who will be successful. It also helps to streamline the services CFA provides, and how the incubator farm space (land, equipment and infrastructure) can be effectively shared among the participants. Early signs indicate that the farmers are increasing gross sales, which is likely due to advanced level training, marketing support, and mentorship, as well as increased infrastructure. An example of a Final Report from 2015 is in Attachment #2.

The project benefitted only specialty crops growers. There were instances where individuals approached the project team for assistance with small-scale livestock. Those inquires that were non-specialty crop related were referred to the appropriate organizations, or farmers with experience in those enterprises. The time spent on responding to these enquiries was expensed through other funding and not through the SCBGP funding.

The CFA incubator program worked closely with selected partners, as such relationships were crucial to the early stage development of the program and will contribute to its future success. The role and contributions of some of the partners/partnerships are listed below:

CFA worked closely with University of California Sustainable Agriculture Research and Education Program at the University of California Davis. Through this collaboration the project team achieved the following:

- Interviewed 14 produce buyers and five farmers
- Presented the findings to the CFA Advisory Committee.
- This study and final report and supporting documents, including contact information for each grocer or retail outlet, were distributed to the incubator farmers
- Produce currently sold at or supplied to grocers, farm stands, farmers markets, and a food bank.

CFA collaborated with Sierra Orchards and California FarmLink. The former has provided land for the incubator program and the latter is helping facilitate land linking and land purchase financing for beginning farmers. The partnerships are ongoing and expected to continue well beyond the life cycle of the grant.

CFA worked closely with National Center for Appropriate Technology (NCAT) and University of California Cooperative Extension. These partners helped develop the workshop and courses for the incubator program.

CFA also worked with the Yolo County Agriculture Commissioner, Yolo County Health and Human Services, the City of West Sacramento, UC Davis Student Farm, the Sacramento County Office of Education, and many more entities. The partner's roles included:

- Helping to match incubator farmers with available farmland
- Assisting with farming job opportunities in specialty crop production
- Providing land for lease
- Market for produce
- Financial support for incubator farmers

In particular, a partnership with the city of West Sacramento helped to initiate the urban farm program. The partnerships helped many incubator farmers to expand, grow and supply specialty crops to urban markets.

Eighteen regional farm businesses support the CFA program directly to provide consulting and mentorship to the incubator farmers.

Goals and Outcomes Achieved

Outcome 1: Thirty incubator farmers on 15 acres in the CFA incubator program and marketed to local and regional outlets.
Activities completed to meet this:

- Continued the CFA incubator program.
- Put in place equipment and infrastructure at the incubator farm facilities to support the incubator farmers
- Provided ongoing training, supervision, mentorship and support to the incubator farmers
- Increased acreage in incubator program through partnerships with grocers, City of West Sacramento, City of Davis
- Identified regional and local marketing opportunities and markets for incubator farmers and connected the farmers with buyers.

Outcome 2: Seventy-five additional specialty crop farmers having received technical assistance from the incubator program.

- Provided technical assistance to non CFA specialty crop farmers
- Shared best practices with other incubator programs supporting new farmers
- In person or phone technical consultations with farmers and/or landowners

Outcome 3: Three additional marketing relationships for beginning specialty crop growers researched and developed, with 12 or more CFA farmers participating directly.

- Conducted market research in partnership with UC Sustainable Agriculture Research and Education Program
- Disseminated the results of study to incubator farmers

- Involved in managing a farmers market
- Established farm stand in four sites in West Sacramento, and one in Davis
- Started an aggregated CSA for a community in West Sacramento
- Facilitated supply of specialty crop produce to grocers
-

The goal of this project was to increase the number of specialty crop growers in California, especially in the Sacramento Valley. This was and is the long term aim of the CFA incubator program.
The aspects that are critical to achieving this goal are:

- Providing the appropriate pathways and right first steps to aspiring new farmers
- Reaching out to a wider cross section of people who are interested in farming
- Identifying new and non-traditional markets that specialty crop growers can cater to economically sustainable farming enterprises

The CFA training program from the 2010 SCBGP Project 32 attracted a wide cross section of people who were interested in farming as a vocation. This included veterans, urbanites, career changers and immigrants. It also helped the individuals to narrow down a farming dream to what can be realistically achieved in the first three years, thus acting as a pathway. The incubator program helps beginning or new farmers take the appropriate first steps. The nature of this program (low risk) helps beginning farmers to make mistakes and learn from lessons rather than being negatively impacted and discouraged. Both these aspects, along with the market linkages that the program provides, helped to create a greater number of well informed, knowledgeable and capable specialty crop farmers. The incubator farmers will go on to establish successful farm enterprises in the region and be the next generation of farmers that will lead to up-coming food and farming systems.

The project was able to accomplish all its grant duration targets, except one, the number of projected farmers in the incubator program.

- CFA had projected 30 farmers in the program, but the project team was able to achieve 22 farmers at the incubator farm sites. This was not due to a lack of participants, but because some of the training program participants already had access to owned or leased land, hence the farmers did not need to start a farm enterprises at the incubator farm sites. CFA continues to support these farmers with business planning and technical knowledge which is just as beneficial.
- At the start of the project the incubator program had access to only two acres, today that acreage has increased to 16 acres
- Technical assistance was provided to 103 specialty crop farmers in the form of phone or in person consultations which is well above the 75 participant target.
- Four farm stands, 11 farmers markets and 21 groceries/restaurants/other direct markets have been developed as part of this project. Some of these marketing outlets were developed by CFA program, while others were established by the farmers as a result of participation in the CFA incubator program. The target was to reach three marketing relationships and this was achieved beyond the target goal.

As highlighted in the previous sections the project team met all targeted outcomes and achieved excess numbers in two of the outcomes. Please see a recap below:

- CFA had four farmers at the start of the project (baseline data) that increased to 22.
- CFA had access to two acres for the incubator project in 2013, which rose to 16 at completion of the project

- CFA was able to provide guidance and assistance to 103 farmers from throughout the region (baseline data zero)

The market research helped CFA to establish local and regional markets, 37 in all. Notable among these markets were the linkages the project team was able to establish with two major grocery stores. It is very rare to see such large grocery chains purchase directly from small scale specialty crop growers and this development was a major highlight of the project. Another highlight in the marketing space was CFA helping to manage and reinvigorate the a farmers market. CFA is in charge of coordinating vendors for the market and in the process providing a market outlet for the incubator farmers.

The project team were able to increase land by 14 acres and number of sites from one to six within a short period of time (two years), this helped to support a greater number of specialty crop farmers. The West Sacramento sites also helped to raise the awareness about specialty crops in urban areas apart from providing access to fresh, local produce in these area that were otherwise food deserts.

The establishment of the Cannery Farm in Davis was another highlight of this project and this initiative is ongoing at the time of writing this report. This partnership was a first of its kind which involved a farm organization, property developer, and a city. The developer established an urban farm with the necessary infrastructure on seven acres of land within the housing development site. CFA will be providing the farmer(s) and ongoing management of the farm site. The farm site is in the process of being taken over by the city from the property developer. This model will serve as an example of how farming can be incorporated into housing development.

The incubator farmers produced and supplied $128,115 worth of produce to local markets. In the process four new farm stands were established (Davis and West Sacramento) and the project was involved in managing a farmers market.

Beneficiaries

During the course of implementing this project CFA worked with other groups or organizations that proved to be mutually beneficial.

West Sacramento Chamber of Commerce - the partnership was established with the Chamber of Commerce to revive the farmers market. The Chamber hopes to bring economic activity and benefit to the city hall area of West Sacramento by establishing farmers markets in the area.

City of Davis / Property Developer – This establishment is the first of its kind, modeled were urban development incorporates farming space in its design. This will serve as an example for how to build sustainable communities in the future.

The direct beneficiaries of this project were:

a) Twenty-two beginning farmers who acquired the knowledge and skills to establish self-owned farm enterprises.
b) One hundred three specialty crop growers who have gained further technical and production skills through the one on one and phone consultations.

The farmers primarily produce for local and regional markets, thereby generating local economic benefit and growth. Further, through services, inputs, and infrastructure that the farmers purchase or benefit from local sources. This program helps new farmers to keep the economic benefits within local communities and towns.

The 16 acres currently in production generated approximately $128,115 worth of specialty crop produce. One of the farmers also leased six acres outside of the incubator program that generated $59,420 in sales.

The markets established by this project help to connect farmers with consumers in the region. Thereby contributing to the “Farm to Fork” mandate of Sacramento. A CSA program has also been established in West Sacramento to serve 35 families in the area.

The potential economic benefits achieved through the accomplishments of this project are twofold:

1) As more beginning farmers continue to establish farms it will help to revive the aging farmer population. Beginning farmers mainly grow for local and regional markets, while there are limited studies on the precise economic impact of this trend, the theory is that it is and will contribute a vibrant local economy. This is further corroborated by the growth in farmer’s markets and CSA’s over the last 10 years.
2) The market linkages that this project initiated with large scale grocery chains has the potential to expand and support more beginning farmers as it provides access to a broader consumer base beyond CSAs and farmers markets. This is a consumer base that many beginning farmers have not been able to tap into or do not have the capacity to supply. There will definitely be a wider economic impact, which has to be measured in the future.

Lessons Learned

The implementation of this project helped to streamline the services and support structures that could be offered to beginning farmers. While the learning needs of beginning farmers are broad in year one and two, and ranges from business planning to source inputs, it is next to impossible and ineffective to teach all the aspects of farming. Staff was able to narrow down the aspects that were critical to a beginning farmers success and focus on those needs. This helped the project team to not only be effective, but also to stretch the financial resources further.

The needs of beginning farmers are individually specific, i.e. learning and on the ground working style are very personalized. The project team was constantly faced with the prospect of setting supports, mainly around infrastructure and equipment needs, for individual farmers to meet individual needs. The project team realized that it is impossible to cater to all the needs, and at the same time reach more beginning farmers. One of the biggest challenges is trying to establish an incubator space that fulfills both these aspects and find the right balance.

CLBL is exploring the possibilities of identifying a network of farmers who can take on beginning farmers as apprentices. The beginning farmers from the incubator program can be directed, in year two or three, to these farmers based on their specific needs. This will help the project team to reach out to a greater number of beginning farmers as the network is now much wider. The project team believes this method is a more effective approach/strategy than trying to make the incubator program cater to individual needs, which will be challenging.

The incubator program was envisaged as a stepping-stone that will help beginning farmers establish self-owned farm enterprises in the rural regions. This still remains the main focus of the program, but the CFA was rather unexpectedly led into urban agriculture space. Urban farm spaces that range from less than .25 - 3 acres gave the opportunity for some of the incubator participants to start micro scale farms and work in the city at the same time. The enterprises the farmers run are big enough to generate a part time or in some cases full time income. Many urban agriculture projects throughout the country are built around the community gardens/allotment plot models. The model CFA was able to initiate is very unique because it has an ability to provide livelihood and is income generating. Currently there are five sites (West Sacrament and Davis) with seven farmer's actively growing and marketing specialty crops from these sites.

The only grant outcome that was not achieved was the number of beginning farmers supported (target 30 achieved 22). As stated earlier, there was no problem in reaching out to beginning farmers but it turned out that not all of the farmers wanted to start at the incubator program level. This is not necessarily a problem as the project team were able to provide those farmers with support and guidance for knowledge-needs, which is still critical for a beginning farmers. Similarly, in order to reach more beginning farmers, support services need to be structured beyond the incubator space.

Additional Information

The CFA incubator program garnered significant media attention, see links below.

- An article highlighting women farmers in The Washington Post (https://www.washingtonpost.com/national/women-expand-their-home-on-the-range/2016/01/23/db2b694c-bc86-11e5-99f3-184bc379b12d_story.html?platform=hootsuite)
- An article about the need for new farmers in The Reporter News (http://www.thereporter.com/article/NG/20160220/NEWS/160229996)
- An article highlighting the Cannery Farm in Sacramento Magazine (http://www.sacmag.com/Sacramento-Magazine/March-2016/The-Farmer-in-the-Hood/)
- An article on women farmers in the Earth Island Journal (http://www.earthisland.org/journal/index.php/eij/article/unconventional_agriculture/)An article highlighting two incubator farmers in the Sacramento Bee (http://bit.ly/1g90NX4)

Additionally, the following photography captures the successes of the California Farm Academy Incubator Program.

West Sacramento CFA Incubator site, Farm Stands, and Farmers Market:

Winters CFA Incubator site:

Cannery CFA Incubator site:

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 18	**Project Title:** California Leafy Greens Industry Food Safety Training Program	
Grant Recipient: California Leafy Greens Marketing Agreement	**Grant Agreement No.:** SCB13018	**Date Submitted:** December 2016
Recipient Contact: Mike Villaneva	**Telephone:** (916) 441-1240	**Email:** mike@lgma.ca.gov

Project Summary

To ensure a safe food supply and protect public health, food safety training for agricultural workers in California's fresh produce industry is critical. This particularly applies to those workers who directly handle fresh produce when performing activities for harvesting and/or packing. Due to a major food borne illness associated with spinach in 2006, which resulted in multiple deaths and losses exceeding 200 million dollars, a real need existed for providing consistent and uniform food safety training for workers in California's multi-billion dollar leafy greens industry.

Formed in 2007 following the 2006 outbreak, the California Leafy Green Marketing Agreement's (LGMA) "best agricultural practices," (hereafter referred to as the metrics) requires all workers who produce, harvest, and/or pack leafy greens for LGMA members must be trained in basic food safety practices. Also during the period in which the project was conducted, the United States Food and Drug Administration (FDA), promulgated regulations (hereafter referred to as the produce rule) pursuant to the Food Safety Modernization Act (FSMA) that requires specific food safety training for field workers and supervisors.

The project is important and timely to the leafy greens industry because it has established a much needed industry wide food safety training program that fully complies with mandatory food safety training requirements prescribed in LGMA's metrics, FDA's produce rule and other specific food safety training for field workers and supervisors required by buyers of leafy greens.

Providing effective, uniform and consistent food safety training as required is challenging. On any given day during the year, there can be as many as 500 individual harvesting crews with thousands of field workers harvesting and packing leafy greens. While the industry does provide some degree of training for workers, the content, frequency, setting, and teaching skills of those providing the training varies widely. As the industry expands and is burdened with new training requirements, the need for a uniform and comprehensive food safety training continues to grow.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The project developed six stand-alone, standardized food safety training programs for field workers, based upon recognized "train-the-trainer" training methods. Course 1 is a two day Train the Trainer course, which is a pre-requisite for all instructors who are responsible for teaching the curriculum. The other five courses cover activities associated with the production of leafy greens, including Course 2) Cleaning and Sanitizing Harvesting Equipment; 3) Managing and Supervising Harvesting Operations; 4) Sampling and Testing Techniques; 5) Worker Hygiene and Handwashing; and 6) Animal Intrusion. A standard process with established steps was followed to produce all courses.

Step 1: Project Core Team, included contractors and LGMA staff, would meet to; 1) select the topic; 2) develop a timeline for completing the course(s); 3) develop a draft outline of the course narrative; 4) identify photo and video needs; and 5) identify special needs and/or considerations unique to the topic.

Step 2: Develop draft narrative of course that includes; 1) course lesson plan; 2) learning objectives; 3) case studies; 4) group activities; 5) power point slides; and 6) quiz.

Step 3: Develop shoot list for photos and written narrative on video needed to meet course goals and learning objectives.

Step 4: Shoot all videos and perform initial editing of raw video footage

Step 5: Arrange with "industry partners" to provide access to fields, harvesting operations, worker training, etc. to shoot needed photos and video.

Step 5: Contractor submits completed draft course to LGMA staff for review and any subsequent revisions.

Step 7: Recruit a select group of industry food safety professionals to "beta test" the course for feedback, recommendations, etc.

Step 8: Incorporate results from "beta test" and develops final version of course which includes USBs containing all videos and PowerPoint slides as PDFs.

Step 9: Final version sent to vendor to reproduce course manuals with all materials.

This project only benefitted California leafy greens. Workshop attendees were limited to personnel associated with LGMA handlers, growers and harvesting companies and verified by LGMA staff.

The project partnered directly with three consultants, to design, develop and in specific circumstances, implement the program. The partners provided critical input and expertise relative to their technical abilities and expertise.

A consultant in the food safety industry is a recognized leader in developing and conducting food safety training for the Hispanic workforce. They provided critical technical expertise for; 1) for developing course curriculum that understood and accepted by this culture; 2) filming various "how to" videos in several courses; 3) creating "draft" manuals used for beta testing courses and as a sample for printing final course manuals; 4) translating course materials into Spanish; and 5) developing a bi-lingual instructor to teaching all courses once fully implemented in April, 2017.

Another consultant developed and conducted; 1) industry survey to establish industry training need for topic, type, length and number of courses offered; and 2) real time evaluation on effectiveness and acceptance of training course for attendees. Survey results were very helpful in designing the courses, while the visual assessments made during the presentation provide data that led to adjustments in course delivery and emphasizing key sections of the curriculum.

The last consultant shot all photos and video clips for the six training courses to promote group interaction and adult learning techniques. They brought years of experience working with the agricultural industry in the Salinas Valley, which contributed to obtaining pertinent media that greatly enhanced the quality of all training courses.

Goals and Outcomes Achieved

The project intended to improve outcomes in several categories, including; 1) number of training sessions provided by LGMA handlers; 2) number of training sessions provided by LGMA Tech; 3) number of training sessions provided by harvesting companies; 4) reduction in number of violations issued for non-compliance with metrics; and 5) compliance rate for audits versus citations issued.

In all cases, project staff reviewed historical data available for the described categories to establish baselines before the project began and the changes after the project was completed. Project staff also asked for pertinent data from its membership in these categories to expand the available data to compare and contrast as a way of assessing the effectiveness of food safety training before and after the project was initiated.

A survey was conducted to establish baseline numbers on worker training data. This approach also attempted to establish baseline data for training provided by harvesting crew supervisors, in order to assess any measurable changes to frequency of training and variety of training topics for crew supervisor training.

Outcome measures were not long term directly; however, project staff expect the data could provide for the ability to measure long term improvements if the baseline data for the current level of food safety training was accurate, an analysis of those measureable changes that occur over time could be made to draw conclusions on the effectiveness of the training.

The project aimed to increase training activity, specifically in the areas of workshops and training for field workers and supervisors by LGMA handlers through their food safety professionals having training responsibilities. In general, project staff feel that those activities to be examined did improve, though not to the levels projected in all categories. Those projections include:

- Increase # of workshops in 2012/13 from 10 to 20 per year and 25% annually thereafter, using 15 as the baseline
  - In 2014/15, LGMA conducted 17 workshops.
- Increase # of supervisors trained annually by 25%, using 128 as baseline.
  - In 2014/15, LGMA trained 118 supervisors.
- Increase # of training sessions for harvest workers conducted by growers, handlers and harvesting companies by 20% annually using crop season 2012/13, using 250 as baseline.
  - No baseline data gathered for this outcome, see the information below.
- Increase # of harvest workers trained by growers, handlers and harvesting companies by 25% annually.
  - No baseline data gathered for this outcome, see the information below.
- Reduce # of N/C issued for crop season 2012/13 by 25%, using 843 as baseline.
  - 702 N/C issued in 2014/15

A major contributor that led to not achieving certain project goals was the lack of reliable and sufficiently detailed data to establish; 1) training hours accumulated for supervisors; 2) specific topics taught during training; 3) training materials used to provide training; 4) attendee evaluations of training provided; and 5) steps taken to improve field worker training.

More accurate data for these categories could have been gathered by conducting a simple phone survey with individuals responsible for food safety training at LGMA handlers, leafy greens growers and harvesting companies. A few standard questions posed verbally would have provided more useable baseline data versus the limited data gathered using mail surveys.

The number of LGMA workshops conducted from crop years 2012/13 to 2014/15 did increase. It was assumed that any changes in training patterns during these years could reasonably be contributed to the increased and targeted training of food safety professionals through the LGMA workshops for LGMA handlers, leafy greens growers providing product to LGMA handlers and leafy greens harvesting companies. As noted, project staff were not able to gather sufficient baseline data to measure any progress in worker training provided to LGMA handlers staff, leafy greens growers and harvesting companies. A better approach would have been to select a small number of companies representing a cross section of the industry and analyze their data. It would have been more manageable and provided more accurate information as to industry trends in this area. But, project staff feel the limited results in this category reflect a strong support for worker training, particularly through the LGMA training curriculum. Further, it suggests that LGMA, by maintaining a strong presence as a provider of food safety training for the industry, can motivate the industry to provide more internal food safety training for workers. But beyond pure numerical measurements of this type of pre- and post-project date, project staff suggest that an appreciation and/or respect for the value and importance of quality food safety training at the field level far exceeds measurable improvements in the quantitative measurement of actual food safety trainings conducted

There were three major accomplishments from the project that stand out; 1) completing Course 1, Train-the-Trainer; 2) developing separate training materials in English and Spanish; and 3) highly favorable evaluations from students attendees who noted the high quality and effectiveness of the course materials and positive response from LGMA members and other industry entities on the value, quality and applicability of the course training curriculum.

Accomplishment (1): Successful completion of Course 1, Train-the-Trainer, filled a critical void by being able to provide this level of training with accomplished instructors and course curriculum to the industry. Multiple "buyers" of leafy greens were requiring that food safety professionals delivering food safety training attend a three day course costing more than $2,000 as a condition of doing business. The LGMA's (1.5) day Train-the-Trainer course developed through the grant was previewed by multiple buyers and accepted as meeting their requirements for an acceptable Train-the-Trainer course. This resulted in a significant savings to the industry in terms of costs associated with attending the course, per-diem for travel and lodging and time away from assigned duties to attend the course.

Accomplishment (2): The leafy greens workforce is predominantly Hispanic, and it is critical that all training materials be presented in Spanish. Having materials, including course narrative, PowerPoints and videos translated into and presented in Spanish as a stand-alone course greatly enhanced the learning experience and was very much appreciated by those attending the courses. To that end, the LGMA is not aware of any formal food safety training programs designed for presentation in formal settings that offer both English and Spanish versions of materials, which are completely self-contained.

Accomplishment (3): Upon completion, all attendees were asked to complete a course evaluation. Categories included; 1) course strengths and weaknesses; 2) length; 3) quality of teaching materials; 4) balance of time between activities and presenting course materials; and 5) value of course activities. In nearly all cases, these evaluations were very favorable in all categories.

Beneficiaries

Based on the organization and function of the California leafy greens industry, three groups benefited from the completion of the projects accomplishments; 1) LGMA handlers; 2) growers of leafy greens and 3) leafy greens harvesting companies. By definition, LGMA handlers are those entities who deliver leafy greens into commerce under their label and are responsible for ensuring that the product complies with the LGMA metrics. Growers of leafy greens are responsible for producing leafy greens that comply with the metrics and produce rule, and in those cases, any additional requirements that are conditions of sale to buyers of leafy greens. Harvesting companies, which includes contract labor companies as an independent source and stand-alone harvesting companies which are part of “fully integrated” handler and grower systems that are common in the leafy greens industry.

There are currently more than 100 LGMA handlers who place leafy greens directly into commerce, and will derive the most direct benefits from the project. Whether they themselves are also the growers, and/or rely upon outside growers for the leafy greens, they are responsible for ensuring that all workers associated with the growing, harvesting and packing are adequately trained in recognized food safety practices. Project staff are confident that LGMA handlers will positively benefit by having these training modules available for their use and participation.

LGMA handlers pay an assessment fee to support the LGMA program, and it is expected that participating and fiscally supporting the LGMA training program will occur. The LGMA Advisory Board unanimously supported LGMA Tech to conduct all of the courses beginning 8/1/16 on thru to 2/30/17 in order to; 1) fine tune the courses; 2) accurately assess industry support and commitment; 3) determine potential costs for establishing and maintaining a long scale food safety training program; 4) determine appropriate fee structure for cost recovery; and 5) develop a group of qualified instructors that can effectively deliver the courses.

But the primary goal of improved food safety training for the leafy greens industry provided by this training curriculum is to reduce and/or minimize the opportunity for another major food borne illness outbreak. The costs associated with major outbreaks cannot be minimized, so increased training with proven materials and methods that will contribute to that positive outcome are nominal. Conversely, the positive image in the eyes of regulatory agencies and consumers that the leafy greens industry is fully committed to ensuring a safety product by training its workforce is invaluable.

One example from the regulatory agency perspective is the acknowledgement by the FDA, who is implementing and enforcing the produce rule, that this targeted food safety training program is setting the standard for field worker training. There will be a significant savings to the industry, accrued by not being subject to routine audits by the FDA for compliance with the produce rule. This, along with other entities in the food distribution who recognize the effectiveness of the expanded training program, will also reduce the demands for food safety audits.

Lessons Learned

Positive results from the project include: 1) acceptance that food safety training for field workers is important; 2) willingness of industry partners to participate in the project; 3) enthusiasm expressed by attendees on the value of the training courses; and 4) recognition from other sectors in the "food distribution system" on the value of LGMA's food safety training curriculum

The training curriculum developed through this grant will provide excellent training tools for the industry. During the process, it was clear that high quality training materials and qualified and motivated instructors were well received. Incorporating train the trainer techniques into a stand-alone course and highlighting the importance of the harvesting crew supervisors of being qualified to train were major positive outcomes from, the project. The ability to reproduce all training materials provided as PDFs on USBs will allow for LGMA members and other leafy greens industry sectors to create proven and high quality training materials at minimal cost to train their field workers and other staff involved with these activities.

Negative results from the project included; 1) perceived resistance to visually observe "tail-gate" training being conducted in the field; 2) lack of comprehensive data on field worker food safety training at multiple levels; and 3) realization that carving out time during the work day for training is and will continue to be a problem.

Training personnel is expensive and time consuming, so meeting training needs with these constraints will be an ongoing challenge. Another concern is having the ability to visually observe and evaluate the effectiveness of field training. This is an important part of accurately evaluating the training materials and will take a concerted effort to establish a working environment that will be open to this type of site evaluation of field training activities. Project staff are however, confident that these particular challenges can be addressed, so that access to field training can be achieved to see first-hand how this type of training is developed and performed and how these and other training materials can be developed to improve and enhance this important process.

One mandatory training being asked by a major buyer of leafy greens was requiring LGMA handlers and/or growers to send individual(s) responsible for training to a three day Train-the-Trainer course. This course cost more than $2,000 and three days of time away from critical oversight duties. After reviewing LGMA's Train-the-Trainer course (1.5 days, free) developed through the grant, the buyer accepted attending and completing the course satisfied their requirements. This resulted in a significant saving to the handler(s) who enrolled staff into the course, which more accurately represented the training challenges in the leafy greens industry. Though project staff were able to offer the training for free through the grant, a mechanism will be developed for cost recovery that includes a registration fee for entities not LGMA certified and possible registration fees for LGMA members to ensure recovery of costs associated with conducting and updating the training materials.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 19	Project Title: Online Continuing Educational Resources for Ornamental Specialty Crops Producers	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13019	**Date Submitted:** December 2016
Recipient Contact: Nicole Clark	**Telephone:** (530) 757-8526	**Email:** ndclark@ucdavis.edu

Project Summary

For twenty years, University of California (UC) personnel have presented the "ABCs" workshops in English and Spanish on basic horticultural topics to serve the continuing educational needs of the ornamental specialty crop plant production workforce. During the recent economic downturn, ornamental specialty crop producers (nursery and floriculture) reduced their workforce to levels that do not easily allow time for attending off-site training workshops. UC faculty and Cooperative Extension (CE) personnel have fewer resources to allocate to these in-person workshops. To date, the majority of producers have still not recovered from the economic recession that began in 2008. Profit margins for all sectors of the nursery industry were impacted and still have not returned to pre-recession levels.

Of the current 324 University of California Cooperative Extension advisors and specialists, 50% are estimated to retire in the next six to eight years, creating an interim gap in personnel with expertise in the California ornamental specialty crop producers. Also, the University of California Nursery and Floriculture Alliance (UCNFA) website metrics indicate that the ornamental specialty crop producers are turning to the internet for information which demonstrated the need for more online educational content. Producers have equested online educational material since they cannot always attend an ABC workshop scheduled in their area.

UCNFA website metrics for July 2014 through June 2015 showed 1,881 users did 6,796 pageviews during 3,176 sessions averaging 157 users per month. Fifty-four percent of the users were "new" visitors. Seven of the top 10 site pageviews (28% of all pageviews) were of the educational programs provided by UCNFA. The website pages devoted to the online tool for generating pest control best management practices for individual nurseries accounted for 5% of the total pageviews.

In addition, UCNFA news website metrics for July 2014 through June 2015 showed 19,626 users did 29,697 pageviews, which is a 20% increase over the previous year, in 23,204 sessions averaging 1,636 users per month.

UCNFA addressed these timely issues by leveraging technology to adapt workshop content to a web-based format in order to reach a broader producer audience within the demands of their work schedules. Previous ABCs presentations were selected and updated with narration from current UC experts and maintained as learning modules on the UCNFA website.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Originally, four ABC workshops (English and Spanish, total eight workshops) were chosen to be reviewed and updated by UCNFA presenters: ABC's of Horticulture, ABC's of Plant Pathology, ABC's of Nursery and Greenhouse Pests, and ABC's of Fertilizers and Plant Nutrition.

Of the four ABC workshops, only three (Horticulture, Plant Pathology, and Nursery and Greenhouse Pests) were reviewed, updated, presented in person (six workshops, English and Spanish), and were videotaped by the Project Director.

ABC's of the Fertilizers and Plant Nutrition workshop was cancelled due to insufficient registration. Unfortunately, this workshop could not be re-scheduled due to conflicts with presenters, and therefore could not be accomplished in the grant timeline.

The Project Director edited the three English workshop PowerPoint presentations in preparation for transcribing into finalized PowerPoints.

Raw videotaping was completed for ABC's of Horticulture, Plant Pathology and Nursery and Greenhouse Pests by the Project Director. Post-editing and review of the videotape for Horticulture determined that the videotape quality of the workshop was not high quality and that it was too time consuming to professionally edit and produce a quality deliverable. Online interactive quizzes could not be accommodated in-house, therefore, Project Investigator (PI) made the decision to suspend editing the two remaining workshops: Plant Pathology and Nursery and Greenhouse Pests.

In May 2015, the Project Director informed the PI of retirement in July 2015. This was unexpected, and at that time, the PI could not take on project management duties due to outside work load. The PI could not find and hire a qualified Project Manager, so in the fall of 2015, PI assumed the Project Director duties with no project fund support. The PI hired an undergraduate student to transcribe raw videotape for the Horticulture, Plant Pathology and Nursery, and Greenhouse Pests English workshops and embed "draft" script directly into PowerPoint slides.

Upon transcription completion, draft English PowerPoint embedded scrips for the three workshops were sent to the UCCE English presenters for final editing. Concurrently, the PI contacted UC Davis Academic Technical Services for technical services to assist in creating web-based, interactive, online educational modules with quizzes.

The PI contacted UC Agricultural and Natural Resources (ANR) Communication Services and contracted work for creating PowerPoint presentations with embedded videos of the presenters for ABC's of Horticulture (English and Spanish), Plant Pathology (Spanish), and Nursery and Greenhouse Pests (Spanish only). The PI cancelled the English Nursery and Greenhouse Pests due to no response back from the UCCE presenter. The PI also cancelled the English Plant Pathology due to the UCCE speaker request and UC ANR internal peer review of English script, and unfortunately, this could not be accomplished in the grant timeline.

The final online PowerPoint presentations were accomplished with corresponding mediasites and have assigned website links for access via the internet:

a. ABC's of Horticulture (English and Spanish)

b. ABC's of Plant Pathology (Spanish)
c. ABC's of Nursery and Greenhouse Pests (Spanish)

ABC workshop PowerPoint presentations were approximately 1.5 hours in length and each workshop presentation had a mediasite for access once UCNFA develops the webpage and online link access which will take place after this grant project and with outside funding. The PI will develop a communication plan for promoting online educational PowerPoint presentations for the respective ABC workshops.

Each workshop was videotaped into topics and each PowerPoint topic can be updated and re-taped in the future without videotaping the entire PowerPoint presentation. Unfortunately interactive quizzes for workshop topics were not accomplished due to insufficient time. However, the process and cost for creating future online educational content with interactive quizzes is still anticipated past this grant project.

Having never designed and created online interactive learning modules before, the PI recommends conducting a thorough review of other agricultural or horticultural products online. Once a product is identified, meet with professionals to assist in identifying project requirements so an accurate timeline and cost estimate can be provided upfront. Online interactive learning modules require professional expertise to design and develop an effective online educational tool.

Project grant funds benefited only specialty crops.

Goals and Outcomes Achieved

ABC's workshops for Horticulture, Plant Pathology, and Nursery and Greenhouse Pests were designed, delivered in person, and videotaped in English and Spanish. Videotaped workshops were transcribed into English PowerPoint presentations. English PowerPoint presentations and script were edited prior to being translated into final Spanish PowerPoint presentations.

Four online educational modules from ABC workshops have been completed (one in English and three in Spanish). A webpage on the UCNFA website has been created where all modules will be hosted. Each workshop is divided into topics and can be accessed and viewed separately from the entire workshop presentation. Each workshop topic is connected to a specify survey which allows for specific topic feedback. Each workshop topic can be edited and updated separately.
http://ucnfa.ucanr.edu/Grants_and_Projects/ABCs_online_workshops/

A communication plan is currently being designed and developed which will be done past this project term with outside funding. Surveys will be implemented once online educational modules have been reviewed by producers. Feedback from viewers will be reviewed and utilized by UCNFA for improving each ABC module.

Initial expected measurable outcome was a targeted increase of 100% to 200% in the number of online participants (14-21 per month/166-249 per year) that would demonstrate the success for providing continuing education in an online format for other topics to increase the competitiveness of California's ornamental specialty crops producers. The modules are now online, and project staff are promoting. Promotion of the modules by in person presentation or by other communication methods did not take place within the project

period due to delays and time restraints.
http://ucnfa.ucanr.edu/Grants_and_Projects/ABCs_online_workshops/

The goal for this project was to design and develop online educational resources for producers with quizzes that would assess user comprehension and performance; and with online surveys that would promote user feedback to content improvement and understanding the effectiveness of the online learning resource. The quizzes could not be completed due to delays and time restraints during the project time period.

Eight ABC workshops were originally planned (four in English and four in Spanish) for the project. Actual accomplishments were four workshop presentations (one in English and three in Spanish) that the nursery and floriculture industry can access via the UCNFA website. Online surveys were developed to promote user feedback to assess the learning resource effectiveness and recommendations for improvements. There was not enough time left in the grant period to achieve the stated grant deliverables, so the grant was amended to create PowerPoint audio-video learning modules for four ABC workshops. Creation of the PowerPoint audio-video learning modules was more cost effective than online learning modules with interactive quizzes. With limited time remaining in the grant, the PI was able to create four PowerPoint learning ABC workshops (one in English and three in Spanish) along with surveys to get feedback.

The success outcomes were the design and development of four workshop online educational modules that can be accessed by ornamental specialty crop producers via the internet. Each workshop was broken down into sub-topics and can be accessed separately from the entire workshop:

1. ABC's of Horticulture (English): ABCs of Horticulture
a. ABCs of Horticulture - Plant structures and functions
b. ABCs of Horticulture - Physiological processes
c. ABCs of Horticulture - Plant hormones
d. ABCs of Horticulture - Plant essential nutrients
2. ABC's of Horticulture (Spanish): ABCs de la Horticultura
a. ABCs de la Horticultura - Estructuras del Plantas y sus Funciones
b. ABCs de la Horticultura - Procesos Fisiológicos
c. ABCs de la Horticultura - Vegetales
d. ABCs de la Horticultura - Nutrientes Esenciales de Plantas
3. ABC's of Plant Pathology (Spanish): ABCs de Fitopatología
a. ABCs de Fitopatología - Introducción a los Principios de Fitopatología y Hospederas
b. ABCs de Fitopatología - Triángulo de las Enfermedades: Agente Causal
c. ABCs de Fitopatología - Triángulo de las Enfermedades: Medio Ambiente
4. ABC's of Nursery and Greenhouse Pests (Spanish): ABCs de Plagas de Viveros e Invernaderos
a. Introducción a Plagas de Artrópodos
b. Clase Insecta, Orden Hemiptera, Suborden Sternorrhyncha
c. Clase Insecta, Orden Hemiptera, Subordenes Auchenorrhyncha y Heteroptera
d. Clase Insecta, Órdenes Dictyoptera, Thysanoptera, Coleoptera, Diptera y Lepidoptera
e. Clase Arachnida

Beneficiaries

California's nursery and floriculture specialty crops growers working at 3,013 locations throughout California are the main beneficiaries of this project. UC professionals also benefit as they now have a process and template for developing future online educational resources for nursery and floriculture growers throughout the state. Other specialty crop growers who have attended these workshops have benefitted.

There are over 3,000 specialty crop nursery and floriculture producers in California who will benefit from these online educational resources. The economic impact will be over $3.5 billion farm gate value for the industry and currently ranks 5th in California agriculture.

Lessons Learned

1. UCNFA should utilize professional technician for creating online educational resources versus in-house, since UCNFA does not possess the in-house expertise.
2. Audio-video recording of workshops and design and development of online learning resources with quizzes should be done by professional technical resources.
3. Professional software is needed to deliver online educational resources.
4. Project team could not deliver the proposed deliverables in the grant timeline and for the costs proposed since professional services were needed for videotaping and project director retired.
5. PowerPoint presentations with embedded video can be cost effective, but these educational resources will not include quizzes for assessing participant performance.
6. Project requirements should have been more clearly defined as part of the final grant proposal.

Unexpected Outcomes:
1. Project Director unexpectedly retired causing delays in the grant timeline.
2. Workshop speakers could not deliver transcribed PowerPoints.
3. Creating online educational resources by in-house untrained personnel was not feasible and caused delay in timeline. Professional services had to be found and employed.
4. Professional software and technical resources are needed for effective design, development and implementation of online educational resources.
5. Could not complete online learning modules either PowerPoint audio-videos or interactive online learning modules with quizzes (8 total workshops in English and Spanish) as per grant outcomes.

In order to design, develop and implement effective online educational resources, professional software and technical resources were needed to be employed. Attempting to develop educational modules with interactive quizzes was deemed not possible in-house and it resulted in having to change scope and direction by employing professional services late in the grant timeline. There was not enough time left in the grant to achieve the stated grant deliverables, so the grant was amended to create PowerPoint audio-video learning modules for four ABC workshops.

Additional Information

Promotion of the four ABC online educational workshops (Horticulture in English and Spanish; Plant Pathology in Spanish; and Nursery and Greenhouse Pests in Spanish will be communicated via:
UCNFA website (http://ucnfa.ucanr.edu/)
UCNFA online newsletter (http://ucnfanews.ucanr.edu/)
UC ANR News & Information Outreach in Spanish (NOS) (http://ucanr.edu/sites/Spanish/Noticias/)
UCNFA Blogosphere (http://ucnfa.ucanr.edu/?blogasset=10592&start=4)
UCNFA Facebook (https://www.facebook.com/UCNFA/
California Nursery Conference (Pests, Diseases & Water Issues) on October 25, 2016 in Watsonville, CA

Non-profit industry trade organization, California Association of Nurseries and Garden Centers' (CANGC) weekly e-newsletter (http://cangc.org/media/index/enews)

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 20	**Project Title:** On-Farm Food Safety Plans for Small-Scale Specialty Crop Growers	
Grant Recipient: Community Alliance with Family Farmers	**Grant Agreement No.:** SCB13020	**Date Submitted:** December 2016
Recipient Contact: Dave Runsten	**Telephone:** (530) 756-8518 ext. 125	**Email:** Dave@caff.org

Project Summary
Though large-scale commercial produce farms have already implemented food safety practices, this is not the case with many small, organic, biodynamic, diversified, or direct-market farms. In a recent survey of such farms on California's north coast, fewer than 20 percent had any experience with food safety issues and even fewer had written food safety plans. Since such a plan is increasingly a requirement for participation in commercial markets, these specialty crop farms are at risk of being shut out of markets. As a result, the project purpose was to reach out to the many thousands of farmers who do not have the funds to hire private consultants, do not sell in markets that currently require food safety plans, and require one-on-one assistance to create customized, written, and auditable farm food safety plans. All farmers face some potential risk from pathogenic bacteria, and hence the Community Alliance with Family Farmers (CAFF) believes that every farm needs a food safety plan appropriate to the risks on that farm.

The project team made significant progress on implementing food safety on small and medium-sized specialty crop farms in California. The combination of the trickle-down effect of the Federal Drug Administration (FDA) Food Safety Modernization Act (FSMA) and state laws mandating Good Agricultural Practices (GAPs) for direct marketing have meant that small specialty crop growers are increasingly anxious to start in on food safety.

- Spoke to over 1,000 people in food safety workshops, answered questions from almost 400 farmers, and assisted about 100 farmers with devising and implementing a food safety plan for their farms.
- Developed materials that help specialty crop growers assess the risks on their farms and devise food safety measures appropriate to their scale and risks. Translated many of these materials into Spanish and are available online.
- Held workshops and worked one-on-one with many low-income and socially disadvantaged farmers, including African American, Latino, Hmong, Mien, and Native American specialty crop growers. The project team learned important lessons about reaching these populations and have developed partnerships of personnel who work with them.
- Extended the reach of the work into new regions, such as the southern San Joaquin valley, San Diego, and northeast California.

The previous two-year period of the work on food safety was funded by the 2011 Specialty Crop Block Grant Program Project 5: *A Family Farm Food Safety Outreach Program for California Specialty Crop Growers*. Lessons learned were used in the outreach effort to expand the groups and the geography reached. CAFF developed new material that was found lacking in the previous project, including a variety of templates that growers could adopt as part of their food safety plans.

Project Approach

Developed materials for famers to implement food safety plans and placed them on the website. Handed these materials out at workshops as part of the packets of food safety material that are distribute to attendees. Record-keeping templates were created at the request of farmers. The core materials that are currently being used can be found at: http://www.caff.org/programs/foodsafety/templates/. Links to other material are continually added to the website at http://www.caff.org/resources/foodsafety/ .

All three of the partners in this project worked on developing new material.

- Created a *Land Use Action Plan* that growers can use to determine the pathogen risks of wildlife, flooding, and water quality on their farms. The plan is tied to the FSMA Produce Rule, which will enable CAFF to insert it into more extensive material on FSMA in the future.
- Worked on post-harvest washing and the various approaches to sanitizing that smaller growers might utilize. The project received many calls from growers about this subject, so another funding source has been secured to continue working with the partner on developing simplified materials for growers. In the interim, a PowerPoint is on the website.
- Modified food safety training resources for urban production farms to reflect specific urban food safety risks such as soil contamination. These materials are available to other UC Cooperative Extension advisors.

Binders and packets of food safety material were distributed to at least 600 specialty crop growers. The materials included have evolved over the course of the project as CAFF became aware of the need for specific templates and other documents that growers needed.

Project staff envisioned updating the small farm GAPs placed on the direct marketing website as guidance in response to a requirement in recently passed state laws, however, it was decided to wait until FSMA was finalized to update these GAPs. Due to this and staff changes, this has been put off until 2017.

All of the material from the packets was translated into Spanish. This translated material is being added to the website. Project staff collaborated with Hmong groups in Fresno on the translation of some material into Hmong that was used in presentations to Hmong growers. However, most Hmong farmers do not read Hmong, so it is more important to engage in simultaneous translation in workshops than it is to provide written Hmong materials. A binder of food safety material from a previous grant was translated into Chinese for a group of Chinese growers who farm south of San Jose.

Project staff have worked with an agricultural consultant on materials about how to co-manage food safety requirements with conservation plantings on the farm. In the previous SCBGP project the team co-produced the publication A Farmer's Guide to Food Safety and Conservation: Facts, Tips, and Frequently Asked Questions, which has been put on the website. CAFF distributed this in the packets to all farmers worked with. In addition, the consultant developed new material on FSMA and land use risks, as noted above.

The food safety section of the website was completely restructured. CAFF developed a series of documents and templates for farmers to implement food safety plans and placed these core materials at: http://www.caff.org/programs/foodsafety/templates/. This material was translated into Spanish at the end of the grant period and is in the process of adding the information to the website. Project staff have continually added links to other material on the website at http://www.caff.org/resources/foodsafety/ . Other items from this project that are currently being added include a PowerPoint on food safety in post-harvest washing, *Land Use Action Plan*, and summaries of the FSMA Produce and Preventive Controls Rules.

CAFF has a list of food safety auditors (of which CAFF has met with the majority of over the years) on the website at http://www.caff.org/programs/foodsafety/thirdparty/. Project staff met with two during the grant period in order to understand their new program and to be able to recommend their services where appropriate.

CAFF held 40 food safety workshops for 1,008 specialty crop attendees. Workshops were held in the following 18 counties: Humboldt, Sonoma, Monterey, Santa Clara, Sacramento, Alameda, Santa Cruz, San Francisco, San Mateo, San Diego, Nevada, Fresno, Amador, Modoc, Yolo, Stanislaus, Shasta, and Mendocino.

Staff directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

Two mailings were sent to all direct-market specialty crop growers in California during the project period; one in October 2014 and the other in April 2016. These letters discussed timely issues related to food safety and offered the assistance of CAFF in preparing on-farm food safety plans. The most recent letter walked through the FSMA exemptions and qualified exemptions, as well as what crops and activities are covered. The mailings have gone to approximately 3,500 specialty crop growers.

The National Sustainable Agriculture Coalition's (NSAC) Food System Integrity Committee is the committee charged with food safety policy. This committee has regular calls and through this committee, CAFF shared many experiences with other member groups within the coalition. The project director attended the annual winter meeting of NSAC and shared experiences there. The Executive Director of the Carolina Farm Stewardship Association visited California and the project manager shared CAFF's materials and approach with them.

NSAC has joined with a consultant to submit a proposal to the FDA for a cooperative agreement that would be focused on food safety in local and regional food systems. If this project is approved, many NSAC organizations will join together to develop food safety materials, and CAFF will directly share the results of this project with them.

Project staff presented a workshop on food safety each year in both the California Small Farm Conference and the EcoFarm Conference.

The project manager attended one Produce Safety Symposium in Southern California

All workshops were advertised for specialty crop growers, and only specialty crop information was presented at these workshops. The farmers CAFF worked with were screened to ensure they were specialty crop growers.

Project Partners:

- One organization created a *Land Use Action Plan* that growers can use to determine the pathogen risks of wildlife, flooding, and water quality on their farms. The plan is tied to the FSMA Produce Rule, which will enable CAFF to insert it into more extensive material on FSMA in the future. In addition, the consultant participated in a number of food safety workshops with the project manager and the project director, with their presentations focused on co-management of food safety and conservation practices
- The second organization worked on post-harvest washing and the various approaches to sanitizing that smaller growers might utilize. (CAFF put the PowerPoint on washing onto the website.) In addition, they reviewed various materials that staff prepared and responded to particular questions that growers had. They also prepared the simplified melon GAPs.
- The last organization modified food safety training resources for urban production farms, to reflect specific urban food safety risks such as soil contamination. They made these materials available to UC Cooperative Extension advisors. When the second project manager was hired, the consultant shared food safety materials, and invited them to several of their workshops. The consultant conducted nine food safety workshops involving 158 specialty crop growers, including many minority growers.

Goals and Outcomes Achieved

CAFF held 40 food safety workshops for 1,008 specialty crop growers.

The project team directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

Over the last five years CAFF has conducted 70 workshops on food safety in California, reaching over 2,000 farmers and assisting 200 farmers with on-farm food safety plans. However, the demand for food safety assistance keeps growing, particularly now that the implementation of FSMA is beginning. CAFF's overall goal is to have every farm in the state that grows FSMA-covered produce implementing food safety practices appropriate to the risks on that farm. This means that even farms with a qualified exemption from FSMA would implement GAPs.

The National Association of State Departments of Agriculture (NASDA) estimates that 35,000 farms in the United States will be subject to the FSMA Produce Rule and that an additional 75,000 farms will be covered but have a qualified exemption. Over half of these farms are located in California; therefore there is a high need for this type of food safety work with growers. Although the acreage of immigrant and minority farms is relatively small, they comprise more than 20% of all California farms, and their contribution to California's crop diversity, their value in terms of specialty commodities grown, their role in the provision of culturally relevant foods for California's diverse population, and their role in preserving green space around the periphery of expanding California cities, all render them an essential component of California agriculture and a key target of our outreach.

The goal was to hold 40 workshops for 1,000 attendees. The results were 40 workshops for 1,008 attendees. The workshops consisted of: workshops organized by partners in which CAFF participated, and also workshops organized and carried out by a subcontractor as part of this project.

The goal was to assist 100 specialty crop growers directly with on-farm food safety plans. The results were: 1) ninety-seven specialty crop growers directly assisted with food safety plans; 2) sent materials to another seven specialty crop growers; and 3) answered questions from 388 additional specialty crop growers.

Baseline data showed significant need for these services and resources. CAFF met or exceeded all goals for outcome measures and farmers served.

Beneficiaries

The more than 1,000 specialty crop growers included people growing all kinds of specialty crops: tree nuts and fruits, strawberries, bush berries, melons, vegetables, and herbs. Some diversified direct market farms in California grow as many as 100 different crops and project staff assisted a number of them. The growers were also highly diverse in terms of size and ethnicity. Project staff assisted a farm that sold $13,000 of herbs per year at a farmers market, and highly diversified organic farms that sold more than $5 million of produce. Specialty crop growers, were white, Latino, Filipino, Sikh, Hmong, Mien, Native American, and Chinese.

CAFF held 40 food safety workshops for 1,008 specialty crop growers.

The project team directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

In addition, an unknown number of other specialty crop growers accessed the material on the website.

Lessons Learned

One lesson learned is the need to schedule trips in clusters. California is a big place and it becomes too costly to drive all over to meet with one farmer. Both workshops and field visits should be grouped to the extent possible.

A lot of the work can be done by phone. Webinars and e-mail are also useful, although sometimes there is no substitute for walking around someone's farm with them and pointing out the issues that a food safety auditor would take note of. Project staff's willingness to meet with farmers, if they wanted this, distinguished the program from other programs that did not offer to visit them.

CAFF found that workshops are best held at a farm that has implemented food safety practices. Several hours of lecture and discussion followed by a farm tour is the most effective learning experience.

Food safety practices can't all be implemented at once. It is a process and it takes time to create habits. A farmer's food safety plan needs to start with a risk analysis. What are the biggest risks on that farm? These are the priorities for implementing food safety.

One obstacle to operating a program on food safety for small, minority, or socially disadvantaged farmers is that once a food safety specialist is trained and experienced, he/she is an attractive hire for the private sector.

Workshops for farmers are a seasonal activity, best done in the winter. One problem confronted was that so many different organizations are presenting workshops on various topics in the winter that there is competition for the limited time of the farmers and workshop fatigue. This is one reason that training farmers in food safety is going to take quite a few years.

No unexpected outcomes have been noted that effected the implementation of this project, or hampered its goals.

The goals and outcome measures were achieved or exceeded.

Additional Information

All material generated by the project is available on the CAFF website: www.caff.org

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 21	**Project Title:** Invasive Species Education	
Grant Recipient: California Foundation for Agriculture in the Classroom	**Grant Agreement No.:** SCB13021	**Date Submitted:** December 2016
Recipient Contact: Judy Culbertson	**Telephone:** (916) 561-5625	**Email:** judy@learnaboutag.org

Project Summary

California produces half the nation's fruits, nuts, and vegetables. Unfortunately, the same agricultural abundance people enjoy is equally attractive to invasive species. The damage caused by invasive species can devastate specialty crops, eliminate jobs, threaten California's food supply, and cost billions. California experiences quarantines to control and eradicate invasive species. The invasive species project educated California teachers and students about invasive species and methods for control and prevention.

The invasive species fact sheets provided teachers with the agricultural content needed for student understanding, and provided teachers with the kind of lessons they need to meet education standards and busy schedules in quick, 30-minute lessons using hands-on, real-life applications.

The goal of this project is to prevent pests and diseases through education, minimizing economic and environmental harm to specialty crop growers. California Foundation for Agriculture in the Classroom (CFAITC) created and distributed six new fact sheets, focusing on species that pose the greatest threat to specialty crops including; Asian citrus psyllid, Mediterranean fruit fly, oriental fruit fly, false codling moth, varroa mite, and European grapevine moth. The set was disseminated throughout California. As students learn about the harm caused by invasive species, they will appreciate the need for preventing the introduction and establishment of invasive species and will understand the basic precautions they can take to support prevention and eradication measures. This understanding will lead to increased productivity, benefits to California's economy and the environment, and an increased appreciation for the healthy, nutritious and useful products provided by specialty crop producers.

The project was important and timely in terms of the need to ensure that future generations possess a basic understanding of invasive species and in terms of recent changes in educational standards adopted by the California Department of Education. With the recent adoption of Common Core State Standards, which address English Language Arts and Math, California's National Science Standards have undergone a major renovation and the Next Generation Science Standards were adopted as well in 2013. This creates a perfect synthesis for providing teachers with standards-aligned resources focused on invasive species.

On a recent survey of teachers using Agriculture in the Classroom materials,

- 80% said they were likely or very likely to use CFAITC's Agricultural Fact and Activity Sheets (344 responses)
- 90% said they were likely or very likely to use short, 30-minute activity plans (396 responses)
- 93% said that the use of hands-on and real-life applications were very important or extremely important when selecting curriculum (396 responses)

This project builds upon previously funded Specialty Crop Block Grant Program (SCBGP) projects, but has not been submitted to or funded by another Federal or State grant program. This project differs from the 2010 SCBGP Project 20: *What's Growin' On*? and the 2012 SCBGP Project 28: *Tasting California Specialty Crops in the Classroom*. This project added to CFAITC's growing cadre of specialty crop resources available to teachers. 2010 SCBGP Project 20 was a 16-page student activity newspaper that was distributed to more than two million readers during the project period with distribution continuing as part of CFAITC's ongoing availability of resources. It remains available for download from CFAITC's website and has become part of a packet of specialty crop resources that CFAITC provides to the 500 teachers participating in the taste test project. The Invasive Species Fact Sheets will be added to this core group of resources focused on California specialty crops providing a well-rounded, comprehensive set of specialty crop resources at all grade levels.

Project Approach

CFAITC worked with agency professionals and experts to identify six invasive species to feature in the fact sheet set. Content was developed including background information, descriptions of the pest, habitat, how invasive species spread, why they are a problem, effect on California specialty crops, and how people can help. The back side of the fact sheets include lesson plan ideas, fun facts, an informational graphic, and a main lesson plan. These pieces were developed during the writing team meeting which included teachers from urban and rural schools that teach in grades five through twelve. Graphic designs for each of the selected invasive pests, designs for the informational graphics, and the front cover design of the booklet were developed.

During the expert review of the fact sheets, it was determined that two of the invasive species identified did not relate to specialty crops. Newcastle disease and yellow starthistle were replaced with the false codling moth and oriental fruit fly. Edits were made to the fact sheets and replacement graphics were created. Evaluation of the original four fact sheets took place during the first year of the project. An evaluation consultant was hired, questions were developed, and surveys and fact sheets were distributed to 19 educators. Feedback from teachers was positive and no changes were made to the fact sheets.

During the second year of the project, the final two fact sheets (False codling moth, Oriental fruit fly) were added to the initial four fact sheets (Asian citrus psyllid, European grapevine moth, Mediterranean fruit fly, Varroa mite) and the set was aligned to current California Education Standards for grades 6-12, including Common Core English Language Arts, Common Core Math, and Next Generation Science Standards. The two replacement fact sheets were sent to 15 educators reaching a total of 296 students. Feedback was positive and no additional changes were made to the fact sheets.

The fact sheets were put together into a multi-page booklet titled "Stop the Invasion." The booklet was printed and distributed at CFAITS's exhibit at the 2015 California Science Teacher Association (CSTA) Conference held in Sacramento, California. There were approximately 1,800 that attended the conference for science educators in grades K-12. A workshop was also presented titled, "STOP the Invasion! Learn about Invasive Species that Threaten California's Food and Ecosystems." Workshop participants (approximately 50) consisted of classroom science educators in grades 4-12, learned about invasive species during the program and did hands-on activities from two of the fact sheet lessons, the Sugar Shake Simulation from the Varroa mite fact sheet and Fly Fragrances from the Mediterranean fruit fly fact sheet.

The fact sheets were also featured and distributed at the 2015 CFAITC conference held in Long Beach, California, with 130 educators in attendance. The project team shared and provided copies of the resource during University Student Teacher Program presentations to CSU Monterey Bay, CSU Stanislaus, and UC Davis as well as during workshops at the San Mateo County Science, Technology, Engineering and Math (STEM) conference, Soil Born Farms Garden Symposium, and the San Diego County after school STEM conference. In addition, the project team shared the resource at the World Ag Expo in Tulare, California, both at CFAITC's exhibit and California Department of Food & Agriculture (CDFA) exhibit. The resources were shared at CDFA's booth at Capitol Ag Day and at Yolo County Farm Connection Day to more than 3,000 school children, teachers, and volunteers. The fact sheet resource was distributed to members and partners of the California Environmental Education Interagency Network (CEEIN) at the January 2016 meeting. In April, California Geographic Alliance organized a Bio Blitz which project staff participated in with a table to share the Invasive Species fact sheets with teachers and students. Project staff had a spin wheel as well as a student activity to create "Stop the Invasion" headbands. In June, CFAITC presented a workshop at the California Agriculture Teachers Association (CATA) conference featuring the resource and using the lesson plans. Teachers participated in the Sugar Shake Simulation, Fly Fragrances, and created a Public Service Announcement about Invasive Species. Also in June, the project team shared the resource with nearly 500 teachers and Ag in the Classroom staff from around the country at the National Agriculture in the Classroom conference in Arizona. CFAITC also shared the resource at El Dorado County Farm Day, San Joaquin County Ag Day, and Merced County Farm Bureau.

Postcards to promote the fact sheet set were printed and mailed to teachers in February 2016. The "Stop the Invasion" booklet, "The Invaders!" activity page (adapted from page 12 of What's Growin' On? edition 12, the invasive species page), and an introductory letter was mailed to every school principal in California in February as well, stressing the importance of teaching about Invasive Species. The "Stop the Invasion" booklets, "The Invaders" page, and letter were also sent to 52 state Ag in the Classroom programs, 53 county Farm Bureaus, and 55 Ag Commissioners in California.

The fact sheet set was put on CFAITC's website in October 2015. There is an average of 3,500 website viewers per month. Educators are able to download or order packets for their classrooms and during this time there were 580 downloads and 600 hard copies ordered. The monthly electronic Cream of the Crop newsletter promoted the new fact sheet set in March 2016 and the fact sheets have been promoted throughout CFAITC'S social media from October 2015 through July 2016. The posts have reached and engaged audiences on Twitter, Facebook and Instagram, boosting awareness of the resources and sparking conversations. Although all engagement has been positive, the posts have received limited success in driving traffic to the website. CFAITC has studied the two tweets that have been a success in driving traffic to the website and is striving to use similar strategies when crafting future social media posts.

Through collaboration with the Art Institute in Sacramento, an art class created six designs of Invasive Species costumes. The draft drawings were sent to a costume designer and six costumes were created. A mask designer created six masks to coordinate with the costumes also. The costumes and masks will be used at conferences and other education outreach events to draw attention to invasive species and provide the free resource to educators. Invasive species face masks were also printed for teachers to use in their classrooms. After teaching the lessons from the fact sheets, students will take their masks home and share with their families about invasive species and how they can prevent the spread.

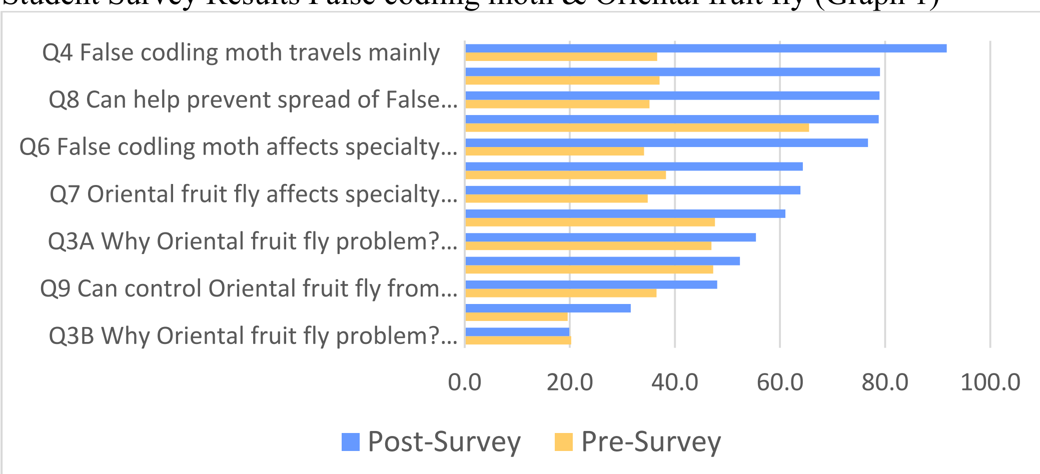
CFAITC worked with invasive species experts from Bayer CropScience, CDFA, and California Farm Bureau Federation (CFBF) throughout the development of the Invasive Species Fact Sheets to review technical information for accuracy.

Goals and Outcomes Achieved

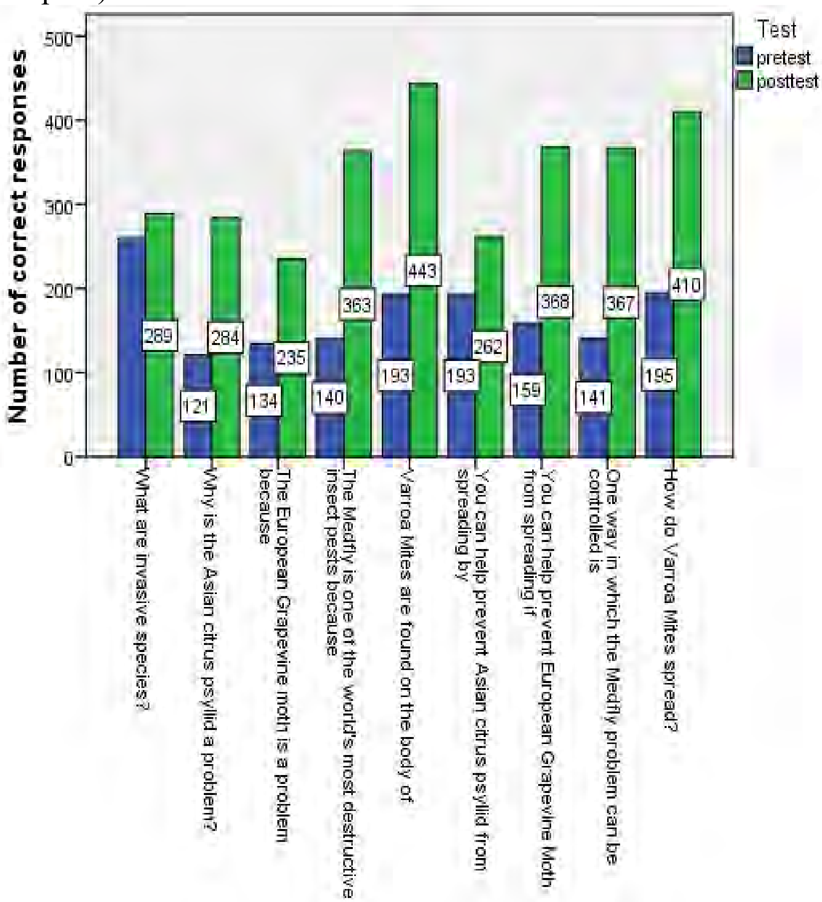
In order to achieve the performance goals identified in the project, CFAITC developed six invasive species fact sheets that affect specialty crops. Fact sheets were illustrated and matched to current California Education Standards. Fact sheet sets were tested in classrooms with teachers conducting pre and post tests to measure any increase in student understanding. Fact sheet set activities were taught at various workshops, the booklets were featured at conferences and sent to all principals in California as well as Ag commissioners, county Farm Bureaus and state Ag in the Classroom programs.

The following graphs show an overall increase in student understanding. Graph 1 shows the false codling moth and oriental fruit fly results. Graph 2 shows the initial four invasive species.

Student Survey Results False codling moth & Oriental fruit fly (Graph 1)



Student Survey Results for Asian citrus psyllid, varroa mite, European grapevine moth, and Medfly (Graph 2)



Each year CFAIC's resources reach approximately 750,000 students and educators. The outreach to teachers and educators through presentations at conferences and university student teaching programs (reaching 390 future teachers), exhibits, mailings to all schools, Ag commissioners, Ag in the classroom programs, and county farm bureaus, as well as promotion on the website and social media has the potential of reaching an even broader audience.

The goals included distribution to all California schools and providing a workshop at the CATA conference. The accomplishments far surpassed the goals. Not only did project staff mail the resource to 14,200 school principals, the resource was also mailed to 53 county Farm Bureaus, 55 Ag Commissioners, and 52 state Ag in the Classroom programs. Six costumes and masks were created, have featured the resource on social media, and shared the resources and activities at a Bio Blitz (a learning activity) in Sacramento.

In the final two fact sheets evaluation, baseline data from the preliminary student and teacher surveys, showed that 72% of the teachers answered questions correctly and 50% of the students answered questions correctly. Teachers from grades 4-12 taught the material to 296 students. Teachers were required to conduct the pre-surveys with their classes. Then teachers were directed to teach all areas of the fact sheets and the lesson plan from the fact sheets. After completing the instruction, teachers were to conduct the post-surveys with their classes, as well as take the post-survey themselves. All surveys were administered through Survey Monkey.

Post survey results indicated teachers answered the questions correctly 84 % of the time and students answered the questions correctly 79% of the time.

Overall, students and teachers showed an increase in knowledge after instruction with the fact sheet sets as indicated in the evaluation- teachers showing 84% understanding and students showing 79% understanding. Success has also been shown with 350 downloads and 568 page views, as well as 600 hard copy orders. 14,200 “Stop the Invasion” booklets were mailed to school principals throughout California, 18 conferences, workshops, and events were attended and the resource shared, and 16,000 people reached through the monthly e-newsletter. This resource was recently shared at the State Fair in the Insect Pavilion as an example of ongoing successful outreach.

Beneficiaries

Specialty crop farmers as well as the Ag industry benefitted through the project by reaching out to farm bureaus, Ag commissioners and Ag in the classroom programs. For example, Mariposa county Farm Bureau had a workshop and provided the invasive species fact sheets; their response was that “people loved them.”

76,400 farmers and ranchers in California benefitted from the project’s accomplishments, as well as all California school teachers (nearly 300,000) and more than six-million students and their families.

Lessons Learned

The initial project lead took another position and the new lead came in during the final year and had to learn the project, complete the final two evaluations of the replacement fact sheets, and complete a final report. Finding that two of the fact sheets did not relate to specialty crops was another important lesson learned. Expert review is an essential part of any project.

Unexpected outcomes or results that were an effect of the project would include the enormous support of educators and industry. At education events, teachers are excited and encouraged to receive free resources. Conducting the lesson plans and activities with teachers always prompts questions and ideas in terms of what they didn’t realize and how they can use the resource in their classrooms. In surveys, teacher responses are always enthusiastic to share the resource with their students and other educators. Industry is supportive in terms of assisting with review of the resources as well as sharing the resources and offering suggestions of additional outreach opportunities.

The goal of 65% increase in knowledge of Invasive Species was based on the premise that teachers and students would know less than 35% about the invaders. As seen from preliminary data, teachers had some knowledge, as well as students. This only allowed for an increase in knowledge of 12% and 29% respectively. Ultimately, the goal was successful with teachers and students having approximately 80% understanding of invasive species.

Additional Information

- Please see Attachments 1-3
- Stop the Invasion Fact Sheet Set at http://learnaboutag.org/resources/fact_invasion.cfm

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 22	**Project Title:** Establishing and Scaling Up Safe and Profitable Cottage Food Operations by California Specialty Crop Growers	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13022	**Date Submitted:** December 2016
Recipient Contact: Shermain Hardesty	**Telephone:** (530) 752-0467	**Email:** shermain@primal.ucdavis.edu

Project Summary

The new California Cottage Food Act that became effective on January 1, 2013 allows processing in home kitchens of certain low-risk food products that do not require refrigeration, and selling up to $35,000 of such products during 2013 (and increased to $50,000 in 2015) under a limited set of marketing conditions. The Act has been praised for empowering people who are unable to start a food business because they cannot afford to establish their own or rent time in a commercial kitchen. However, access to a kitchen is only one step. Specialty crop producers often lack food safety, food processing, business and marketing skills needed to establish successful cottage food operations. The training by the California Department of Public Health (CDPH) for registered cottage food operators (CFOs) that was required in the Act failed to materialize due to lack of funding. Instead, CDPH is referring new CFOs registrants to online Food Handler courses, which do not teach individuals how to safely process foods such that they can be preserved for future consumption.

Maximizing the potential viability of a CFO requires food processing expertise and sound food safety practices, as well as marketing and business planning skills. This project provided such training to specialty crop producers and others who aspired to become CFOs or Specialty Food Producers (SFPs). During the first project year, the workshops covered food safety and food processing, while also providing information about the Cottage Food Act's specific restrictions and requirements and related zoning and environmental health regulations. Workshops during the second year provided information about regulations, marketing and business planning, so that CFOs and SFPs can maximize their viability, and potentially expand their businesses by having their own registered food processing facilities or obtaining services from co-packing firms. This project's primary objective was to provide specialty crop producers with the knowledge needed to process part of their production into cottage foods both safely and legally, and to market these products effectively. This project also expanded demand for California's specialty crops by educating individuals who are not farmers but who took the classes and purchased California-grown specialty crops to produce cottage foods or specialty foods.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

Workshops #1 and #2: The Project Director (PD) and collaborators developed curriculum, presentations and binders to provide education for specialty crop producers and others in the requirements and operations of California Cottage Food Operations. The curriculum was approved by the University of California Cooperative Extension (UCCE) Food Safety Specialist collaborator. At least one CFO made a presentation at each workshop. The 207-page binders were divided with tabs into the following categories, with the number of pages in each category indicated in parentheses:

- Introduction (2)
- Cottage Food Law (31)
- Food Safety (32)
- Canning Basics (18)
- Fruit Butters, Jams, Jellies & Preserves (64)
- Honey & Tree Nuts (8)
- Dried Fruits, Vegetables & Herbs (22)
- Vinegar & Baked Goods (14)
- Managing a Cottage Food Business (16)

The Project Team promoted and held 2-workshop (workshops #1 and #2) series at six different locations in northern California between May 1, 2014 and July 9, 2014; most attendees were present at both workshops. 211 participants attended these workshops, not including the presenters. 100 (47%) of them were specialty crop producers. Twelve of them were already registered/permitted CFOs. In 2015, the PD and UCCE collaborators organized, promoted and held two additional Cottage Food workshops in two Southern California locations, using the already-prepared curriculum. There were 105 attendees at these Southern California workshops.

Website: The PD, Project Coordinator (PC) and UCCE collaborators developed and published a website containing all the prepared materials and links to other resources of use to potential CFOs in California. The website is http://ucanr.edu/sites/cottagefoods/. Much of the information from the workshop binder is included on this website.

Workshops #3: The PD organized five sessions of workshop #3 (Starting a Specialty Food Business) at different Northern California locations in 2015, and one session of the workshop in 2016. The PC and collaborators helped promote the workshops and the PC assisted with logistics. Participants in workshops #1 and #2, other specialty crop producers, urban farmers and others were invited to participate in workshop #3. A total of 176 participants (not including speakers) attended one of the 6 sessions of workshop #3. Topics covered in workshop #3 included: Food Safety & Regulations, Marketing Specialty Foods, Getting Product on the Shelf, Processing & Packaging Options, Pricing for Profit, and Business Financing Options. Evaluations showed significant increases in knowledge levels for all topics. The Workshop #3 materials are posted on the UC Small Farm Program website at http://sfp.ucdavis.edu/marketing/Specialty_Foods/

Case Studies: The PD and the PC interviewed two specialty crop growers who are also SFPs to learn the details of their business planning, business development, production process, regulatory compliance process, expenses, income and future plans. The PD and PC then wrote up their responses as two case studies, sent each to the grower for verification, and completed final versions for publication. The case studies are posted on the UC Small Farm Program website specialty food section (http://sfp.ucdavis.edu/marketing/Specialty_Foods/), and were shared with participants at the 2 workshops #4

Workshops #4: The PD developed curriculum, selected locations and arranged facilities for two sessions of workshop #4 (Developing a Business Plan for your Specialty Food). The PC promoted these workshops to participants of the earlier workshops in this project, and to registered CFOs in the regions where the workshops were to be held. The PD conducted workshop #4 in Davis and in Oakland. A total of 29 participants, not including speakers, attended one of workshop #4. The Davis Workshop #4 materials are posted on the UC Small Farm Program website at http://sfp.ucdavis.edu/marketing/Specialty_Foods/. Both farmers who were profiled in the case studies attended each session of Workshop #4 and gave presentations about their business planning and development. Their presentations were very well received by the participants, many of whom said in workshop evaluations that the case studies and personal presentations were the most valuable parts of the workshops.

Final Project Outcomes report: The PD and PC contacted all participants who had attended at least one Cottage Food or Specialty Food workshop, had provided an email address and had not unsubscribed from the project email list. Each was invited to complete a form asking if and when they had become registered CFOs or permitted SFPs, whether they planned to become either, and also asked for processing and sales data from those who had become CFOs or SFPs. The invitation was sent to 491 people. Seventy-five unique complete responses were received, for a response rate of 15.3 percent. The responses are summarized in an answer to a later question below.

For all workshops and educational materials, the PD ensured that all of the workshop curricula were designed to cover only specialty food products or cottage food products with specialty crops comprising at least 50% of the total weight of all of the ingredients. The CFOs and Specialty Foods business owners who spoke at all workshops produced only jams, jellies, candied fruit and nuts, cured olives, pickles, relishes, salsas, honey, olive oil, and tomato-based sauces.

The PD and UCCE project team members drafted the curriculum materials for Workshops#1 and #2 and finalized them after the Food Safety Specialist Project Collaborator approved them. UCCE collaborators worked with the PD and PC to organize, promote, conduct and evaluate results from the Cottage Food workshops in eight different California locations. One UCCE project collaborator developed the online Registration Form for the workshops. This effort was not included in the work plan, but it required major effort.

The PD and PC had the primary responsibility for organizing and conducting the six Specialty Food workshops (Workshop #3). A UCCE Food Safety Specialist made a Keep It Safe and Legal presentation at all six Specialty Food workshops. The PC had primary responsibility for creating the existing UCCE Cottage Foods website, http://ucanr.edu/sites/cottagefoods/. An independent contractor made two presentations, Getting Your Product on the Shelf and Pricing for Profit at all six Specialty Food workshops; he provided information that is essential to ensuring the financial viability of specialty food businesses that utilize specialty crops. Additionally, project partners included 10 specialty food business owners who process specialty crops into specialty foods; they made presentations at the six Workshop #3 that were very well received by workshop attendees.

The PD and PC had the primary responsibility for organizing and conducting the two Specialty Food Business Planning workshops (Workshop #4). This included finalizing the contractual agreements to conduct interviews with the two specialty crop growers who are also SFPs, interviewing them, and writing the case studies about the development of their specialty food businesses. The PD then worked with the two specialty crop/SFPs to ensure that their presentations were comprehensive and accurate.

The PD developed the curriculum outline for the rest of the workshop. They also developed and presented materials regarding the following topics: Importance of Business Planning and Business Plan

Formats, Assessing Your Specialty Food Business Readiness, and Let's Get Started on Your Business Plan.

The PC had primary responsibility for updating the existing UCCE Cottage Foods website, http://ucanr.edu/sites/cottagefoods/, and adding the Specialty Food Business presentations to the UC Small Farm Program website, http://sfp.ucdavis.edu. An independent contractor made two presentations, Getting Your Product on the Shelf and Pricing for Profit at this workshop; he provided information that is essential to ensuring the financial viability of specialty food businesses that utilize specialty crops.

The PD and PC conducted the request for information from all project workshop participants. The PC compiled the results of the responses and drafted a project follow-up report.

Goals and Outcomes Achieved

Outcomes Measurement Process

An invitation to participate in outcomes measurement with a link to a follow-up form was sent three times by email in May 2016 to all of the 491 people who participated in at least one of the Cottage Food or Specialty Food workshops offered through this project. Seventy-five unique complete responses were received, for a response rate of 15.3 percent.

Summary of responses

- Specialty Crop Producers: 29.3 percent of respondents (22) identified themselves as Specialty Crop Producers. Extrapolating this percentage to the full number of workshop participants results in an expectation of 144 Specialty Crop Producer participants in the project
- Cottage Food Operations: 17.4 percent of respondents (13) had registered as Cottage Food Operations, either Class A or Class B. Extrapolating this percentage to the full number of workshop participants results in an expectation of 85 Cottage Food Operations among project participants.
- Specialty Foods Producers: 8 percent of respondents (6) had received permits to operate as SFPs. Extrapolating this percentage to the full number of workshop participants results in an expectation of 39 Permitted SFPs among project participants.
- Total Sales Revenue: 17 respondents (17 of the 19 respondents who identified themselves as either CFOs or SFPs) reported annual gross sales revenue totaling $148,788, or an average of $8,750 gross annual sales per respondent who reported sales. When this average gross sales revenue figure is multiplied by the expected number of workshop participants who are either CFOs or SFPs (124), the expected total annual gross sales revenue is $1,085,000
- Value of Specialty Crops processed: 16 respondents (16 of the 19 respondents who identified themselves as either CFOs or SFPs) reported a retail value of specialty crops processed as ingredients totaling $106,036, or an average of $6,627 value retail value of specialty crop ingredients processed per respondent who reported this value. When this average specialty crop ingredient value is multiplied by the expected number of workshop participants who are either CFOs or SFPs (124), the expected total retail value of specialty crops processed as ingredients is $821,748.

- Website visits since creation of website: 6,845 (3,806 during the past 12 months)
- Sales venues for Cottage Foods Operations and SFPs: The 19 respondents who are CFOs or SFPs reported selling their products at these venues:
  - 63 percent (12) sell at farmers' markets or fairs
  - 32 percent (6) sell at their own farm stand
  - 26 percent (5) sell at grocery stores
  - 47 percent (9) sell at specialty stores
  - 10 percent (2) sell through distributors or brokers (= 33.3 percent of the 6 SFPs)
  - 37 percent (7) sell online
- Types of products produced: The 19 respondents who are CFOs or SFPs reported producing these types of products:
  - 32 percent (6) produced fruit butters, jams, jellies or preserves
  - 5 percent (1) produced tree nuts or nut butters
  - 16 percent (3) produced dried fruits, vegetables or herbs
  - 32 percent (6) produced baked goods
  - 26 percent (5) produced oils or vinegars
  - 5 percent (1) produced pickles, relishes or fermented vegetables
  - 10 percent (2) produced candy or confections
  - 5 percent (1) produced sauces
  - 5 percent (1) produced fruit or vegetable juices or smoothies
  - 16 percent (3) produced granola or grain products
  - 16 percent (3) produced other products

Future plans: The 18 respondents who are currently CFOs or SFPs reported the following plans for their businesses over the next five years:

- 72 percent (13) plan to expand or diversify their product line
- 44 percent (8) plan to hire more employees
- 39 percent (7) plan to invest in buildings or equipment
- 18 percent (3) plan to maintain the current level of operations
- 6 percent (1) plan to scale back or reduce production
- none plan to close the Cottage Food or Specialty Food operation

Future Plans to become CFOS: Of the 56 respondents who were not currently CFOs, 37.5 percent (21) plan to become registered CFOs within the next 12 months. Extrapolating this percentage to the full number of workshop participants who are not currently CFOs (406) results in an expectation of 152 project participants who intend to become registered CFOs within the next 12 months.

Future Plans to become permitted SFPs: Of the 69 respondents who were not currently permitted SFPs (including the 13 CFOs), 30.4 percent (21) plan to become permitted SFPs within the next 12 months. Extrapolating this percentage to the full number of workshop participants who are not currently SFPs

(452) results in an expectation of 137 project participants who intend to become permitted SFPs within the next 12 months.

Utilizing the previously reported average annual revenues and annual specialty crops processed, these 289 future CFOs and SFPs would generate $2,728,750 in total annual sales revenues of processed food products and would utilize an additional $1,915,203 worth of specialty crops to produce their processed food products.

Goals accomplished:

- Number of specialty crop producers attending workshops – the expected number of specialty crop producers was 150. The actual estimated number, extrapolated from the follow-up questionnaire responses, was 144. There were at least 491 people who attended at least one project workshop; many of them are currently or plan to become CFOs or SFPs using specialty crops as their primary ingredients.
- Number of workshop participants who became CFOs – the expected number was 90. The actual estimated number, extrapolated from the follow-up questionnaire responses, was 85.
- Retail value of specialty crops processed – the expected value was $450,000. The actual estimated value, extrapolated from the follow-up questionnaire responses, was $821,748, plus the additional $1.9 million used by workshops who plan to become CFOs or SFPs.
- Total cottage food sales – the expected total cottage food sales was $1,200,000. The actual estimated gross sales of both cottage foods and specialty food by project participants, extrapolated from the follow-up questionnaire responses, was $1,085,000, plus the additional $2.7 million in revenues estimated to be generated by attendees planning to become CFOs or SFPs.
- Changes in levels of knowledge – The expected increase in knowledge level for relevant topics at each workshop was an average of at least 20 percent. This goal was exceeded in all cases, as demonstrated by the following summary of workshop participants' self-assessment:

Evaluations for UCCE Cottage Food Workshops Held May 1-July 9, 2014
Average Ratings or Percentages

Average Ratings, 1-5 scale	All locations (n=78)
Workshop #1 meet expectations	4.3
Workshop #2 meet expectations	4.5
Understanding of Law before workshop	2.1
Understanding of Law after workshop	4.5
Manual Easy to Use (% Yes)	95
Used Manual (% Yes)	88
Contacted Local Environmental Health Office (% Yes)	25
Since Workshops, likelihood of becoming a CFO (%)	
Equally likely	42
More likely	33
Less likely	25

Instead of asking the participants to assess their current level of understanding of a variety of knowledge areas related to cottage foods on a 5-point scale both before and after the workshop, the Project Director measured changes in knowledge attributable to the workshops were measured using TurningPoint software. At the beginning and end of each workshop, a series of 10 questions related to key cottage foods concepts were displayed. Attendees were asked to use their clickers to indicate the correct multiple-choice answer. The average percentage of attendees with correct answers increased from 48% before the workshop to 87% after the workshop--representing an 81% gain in knowledge.

Knowledge gained from Specialty Foods Workshops (3 workshops#3)
At the three Workshop #3 sessions conducted in Spring 2015, changes in the attendees' knowledge levels were measured through Pre- & Post evaluations. On a scale from 1 (little or no knowledge) to 5 (extremely knowledgeable), the pre- and post-knowledge levels increased by the following average amounts:

	Pre-workshop	Post-workshop	% Increase
Food Safety & Regulations	2.52	4.10	59
Marketing Specialty Foods	2.13	4.03	89
Getting Product on the Shelf	1.88	3.95	115
Processing & Packaging Options	1.95	4.90	100
Pricing for Profit	1.92	4.12	115
Business Financing Options	1.55	3.82	150

There were significant increases in knowledge levels; the goal of a 20% increase was clearly exceeded for every knowledge area. The overall quality rating for the workshops averaged 3.67 (with 4 being excellent).

Knowledge gained from Specialty Food Business Planning Workshops (two workshops #4)
At the two Workshop #4 sessions, changes in the attendees' knowledge levels were measured through Pre- & Post evaluations. On a scale from 1 (little or no knowledge) to 5 (extremely knowledgeable), the pre- and post-knowledge levels increased by the following average amounts:

	Pre-workshop	Post-workshop	% Increase
The importance of Business Planning	3.4	4.7	39
Business Plan Formats	2.2	4.1	88
Preparing a Projected Income Statement	2.3	4.1	75
SBDC Resources	1.7	4.0	144
Case Studies of Sp. Food businesses	1.8	4.6	156
How to start a business plan	2.3	4.3	85

The table on the next page summarizes the data reported on the previous pages. The 7-fold increase in the number of CFOs from the baseline to the end of the project is remarkable. If all 152 who plan to become CFOs actually do so, the overall project impact would be a 20-fold increase in the number of CFOs. The projected 3.5-fold increase in SFPs is also impressive. Similarly, the projected 2.3-fold increase from the end of the project in the values of specialty crops used by these producers also reflects the payoff of educating the attendees about cottage food and specialty food production, marketing and business management.

	Baseline	End of Project	Planning to become Cottage Food or Specialty Food producer in next 12 months
Cottage Food Operator	12	85	152
Spec Food Producer	unknown	39	137
Annual Gross Sales	unknown	$1,085,000	$2.7 million
Annual value of specialty crops used to produce foods	unknown	$821,748	$1.9 million

Beneficiaries

- Small and mid-scale specialty crop producers, particularly growers of fruits and tree nuts, benefited from the project by gaining the knowledge and contacts needed to develop successful Cottage Food Operations or Specialty Food Production businesses. As CFOs or SFPs, they were able to add value to raw crops produced on their farms which increased revenue. Those specialty crop producers who participated in workshops but did not become food processors benefited by improved knowledge about food safety, marketing and business planning. They also benefited from the knowledge gained by attendees who were not farmers but who then became or planned to become CFOs or SFPs and process specialty crops.
- The employees of the Cottage Food and Specialty Food Operations developed through this project benefited through increased or continued employment revenue.
- Farmers' markets, grocery stores and specialty stores benefited from this project by having additional locally produced specialty crop-based products to offer to their customers.
- Consumers who purchased cottage foods or specialty foods produced by project participants benefited by having access to a greater variety of locally processed foods.
- Communities benefited because money spent on locally produced foods is likely to flow back into the communities of the producers.
- An estimated total of 144 specialty crop producers benefited by participating in at least one of the project workshops.
- An estimated total of 85 registered CFOs (including those already registered before the workshops and those newly registered after the workshops) benefited by participating in at least one of the project workshops.
- An estimated total of 39 permitted SFPs (including those already permitted before the workshops and those newly permitted after the workshops) benefited by participating in at least one of the project workshops.
- Registered CFOs and permitted SFPs who participated in the project generated an estimated total of $1,085,000 in annual sales revenue. Since the post-workshop gains in knowledge regarding marketing and various other business management areas were significant, we expect that their annual sales revenues will increase in the future.
- Registered CFOs and permitted SFPs who participated in the project processed specialty crops with an estimated retail value of $821,748 as ingredients in their processed products. The gains in sales states above should also generate increases in the value of specialty crops purchased to produce the Cottage Foods and Specialty Foods.

- Additionally, the potential economic impact of these producers is expected to increase, as 72 percent of them plan to expand or diversify their operations within the next five years.
- The potential economic impact of the estimated 152 project participants who intend to become registered CFOs and the estimated 137 who intend to become permitted SFPs within the next 12 months generates an additional $2.7 million in annual sales revenue and $1.9 million in retail value of specialty crops to be processed as ingredients.
- Data were not collected regarding the number of specialty crop suppliers each Cottage Food or Specialty Food producer was using; therefore, the total number of specialty crop producers who benefit as ingredient suppliers is unknown. However, it is reasonable to expect at least one specialty crop supplier for each Cottage Food and Specialty Food producer. This means that there were at least 124 specialty crops suppliers for these processed food producers by the end of the project, and potentially 289 additional specialty crop supplier within the next 12 months.

Lessons Learned

Cottage Food Operation product restrictions seem to prevent many specialty crop producers from becoming registered CFOs. The goal of 90 CFO workshop participants becoming CFOs soon after the workshops was much too optimistic. Online evaluations submitted by 37% of the attendees indicate why this is the case. While 75% of the attendees reported that they were equally or more likely to become a CFO after attending the workshops, only 25% of them had contacted their local Environmental Health Office about becoming a CFO when questioned several months later. Their comments indicated that the "less likely" group was discouraged by the limited range of products that were approved Cottage Foods, and/or by the processing requirements for specific foods. For example, all jams must be made to be in compliance with the FDA's standard of identity, which requires that jams contain more sugar than fruit on a weight basis. When the attendees made strawberry jam during the workshops with the FDA-compliant recipe, they remarked that the jam was much too sweet.

Although the initial target participants for the project were specialty crop producers who would process their own crops as CFOs, many workshop registrants were not specialty crop producers. Instead they were potential CFOs or SFPs interested in purchasing specialty crops from farmers to use as ingredients in their food production businesses.

Because of the restricted list of products allowed to be produced as cottage foods, project organizers found more interest than expected in the more general category of specialty food production, including much interest from workshop participants in the options of shared kitchens, co-packers and the establishment of their own health department-approved production kitchens.

Additional Information

UCCE Cottage Food website: http://ucanr.edu/sites/cottagefoods/
Specialty food production resources: http://sfp.ucdavis.edu/marketing/Specialty_Foods/
Case studies of farmers who developed specialty food businesses:
Penny and Vince Granberg, Rose Lane Farm, Oakley, CA – (http://sfp.ucdavis.edu/files/239615.pdf)
Courtney Smith, Bloomingcamp Ranch Bake Shop and Farm Stand – (http://sfp.ucdavis.edu/files/239616.pdf)

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 23	Project Title: Food Safety Training for Supervisors and Farm Workers	
Grant Recipient: AgSafe	**Grant Agreement No.:** SCB13023	**Date Submitted:** December 2016
Recipient Contact: Amy Wolfe	**Telephone:** (209) 526-4400	**Email:** jeff@agsafe.org

Project Summary
Beginning in 2012, with the unanimous approval of all state handlers to extend the Handler Marketing Order to include mandatory compliance with science-based food safety practices and verified by the California Department of Food and Agriculture (CDFA) auditors, all growers, handlers, packers and distributors in the cantaloupe industry must adhere to the Cantaloupe Best Practices. Seeing the need of these groups to adhere to these newly expanded standards, AgSafe reached out to the California Cantaloupe Advisory Board (CCAB) to create a food safety program to ensure that everyone in the cantaloupe industry had access to trainings that would ensure the safety of this crop.

With recent food safety outbreaks and increasing scientific knowledge around foodborne illnesses, specialty crops have been under increased scrutiny due to the fact that they are often consumed fresh and with minimal processing. Historically, most of the focus had been on handlers; however, in a study conducted by the Arizona Leafy Greens Consortium, it was revealed through third party audits that the majority of food safety infractions occur in the field. For this reason, it was critical to develop a program to educate farm workers and supervisors on food safety protocols and commodity specific procedures. Additionally, given the fact that supervisors are tasked with training workers, by providing these individuals with the ability to pass on this knowledge and understanding to new employees, a meaningful impact in the safety of cantaloupes could be made and the reduction of foodborne illnesses could be made.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach
In October 2013, project staff began to work with the CCAB to design a four hour cantaloupe specific food safety workshop specific to the guidelines that were developed by the CCAB, a four hour universal food safety workshop and a four hour train-the-trainer workshop. With CCAB guidance, project staff utilized food safety industry experts, and a bilingual, bicultural educator to help develop curriculum that addressed the language, literacy, and cultural challenges of the workers that needed to be trained.

The three modules developed are the following:

- Module 1 - Food Safety: Harvest Protocol for Supervisors and Farmworkers
    - This module provided supervisors and farmworkers with information on universal food safety protocol for hand harvested specialty crops.
- Module 2 - Cantaloupe Food Safety: Harvest Protocol for Supervisors and Farmworkers
    - This module addressed the specific food safety protocol for harvesting cantaloupe using guidelines developed by the CCAB.
- Module 3 - Food Safety Tailgate Training Essentials

- This module was developed to teach supervisors tasked with training their workers how to deliver effective training. Participants were given tools and resources to use in their operation and to develop and enhance their presentation skills with fellow course participants using tailgate-to-go training toolkits. The toolkits consisted of one set of supervisor cards and five sets of worker cards, DVD training instructions, topic outlines and activities. The toolkits are available in both English and Spanish.

In April 2014, project staff began offering Module 1 of the training by following the harvest trail and beginning in the south and working north in four locations in California. In 2015, Modules 2 and 3 were completed, and all three training modules were taught beginning in April 2015 and April 2016. The four locations were:

- Holtville, California
- Huron, California
- Firebaugh, California
- Fresno, California

This project focused only on crops that are consumed fresh, and specifically targeted cantaloupes and what makes them particularly susceptible to foodborne illnesses. Therefore, these trainings only directly benefitted supervisors and farm workers who specifically work with and harvest cantaloupes.

The CCAB, a partner in this project, was instrumental in their assistance with the following:

- Promoted tailgate-to-go toolkits and upcoming trainings to agricultural operations in the cantaloupe industry;
- Provided input on the timing of upcoming trainings;
- Provided information through their voluntary food safety audits to determine if there has been a change in behavior among supervisors and farm workers;
- Reviewed tailgate-to-go training toolkits to ensure accuracy;
- Reviewed updated curriculum based on feedback from course attendees.

Goals and Outcomes Achieved

In order to achieve the performance goals and measurable outcomes of this project, project staff developed a three-part supervisor and farm worker training program, which included a food safety module, a cantaloupe food safety module and a train-the-trainer module, described above. Additionally, tailgate-to-go training toolkits were developed, which were designed to be used by supervisors in training farm workers. Lastly, the curriculum was developed into a webinar to enhance the sustainability of the project.

The overall focus of this project was to positively impact the cantaloupe industry through the implementation of food safety protocols throughout the production and handling of cantaloupes and reduce the potential for foodborne illness outbreaks. To date, project staff have successfully developed and implemented a culturally and linguistically appropriate training program for supervisors and farm workers in the cantaloupe industry. Additionally, a webinar series was created and tailgate-to-go training toolkits developed.

Each module was delivered, resources were given to participants as well as the CCAB, and a webinar was developed and recorded that was provided to CCAB and is also available on the AgSafe website.

Although the target number of supervisors and farm workers was not met due to the unforeseen drought and subsequent reduction in cantaloupe producing acres, through pre- and post-training assessments it was determined that more than 75% of supervisors and workers have reported an increased knowledge in their understanding of food safety procedures.

Through this project, approximately three quarters of the number of workers anticipated were reached, approximately 526 participants. Although the goal was not met, webinars developed are available on the AgSafe website for others to access and tailgate-to-go training toolkits were provided to the CCAB for future use.

Cantaloupes 2016
Progress made:

Number of CDFA Visits

	2013	**2014**	**2015**
Desert	13	25	32
Valley	40	75	59
Total	**53**	**100**	**91**

Number of Infractions

	2013	**2014**	**2015**
Major	4	5	5
Minor	258	207	98
Minor Infractions	94	67	86

Infractions include:

- Sanitary units- Unsanitary- Soiled Toilet paper- Fecal matter
- Crews not using proper hygiene-handwashing- Spitting in the field
- SOP's incomplete and/or not available for review
- SOP's not being enforced in the field
- No SOP's for employee eating areas, food trucks, personal items
- No glove policies
- Grey water leaking and cross contamination
- No foods safety plan
- Worker hygiene and training
- Training and worker hygiene/worker health
- Sanitation and training of cleaning personnel
- Assessments
- Facility maintenance/ water use
- Food safety availability 24/7
- Spitting in the field or growing areas

- Falsification of a record
- Hand wash water testing
- Feces near unharvested field
- No hazard analysis; no plan; no self-audits; no mock traceback

Progress
1. Total deviations dropped from 356 in 2013; to, 279 in 2014; to 189 in 2015
2. Deviations per audit dropped from 5 per audit in 2013 to 2 per audit in 2015

Areas still needing improvement:
- Training- on going
- Submitting CAP's in a timely manner
- Attention to detail

Through this project, approximately 526 individuals were trained. Of those, according to survey results, 50% of the harvesting workforce was through farm labor contractors. Supervisors and farm workers are trained daily by over 50% of respondents with almost 60% of those trained using videos and written materials. It was also determined that employers gave an average rating between 7.46 to 8 on a scale of 10 on their employee's knowledge in the areas of worker health and hygiene, field sanitation, food contact surfaces and proper decontamination.

Tailgate-to-go training toolkits were also developed in 11 different topics, two partnerships were establish which will enable the project to continue beyond the scope of the grant, and three webinars were created, covering hygiene, field sanitation and the Food Safety Modernization Act. The project allowed creation of a template for the tailgate-to-go training toolkits, which can be replicated and used in other specialty crops.

Beneficiaries

This program was designed to benefit all growers, packers, handlers and distributors in the cantaloupe industry. Specifically, the project targeted supervisors, workers and farm workers who are on the front lines and where food safety practices begin. 526 participants were directly reached during the grant term.

The potential economic impact of this grant is huge as the cost to a business resulting from a foodborne illness outbreak can de debilitating. With the Food Safety Modernization Act and Produce Safety Rule, this program has prepared project staff with the tools to deliver high quality food safety training. Additionally, participants in this project will have a leg up when it comes to having to comply with these new regulations.

Lessons Learned

Project staff started this project with the expectation that growers would be trained on food safety procedures; however, when the training courses began, there was a high number of farm labor contractors who, along with their workers, attended the trainings. Project staff have been able to help farm labor contractors become more competitive through the trainings by enabling them to be able to comply with the regulations that their grower customers face.

This project was implemented when California's drought was beginning to become severe. Many growers opted not to plant cantaloupes and instead keep water for higher value permanent crops. Those growers who did plant cantaloupes experienced a much earlier harvest than normal which kept some growers from sending supervisors and workers to the workshops. In Year 2, tailgate-to-go training toolkits were developed to provide supervisors who had taken the trainings in Year 1 the necessary materials to successfully teach proper food safety protocols to workers. The creation of the tailgate-to-go training toolkits were not imagined to be utilized outside of this grant. However, the response received in the second year of this grant was so positive, that project staff decided this model could be replicated in other safety and human resource topics. There really wasn't anything like this available for supervisors to use in the field to train which also met the cultural and linguistic needs of this workforce. Then in Year 3, with California's drought still ongoing and a lot of cantaloupes still not being produced, a webinar was created, which can be used to train supervisors and workers well beyond the scope of this project.

In conclusion, although growers and grower employees did not turn out as hoped, project staff were still able to train three quarters of the anticipated workers through farm labor contractors who focus their businesses in specialty crops.

Although there was no way to predict the changing weather patterns that were heading to California and the subsequent effects, project staff were able to come up with creative solutions to develop curriculum and resources which can be used well into the future.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 24	Project Title: Revitalizing Specialty Crop Agriculture in the Valley of the Heart's Delight: a Model for Linked Urban – Rural Sustainability	
Grant Recipient: Sustainable Agriculture Education	**Grant Agreement No.:** SCB13024	**Date Submitted:** December 2016
Recipient Contact: Sibella Kraus	**Telephone:** (510) 928-2972	**Email:** Sibella@sagecenter.org

Project Summary

Prime urban-edge farmland can help contain and sustain cities, but only if revitalized and protected through strategic collaborative actions by urban and rural stakeholders. Farmland threatened by urbanization and with significant agronomic value - good soils, sufficient water and large parcels - is a vital resource needing urgent protection. Heritage farmland is doubly important, as tradition can nurture and help revive the cultural value of local agriculture and urban-rural connectivity. This is the case with the need and opportunity to revitalize specialty crop (SC) agriculture in the Valley of the Heart's Delight. Renowned a century ago for its fertile soils, diverse crops and fruit production that created a vast vista of springtime blossom, today the valley is mostly known as urbanized Silicon Valley. What remains undeveloped is the Coyote Valley (CV), an area of around 7,400 acres - mostly farmland - located between San Jose and Morgan Hill, California. For decades, CV looked to development for its future. However, the cessation of the CV Specific Plan in 2008 created an opportunity to reconsider a future for CV in which agriculture would be revitalized as a significant regional resource. In late 2012, Sustainable Agriculture Education (SAGE) completed a two-year, multi-stakeholder Feasibility Study, Sustaining Agriculture and Conservation in the Coyote Valley: Findings and Recommendations. Recent local general plan updates and a new Habitat Conservation Plan (HCP) confirm the Valley's resource values. Now SAGE and key stakeholders are poised to implement the Study's recommendations for Start-Up Phase activities that will initiate fulfillment of this long-term vision. The CV is home to a regionally significant agricultural resource area that contains important farmland and key habitat; supports livelihoods for its farmers, ranchers and agricultural employees; provides healthy food and a recreational amenity for Bay Area communities; and protects important ecological and cultural resources of the region.

To enhance marketability of locally grown SCs, project partners educated consumers through marketing campaigns, events and worked with farmers to increase agritourism. To enhance environmental performance, partners provided workshops, technical assistance, demos and outreach to increase SC growers' use of sustainable agriculture practices and establish new habitat enhancements such as hedgerows. To improve financial performance, the project helped growers transition to higher value SCs and increase sales to local market outlets. To expand access to SC, the project catalyzed transition to SCs from land in hay or fallow and facilitated connections between local markets, urban communities and growers. To invest in the next generation of SC operators, partners recruited and supported new beginning, immigrant, transitioning and scaling-up farmers.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

The activities and tasks performed during the entire grant period are as follows:

Goal #1. Increase number of SC operations by recruiting and supporting beginning, immigrant, transitioning and scaling-up farmers.

- Planned activity 1: Identify farmers interested in starting or expanding production of SC in CV.
  Results: Compiled database of all SC growers in the CV; reached out to all eight main SC growers to ascertain interest in expanding production; reached out to three main hay growers to ascertain interest in converting some land to SC (one hay grower was interested, but did not have the capacity to start vegetable production; one hay grower felt threatened by potential for rising lease rates; another hay grower is rotating some hay land with pumpkin crops grown by another farmer). Six new SC operations, four by scaling up farmers and two by beginning farmers.
- Planned activity 2: Identify private and public landowners interested in leasing or selling land for new SC production.
  Results and conclusions: Reached out to all major main landowners and some smaller landowners to ascertain interest in leasing land for SC production. There was limited availability due to long-term relationships with other leases; and unrealistic lease terms (short duration and/or unfeasibility requirements for irrigation system upgrades).
- Planned activity 3: Connect interested farmers with interested landowners.
  Results and conclusions: This was done on a one-on-one basis throughout the project with plots of land ranging from 6 acres to over 100 acres. A match that still holds promise is between IBM, which has 1,000 acres of land in the CV including 100 acres of SC ground, and an experienced, well-resourced local farmer.
- Planned activity 4: Provide technical assistance to support establishment of new farming operations, including inviting new farmers to all workshops.
  Results and conclusions: Conducted a Production 101 workshop for beginning farmers in Morgan Hill, California (next to the CV), which was attended by 21 diverse beginning farmers in the area. There was much enthusiasm about the practical nature of the material, appreciation for the resources provided, and a request to address needs/concerns of very small (~1-acre) farms in the future. Supported the Bay Area Chrysanthemum Growers Association (BACGA), with ~ 100 members (mainly growing Asian greens) with technical assistance for the organization and members, translation services to facilitate utilization of financial assistance, and a detailed action plan for accessing additional needed resources. Developed a feasibility study and business plan for a 10-acre sustainable agriculture demonstration farm in collaboration with the Ag Program of Ann Sobrato High School, which is located in the south-eastern corner of the CV. This plan has been embraced by the school and agriculture partners. The school district is currently looking at funding and staffing in order to implement. Meantime, the agriculture partners are assisting the school with program design.

Goal #2. Increase SC acreage and profitability by transitioning hay or fallow land to SC and/or by growing higher value SC.

- Planned activity 1: Identify local market demand for new SC.
  Results and conclusions: Identified demand for dozens of SC that could be produced in the CV. The demand for land and for CV-grown SCs far exceeds supply.
- Planned activity 2: Identify farmers interested in starting/expanding/upgrading SC production.
  Results and conclusions: Identified over 20 farmers interested in starting SC production, with capacity to start at 2 to 100 acres. All of the 5 main SC producers in the CV, want more land. 580 acres in new

plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (260 acres).

- Planned activity 3: Meet one on one with interested farmers.
  Results and conclusions: Met one on one with interested farmers to communicate market data and share information and resources about production.
- Planned activity 4: Establish research plot for SC (e.g. specialty peppers).
  Results and conclusions: Facilitated a chili pepper SC production trial in partnership with University of California, Cooperative Extension (UCCE) and a 5,000 acre family-owned farming operation located in Gilroy, California. Extensive data was collected on the 68 varieties of chili peppers. Peppers were harvested with data recorded to provide information on specific production.
- Planned activity 5: Conduct two field days for farmers at the research plot.
  Results and conclusions: Information and training were provided to other local farmers and agricultural professionals through two field days at the chili pepper SC production plots, both led by UCCE Small Farm Program Advisor. The August 19 field day targeted master gardeners and local culinary professionals. The August 28 chili pepper production seminar and field day included presentations by six experienced agricultural professionals who presented on topics of SC chili pepper varieties, their production in CV, and chili pepper marketing. Beginning farmers and Santa Clara County growers were targeted for outreach for the event, and the workshop served 25 farmers interested in improving their SC production. AgAlert wrote a feature story about the crop trial.

Goal #3. Enhance natural resource stewardship by adopting new sustainable agriculture practices and establishing habitat enhancement.

- Planned activity 1: Identify farmers interested in utilizing sustainable agriculture practices and/or installing habitat enhancement.
  Results and conclusions: Direct outreach to farmers was not productive, mainly because all row-crops farmers are leasing land. However, outreach at relevant workshops, where the audience already inclined toward sustainable agriculture, was well-received.
- Planned activity 2: Hold a workshop about sustainable agriculture practices for greenhouse farmers.
  Results and conclusions: Organized a two-part weed management demonstration project for greenhouse grown Asian greens at the site of two different growers. The same type of Asian greens were planted in both areas, with one area planted by broadcasting seeds (the traditional method) and the other area planted by seeding in rows with a seeder. Both areas were irrigated and fertilized the same way. The primary purpose of the demo project was to assess and compare these two planting methods for weed management efficiency and also to compare efficacy of two different types of seeders. It was concluded that use of the seeder proved to be more efficient, but growers were reluctant to change long-standing habits; it is essential to select partner growers who really want to learn new practices and who are willing to share findings with other growers.
- Planned activity 3: Hold a workshop for farmers about sustainable agriculture practices for row crops.
  Results and conclusions: This workshop was not held due to insufficient interest from row crop farmers, despite extensive outreach. In lieu of this workshop, a two part weed-management demo was organized instead (see above).
- Planned activity 4: Establish demo hedgerow at Ann Sobrato High School.
  Results and conclusions: Developed and implemented the site plan, plant list, land preparation plan, irrigation plan and planting days plan for a 10,000 sq. ft. hedgerow around the school's 2-acre farm.

- Planned activity 5: Establish demonstration hedgerow on CV open space preserve.
  Results and conclusions: Developed the site plan, plant list, mulching plan, irrigation plan and planting day plan for a 3,000 sq. ft. hedgerow in the CV open space preserve (that adjoins CV farmland). This has not yet been implemented due to insufficient water supplies due to the drought, but will be in the future.
- Planned activity 6: Hold a workshop for farmers about habitat enhancement.
  Results and conclusions: Held two workshops. In partnership with the National Resources Conservation Service (NRCS), organized a hummingbird habitat workshop. Conducted a hummingbird habitat workshop on April 22, 2015 with NRCS and San Benito County Resource Conservation District. Held at Ann Sobrato High, the workshop was attended by about 30 farmers and included presentation by several students about specific habitats for hummingbirds and other bird species. In partnership with the Loma-Prieta Resource Conservation District, organized an introduction to hedgerows and pollinators workshop followed by a walking tour of the Ann Sobrato High School. Participants gave strong positive evaluations.
- Planned activity 7: Develop a project to demonstrate methods for increasing irrigation efficiency in greenhouse operations.
  Results and conclusions: With support from the Santa Clara Valley Water District, organized an irrigation efficiency demonstration project, a partnership between an ecological landscaping and consulting company that specializes in water management, and a grower. The new drip irrigation system was a major improvement over the existing system. Other interested growers will need additional training in how to design, install, and maintain efficient drip irrigation systems.
- Planned activity 8: Irrigation Efficiency project workshop.
  Results and conclusions: Conducted the workshop in English and Chinese for the irrigation efficiency demonstration project. The workshop was attended by approximately 40 people including greenhouse growers, natural resources agency personnel, equipment providers, and representatives from PG&E.
- Planned activity 9: Support farmers' adoption of natural resource conservation.
  Results and conclusions: In partnership with the NRCS, presented information to farmer's at all relevant workshops about habitat establishment and management plans; provide info about Environmental Quality Improvement Program (EQIP) and other funding sources. At the high school, UCCE is establishing a manure composting demonstration project, with the finished compost destined for the school farm garden beds.
- Planned activity 10: Identify groups of volunteers interested in working with farmers to establish habitat enhancements.
  Results and conclusions: Groups of volunteers were identified to help plant the CV open space preserve hedgerow, but that project was postponed. Around 50 students were involved in planting the hedgerow at Ann Sobrato High.
- Planned activity 11: Monitor new sustainable Ag practices and new habitat enhancements; provide ongoing technical assistance to farmers.
  Results and conclusions: Conducted site visits of habitat on agriculture lands with Audubon Society staff and DeAnza College Wildlife Biology instructors; a strong interest in maintaining and enhancing on-farm feeding habitat for species including tri-colored blackbird, Swanson's Hawk and migrating raptors. Alfalfa fields have been proved to be especially good habitat; however with alfalfa production declining in the CV, the thought is to see if it might be possible to work with growers to rotate alfalfa and row crop production over several year rotation period. Obviously, this is challenging in general since growing

row crops and alfalfa are not usually combined within the one operation; and challenging in the CV in particular due to continued uncertainty about development.
- With staff from a related project, did a site visit of CV wildlife corridor camera tracking stations along Fisher Creek, in order to consider how to encourage farmers to adopt practices, such as wildlife-friendly fencing and creek clearing, to facilitate wildlife movement.

Goal #4. Increase agritourism
- Planned activity 1: Compile data about current agritourism and related recreation visitation.
  Results and conclusions: Researched information about current agri-tourism and related recreation visitation through the local Chamber of Commerce and the California Agri-tourism Program. There is no good data available; however the local Chamber said that such information would be very valuable to have.
- Planned activity 2: Hold two workshops for farmers interested in starting or increasing agritourism on their farms.
  Results and conclusions: Held an all-day Agritourism workshop, which attracted 18 presenter-participants and another 20 farmer participants. Highlights from the evaluation included: appreciation for the breadth of information presented the diversity and caliber of the presenters, and the relevance of the information to beginning farmers.
- Planned activity 3: Connect farmers with relevant technical assistance.
  Results and conclusions: Facilitated at the Agritourism workshop.
- Planned activity 4: Create and launch a 'Visit Coyote Valley', Rebirth of the Valley of the Heart's Delight campaign.
  Results and conclusions: Created a Discover Coyote Valley initiative, including a spectacular logo, lively website, interactive map of CV features, and series of monthly events. The website is regularly updated and is promoted with enewsletters.
- For a lead article in the Edible Silicon Valley about CV agriculture, was the key informant, facilitated interviews with farmers, and organized an all-day site tour.
- Planned activity 5: Organize five events promoting CV agritourism and farm products, and related recreational activities.
  Results and conclusions: Organized or partnered on seven events celebrating agriculture in the CV including: a farm tour and hike; three major festivals (for which the project staff provided educational booths); a tour of farms near the creeks; a presentation about farmland as habitat for birds and other wildlife, with a walking tour; and a walk to a CV overlook with presentation about CV agriculture.
- Planned activity 6: Create a 'Friends of Coyote Valley' group.
  Results and conclusions: Created a sign-up space on the webpage and now have several hundred participants; are participating in an I Love Coyote Valley campaign.

Goal #5. Increase sales of SCs to local market outlets
- Planned activity 1: Identify farmers interested in developing new local market outlets (through a baseline survey).
  Results and conclusions: Worked directly with all interested CV SC growers, including members of the Bay Area Chrysanthemum Growers Association, to help them refine their marketing plan to local outlets; provided contact information for key market outlets.

- Specialty peppers produced in the SC research plot were given to 10 different restaurants and chefs in the Bay Area. Chefs were given a large sampling (over 25 different types) of chili varieties and asked to experiment with the chilies in whatever culinary ways appealed to them. Result: a strong interest in a steady supply of several varieties.
- Planned activity 2: Increase promotion of CV SC farmers in Santa Clara Valley 'Buy Fresh, Buy Local' Results and conclusions: Included profiles of all CV SC farmers on the DCV website: http://www.discovercoyotevalley.org/agriculture/ . Adding a CV-grown sub-label to the Santa Clara Valley 'Buy Fresh, Buy Local' label proved not important; more important was direct assistance with building marketing relationships.
- Planned activity 3: Provide information to farmers about additional new local market outlets. Results and conclusions: Organized and facilitated in-person meetings between leading local buyers and interested CV SC farmers. To date, these meetings have not yet led to sales contracts. The most promising connection is between the leading CV SC grower, and the organization facilitating local SC procurement for San Jose's Healthy Corner-store Campaign.
- The Food Works will continue to provide opportunities for CV SC farmers to connect with market outlets in San Jose.

Project Administration

- Planned activity 1: Convene the Coyote Valley Agricultural Enterprise and Conservation (COVAEC) committee to get guidance on, and new partners for, project activities. Results and conclusions: Formed a COVAEC program advisory committee which includes 18 local stakeholders including representatives from organization and agencies involved in food, agriculture, as well as local farmers. The advisory committee met six times; communications with members was ongoing and essential for guidance on and support for project activities.

SCBGP funds were solely expended on activities and costs that enhance the competitiveness of eligible SCs. Project staff verified that project activities were solely for the benefit of SCs, through the following measures:

1) Project staff kept lists of farmers assisted through the program such as registration lists of workshop attendees, farmers who attend field days and trainings, farmers reached through outreach efforts, farmers who receive technical and/or marketing assistance, and farmers who participate in valley-wide events, in order to verify farmers are growers of SCs, or participating in the project in order to assist transition to SC production.

2) For any project activity that incidentally generated interest in CV as a whole, such as the valley-wide events and the "Visit Coyote Valley" agritourism efforts, project staff ensured SCs were highlighted. The logo integrated SCs grown in the Valley, and the events focused on and highlighted seasonal SCs such as cherries, strawberries, spring greens, early squash, fresh onions, and plant starts in late spring, and peppers, sweet corn, tomatoes, figs, melons, and pumpkins in early fall. Slogans and marketing materials highlighted SCs, especially fruits and vegetables. These efforts did not highlight any one brand or grower.

3) Project staff designated SCBGP funds only for the portion of activity that directly benefited SCs and secured separate support (matching funds or in-kind support) for any aspect of the program that benefited non-SCs or recreation. For example, for valley-wide event materials, all SCs and growers were listed under the category of SCs with funding designated from SCBGP.

The project formed a COVAEC program Advisory Committee, which met six times during the project to support, coordinate, advise on, and provide outreach for project activities. Members and their specific contributions and roles were as follows:

- Santa Clara Valley Open Space Authority (SCVOSA) took the lead in all land conservancy efforts, which resulted in 80 acres of fee title land being transferred to them, and in serious offers for easements for acquisition being made on over 1,000 acres of farmland. With the primary partner in major and minor public events, attracted well over 5,000 people to the CV to learn about its SC's and experience its natural beauty.
- UCCE was the lead researcher in the successful Chili Pepper Variety Trial Demonstration, and a research collaborator on the Weed Management in Greenhouses Demonstration sub-project. UCCE staff advised individual SC growers and participated in outreach efforts throughout the project.
- NRCS Hollister Office was the lead in outreach to SC growers about natural resources stewardship enhancement practices, including cost-sharing opportunities for implementation of such practices.
- Guadalupe-Coyote and Loma-Prieta Resource Conservation Districts was the lead partner for Coyote Valley Hedgerow Workshop and Tour at Ann Sobrato High School, where the project established an extensive native plan hedgerow. Supported the planning for a 10-acre sustainable agriculture demonstration farm. Provided technical assistance to SC growers throughout the project.
- Community Alliance with Family Farmers provided detailed information about local demand for specific SCs that were being grown or that could be grown in the CV.
- Santa Clara County Farm Bureau (FB) hosted the project to engage FB members with opportunities to participate in project activities, and provided outreach for such activities.
- California FarmLink provided, and regularly updated, detailed information about SC growers seeking land to farm in the CV.
- The Health Trust was a liaison between the project and the Healthy Corner-store initiative in San Jose, which resulted in direct connections being made between CV SC growers and potential new markets in San Jose.

Goals and Outcomes Achieved

The activities that were completed in order to achieve the performance goals and measurable outcomes are described in detail on the Project Approach.

The project will have local impact in two to three years: providing land access and support for beginning farmers, new ideas for established farmers, fresh food and agritourism opportunities for diverse, nearby communities, and new ag-conservation co-management models. Over time, the project will also have regional impact: saving over 2,000 acres of farmland; adding up to $20M in agriculture value; enhancing wildlife linkages between the Diablo and Coastal ranges; and fostering infill versus suburban development.

The project will result in successful implementation of the COVAEC start-up phase activities identified in the CV Study, and will have these key outcomes: (1) 75- 150 acres of farmland with new ag easements; (2) at least six new SC farmers; (3) 25% increase in average ag production value per acre, currently ~$2,000; (4) 15% increase in farmers' utilization of sustainable ag practices; (5) at least 10 ten acres of new hedgerows with a focus on habitat for pollinators (5) 50% increase in the number of agritourism visitors; (6) 20% increase in the volume and value of CV-produced products sold within the county; (7) County-wide recognition of the CV grown-brand; and (8) 25% increase in public, philanthropic and private investment in individual enterprises and valley-wide elements.

Completion of achieving outcomes and showing the progress toward achieving set targets are as follows:

1. Increase number of SC operations by recruiting and supporting beginning, immigrant and scaling-up farmers.
Goal: Support next generation of SC growers
Performance Measure: Number of SC operations begun or expanded
Benchmark: ~44 SC operations (1/3 in nursery crops)
Target: By December 2015, there will be at least six new SC operations
Result: Six new SC operations, four by scaling up farmers and two by beginning farmers.

2. Increase SC acreage and profitability by transitioning hay or fallow land with available water to SCs and/or by growing higher value SCs.
Goal: Increase SC acreage & profitability
Performance Measure: Number of acres transitioned and/or with improved profitability
Benchmark: ~1,000 acres in hay, fallow or lower-value SCs
Target: 75 acres (7.5% of benchmark) will be in new SCs
Result: 610 acres in new plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (290 acres).

3. Enhance natural resource stewardship by adopting new sustainable ag practices (e.g. crop rotations, water conservation, bio-controls) and establishing habitat enhancement (incl. hedgerows)
Goal: Enhance environmental performance, valley-wide ecosystem services/habitat
Performance Measure: % of SC growers; sq. ft. of habitat enhancement
Benchmark: ~44 growers; limited adoption of sustainable agriculture practices
Target: 25% of growers will have adopted new sustainable practices; 200,000 sq. ft. of new habitat enhancement
Result: ~ 10,000 sq. ft. of new habitat hedgerow established, and another 3,000 sq. ft. planned; new water conservation system for greenhouse production adopted; water conservation in row crop operations refined; otherwise limited adoption of new practices

4. Increase agritourism
Goal: Improve financial performance, community engagement with CV, access to SCs
Performance Measure: # of agritourism visitors to SC farms, agritourism operations
Benchmark: Limited visitors at two seasonal farm stands
Target: 30% increase in agritourism visitors; two new operations
Result: Over 5,000 new visitors, which is likely 100% increase in agritourism (however, baseline data was not available); one new farm-stand and one upgraded farm-stand

5. Increase sales of SCs to local market outlets (incl. on-farm sales)
Goal: Improve financial performance, access to SCs
Performance Measure: % increase in sales of SCs to local markets
Benchmark: Limited; to be measured in baseline study
Target: 20% increase in sales to local markets
Result: Direct connections established between the major SCs sold in the CV and new retail outlets in San Jose. Surveys of 20 restaurants, 15 retail stores, 11 corner-stores, and nine distributors in San Jose, showed that most of these businesses have far more demand than supply of locally-grown SCs. CV is the closest

growing area to San Jose. Establishment of over 600 acres of new SCs, and creation of a new and an upgraded farm stand will clearly result in a significant increase local sales. Baseline research showed no tracking of CV-grown SCs sold to local markets, beyond through farm stand sales.

The major successful outcome of the project was the increase in SC acreage. Six hundred ten acres in new plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (290 acres). A related qualitative outcome is that CV SC agriculture is the most major resurgence in the past 40 years, since pears and prunes for canning were leading crops in the area.

Beneficiaries

The groups and other operations that benefited from the completion of this project's accomplishments are as follows:

- 44 SC growers in the CV and 100 in the Santa Clara Valley in general
- More than 10,000 consumers and market outlets who enjoy and/or who might enjoy in the future CV-grown SC

Lessons Learned

The primary lessons learned were: (1) the importance of relationships with farmers and partners in trying to bring about change: (2) it takes time to build relationships and trust; (3) cultivating relationships with existing farmers needs to take precedence over bringing in new farmers, even when the existing farmers may question long-term agriculture viability and new farmers are very eager to get engaged; (4) the value of prime farmland near a dense urban area was re-enforced; and (5) it is very challenging to bring about re-investment in agriculture (e.g. investment in natural resources stewardship and in upgraded irrigation infrastructure) on farmland owned by developers, where future land use is uncertain.

A very positive unexpected outcome was the number of acres converted to SCs (410) and new management of SCs (200) exceeded the project goals by eight times.

Additional Information

Attachment 1

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 25	Project Title: Farmer Education and Enterprise Development	
Grant Recipient: Agriculture and Land-Based Training Association	**Grant Agreement No.:** SCB13025	**Date Submitted:** December 2015
Recipient Contact: Chris Brown	**Telephone:** (831) 758-1469	**Email:** chris@albafarmers.org

Project Summary
Despite the prosperity of Monterey County and the strength of the local agriculture sector, many hard-working families employed in agriculture remain near or below the poverty line. Though the poverty rate in Monterey County of 13.9% is comparable to California's rate of 13.7%, there is a significant variance within the county. A closer look at communities with higher concentrations of Latino immigrant families is more reflective of the dire economic conditions Agriculture and Land-Based Training Association (ALBA) is trying to confront. For instance, Salinas' poverty rate is 18.1% and families residing in Salinas' East Alisal neighborhood suffer a rate of 21.5%, which is more than 50% higher than the California state and county levels. Many of these families depend on low-paid, seasonal work in the fields. To reduce poverty and increase economic self-sufficiency, it is crucial for local families to have opportunities to invest themselves in their communities with economic and educational advancement.

The opportunity to establish a family farm showed great promise as the demand for organic, locally grown foods was increasing at a rapid pace. Furthermore, California agriculture suffered a huge demographic gap with the average farm owner approaching 60 years of age, and no younger generation poised to take their place. Many Latino farmers have the work ethic, entrepreneurial drive, and agricultural skills to fill the gap. What was lacking in transforming these skills into enterprise creation, job creation, and local investment was educational opportunities and access to land and finance. This project provided access to education, technical assistance, land and equipment for aspiring family farms, as well as developed ALBA's food hub, which aggregates and markets organic produce from small family farms. Furthermore, this project expanded regional market channels which value local, organic produce; and provided long-term education and hands-on skills training through land-based farm incubator program.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach
Project staff educated sixty aspiring farmers through a ten-month, 300 hour, Farmer Education Course designed to launch an organic farm growing specialty crops. Two classes of thirty participants were set to run from January to October of 2014 and 2015, meeting twice a week. Modules included organic production, marketing, business management, compliance and record-keeping. The final module applied organic farming, during which students farmed a 1.3 acre piece. They grew several products, such as zucchini, kale, tomatoes, peppers, and carrots. Produce was sold through ALBA Organics and other direct market channels. The student farmers grew and sold nearly $20,000 in produce, gaining valuable experience in cultivation, packing, handling, and marketing. Students also gained exposure to successful practices and organic farms through site visits and guest speakers. Also contributing to the course were ALBA staff with Master Degrees in crop science, environmental policy, and business.

Important changes were made to the curriculum to better serve the students:
The term started in November in order to take full advantage of the off season when participants are often unemployed or underemployed. Project staff would fast track one to three capable students, allowing them to lease their land while finishing up the Programa Educativo para Agricultores (PEPA) course. This was an attempt to allow individuals to advance toward farm ownership at their own pace. For those needing more farming experience prior to entering the incubator, project staff would introduce another 'cooperative farming' module allowing them to group farm for another crop cycle prior to signing a lease.

In the organic farm incubator, fifty-five farm businesses received access to affordable land, equipment and markets. ALBA leased 150 acres of land annually to beginning specialty crop farmers. These farmers received an average of fifty hours of individual technical assistance on production, business management, and marketing each year of the program.

The Farm Incubator Manager provided daily technical assistance in the field, assisting farmers on soil preparation, input procurement, pest management, and irrigation. The Enterprise Development Specialist assisted farmers on financial management, facilitating loans, and organic and food safety compliance. The Executive Director advised farmers on business strategy and expansion plans, while the Finance Director advised them on accounting and financial management.

In addition to technical assistance, ALBA held monthly workshops on a variety of production and business-related topics. These allowed farmers to continue their education while employing the knowledge to run their businesses. Thirty workshops were held at ALBA during the project period, with a cumulative attendance of 385.

The ALBA organics staff worked with farmers on a daily basis to provide market access for produce, selling 450,000 cartons of specialty crop produce in two years valued at $8 million. ALBA Organics staff worked daily with farmers on forecasting production, advising on quality, harvest, pack and order fulfillment. This aggregation and marketing service not only allowed farmers to reach clients that would otherwise be unattainable to them, it provided essential lessons on how to meet the demanding requirements of California's competitive produce markets.

ALBA worked solely with helping new farm businesses grow and market organic strawberries and vegetables such as kale, cilantro, celery, cucumber, tomatoes, peppers, squash, beets, broccoli, and beans among others. The few activities that project staff undertook that did not relate to enhancing the competitiveness of specialty crops were funded and managed under specific grants which had adequate designated funds outside of this project's budget. One such unrelated activity was funded entirely by the Packard Foundation which supported visits from local elementary schools in order to teach fourth and fifth grade students about organic farming.

Partners were not sub-contracted on this project but several partners still made significant contributions: California FarmLink is the most significant ongoing partner for the Farmer Education and Enterprise Development Project (FEED) program. FarmLink makes operating loans to ALBA's participating farmers. Over the project period, they provided loans for over twenty-five beginning specialty crop farmers. FarmLink also helps in finding land for graduates as they transition to new land. During the project period, they helped four farmers find land outside of ALBA and assisted other farmers in networking with prospective land owners.

El Pajaro Community Development Corporation provided marketing education through workshops and technical assistance to farmers on developing financial statements.

Community Alliance for Family Farmers provides workshops on marketing for the Farmer Education Course and incubator farmers.

Goals and Outcomes Achieved

Project staff educated over fifty farmers, and conducted two classes over two years in organic farm production and business management in preparation for launching an organic farm. Each annual course lasted for ten months with 300 hours of class and field study. Project staff provided intensive, hands-on business development services for fifty beginning specialty crop farm businesses. Each farm business received an average of fifty hours of technical assistance per year in addition to workshops and access to land and equipment at a subsidized rate. Project staff also provided marketing services to fifty-five current and former ALBA farm businesses, allowing beginning farm businesses to reach lucrative markets statewide.

Longer term outcomes of FEED work include: Increase in the number of viable specialty crop businesses (expecting twenty to graduate and transition to independent farming in the next four years). Increase in the acreage grown by ALBA alumni due to newly graduated farmers and those expanding acreage farmed. Increase in jobs created and retained by newly launched and expanding farms. Increase in cumulative production and sales volume of specialty crop growers launching and/or expanding their business at ALBA.

The FEED program achieved its goal of educating and advancing the business goals of the farmers involved. However, the goals stated in the project proposal focused exclusively on sales growth of farmers and the food hub – ALBA Organics. The project fell slightly short of meeting these goals but project staff are achieving the mission of supporting beginning specialty crop farmers. Participation in the program was strong and is growing, as is the pipeline of developing farmers who will transition to independent farming in the coming three to four years. In addition, these courses advanced the competitiveness of the specialty crop industry by providing a rare opportunity for low-income farmers to develop their skills and obtain better employment while strengthening the industry as a whole.

There are two main reasons as to why project goals were impacted: The loss of key personnel (General Manager in the first year of the project) caused temporary disruption in marketing operation until late in the project period. Project staff anticipated a continued growth path in sales; this growth trend showed $500,000 in annual sales to over $5 million at their peak in 2013. The project staff expected this growth to continue at a slowing but healthy pace, which did not materialize. The project staff assumed that the growth would be driven by a pipeline of rapidly growing incubator and alumni farmers, instead, their expansion levelled off and many encountered disappointing strawberry production and lower average box prices due to the staff transition.

Project staff set a goal of $15 million in sales during the project period, but only achieved $8 million. The expected sales of $6 million in 2014 and $7 million in 2015 turned out to be $4.5 and $3.5 million, respectively. Instead of a 35% increase projected, it declined by 16% from the base period of $9.5 million (2012/2013).

Although farmers found alternative market channels, their growth did not meet the expectations. Rather than thirty farms increasing sales by at least 40%, only ten of the farms did. Most farmers experienced fairly flat sales growth or a minor decline over this period.

Ultimately, falling short of ambitious growth targets does not connote failure. Particularly in view of the challenges faced by beginning farmers in establishing viable businesses. Rather, the project staff consider the sales pattern experienced over the project period to be an understandable disruption arising from the loss of a dynamic individual who held valuable relationships with farmers and clients. The project staff have since managed to stabilize the food hub's financial performance and look to resume a growth path.

The baseline for overall sales of organic produce was $9.5 million in 2012 and 2013 ($4.5m/$5m). Though project staff projected a $5 million increase in sales over two years, sales actually declined by $1.5 million.

Individual farmer baseline data is regularly collected through the annual survey. The project staff projected that thirty farmers would increase sales by 40% or more. It was expected that this would be achievable through their rising capacity and increasing land base while in the program. As it turned out, most of the ongoing farmers did not increase their acreage as fast (due to short labor supply), while strawberry production declined due to weather. In other words, assumptions were too optimistic and other factors intervened. More importantly, most of the farmers are sticking with it and have managed to not only weather the difficult period but to establish new client relationships as a result.

Outcomes achieved during the project period include: Production and business skills development of one-hundred and five aspiring and existing specialty crop farmers; launched twenty-five specialty crop farm businesses on small acreage; provided intensive business development and marketing assistance to strengthen an additional thirty farm businesses; facilitate access to loans and credit line services to over thirty specialty crop farmers; assisted forty farmers annually obtain or renew organic and food safety certification; sold $8 million in produce on behalf of beginning specialty crop farmers; ten farmers increased sales by at least 40% (target thirty farmers); transitioned eight farmers to their own land to continue farming independently; and created or retained one-hundred twenty jobs through businesses supported in ALBA's program.

Beneficiaries

One-hundred and five aspiring and existing farmers were assisted by the project to start their own farms growing specialty crops such as lettuce, strawberries, wine grapes, and spinach. Participants farmed one-hundred and fifty acres over two years. Assuming an average of $25,000 of revenue generated per acre, this comprised roughly $5.5 million in revenue flowing back to the farmers. In turn, this revenue creates a multiplier effect in the local economy as these revenues are passed on to workers and input suppliers, who then spend it on other goods and services. The final impact depends on the multiplier assumed.

This project worked primarily with low-income, aspiring farmers. These are people who have extensive agricultural experience but don't have access to the education and resources to be able to establish an independent farm. Many of these farmers are immigrants who have the work ethic, agriculture experience and entrepreneurial spirit to be farmers. ALBA offered access to resources and assistance to develop the business management and production skills to supplement their experience and establish a viable organic farming businesses.

The small farm businesses that benefitted from ALBA also benefit participants' families and their employees. In addition, these small farms generated revenue for business service providers. Skills developed at ALBA benefit employers and the industry as a whole.

Project staff believe the longer term impact by a farm business and/or careers advanced is much greater. Businesses launched and expanded at ALBA during the project period will grow and multiply their impact. Young professionals trained will gain practical experience, hone their focus and advance their careers which stretch well into the future. Investment in ALBA is in investment in people who will contribute to the growth and competitiveness of the industry. The investment will produce dividends in the form of new specialty crop businesses and professionals.

Lessons Learned

Project staff learned that farming (and running a food hub) is not a steady upward march of progress. During the project period, setbacks have included: Departure of the long-time General Manager, a steep drop in sales during the 2014 and first quarter of 2015, and farmers looking for other market channels.

Project staff managed to achieve the goal of advancing the specialty crop industry by strengthening the skills and capacity of farm owners and employees in the industry. It didn't show up in the numbers as expected because the project targets set anticipated a continued expansion, when in fact project staff went through a period of reorganization. Still, the food hub sold over $8 million in specialty crops grown by beginning farmers during this period, an achievement in itself.

The project staff learned how dependent ALBA was on the knowledge and relationships that were acquired during the General Manager's tenure at ALBA. This is not atypical in the produce industry at large, particularly at a relatively small operation.

The project staff learned that minimizing fixed costs is essential. One of the strong sales growths leading up to this project resulted in moving to a second cooler. Although this added operational complexity as well as extra personnel, rent and utilities costs which made breaking even difficult even in periods of high sales; as a result, costs were cut by moving out of a second warehouse, moving back to the smaller site. This brought back sales and management to the main site which provided for better field oversight and helped in re-establishing relationships with farmers.

The project staff made a number of facility upgrades to make the smaller cooler more functional. Investment in a new inventory software system enabled better business management. These changes will help more effectively market the goods of the emerging specialty crop farmers.

The project staff also realized that outcomes are not encapsulated in financial performance (e.g. growth in sales and profitability) over a fixed period of time. Progress in farming is less predictable and often involves a fair amount of failure. This drives learning, forges resilience, and sets the stage for future success. Future proposals will set more modest financial targets and diversify the array of targets to reflect broader measures of success.

A survey was completed in 2015 which reached about one-third of ALBA's alumni. The survey results revealed that 38% of respondents are still farming independently. Over 70% are still working in California agriculture and nearly two-thirds state they are better off financially for having participated in the program. ALBA remains an engine of economic growth and a rare opportunity for advancement among low-income specialty crop farmers. Through skills building, enterprise creation and job creation, ALBA contributes to developing the California's specialty crop industry.

Additional Information

No additional information.

USDA Project No.: 26	Project Title: A Business of Details for California Specialty Crops	
Grant Recipient: Center for International Trade Development, State Center Community College District	**Grant Agreement No.:** SCB13026	**Date Submitted:** December 2016
Recipient Contact: Alicia Rios	**Telephone:** (559) 324-6401	**Email:** alicia.rios@scccd.edu

Project Summary

A key component in expanding California's advantage in marketing specialty crops internationally has been the development of a highly-skilled, well-trained workforce. Maintaining this competitive edge is a continuous process, particularly with rapid developments in such areas as information technology, transportation, cold-chain, and ongoing changes in regulations. Although the Center for International Trade Development (CITD) at State Center Community College District (SCCCD) has conducted regular training activities to develop regional exporters, effectiveness and training impact are both restricted by outdated training materials and program limitations in reaching specialty crop industry members in all corners of the State.

The "Business of Details" project was developed to help remedy these factors by funding an up-to-date training video and collateral materials for California specialty crop exporters. The combination of video topics with more in-depth, hands-on training treatment will help to reach a broader audience while providing intensive education in focused lessons. Primary distribution for the video and supplemental materials will be through online training/viewing.

This project was particularly relevant and timely at the time of funding, as the President's 2010 National Export Initiative called for a doubling of U.S. exports through 2015. This initiative inspired many specialty crop producers to look towards exporting as a means of diversification and expanding markets. One of the key means of accomplishing such a goal has been to increase the overall number of California specialty crop exporters, while upgrading the skills of both current and future exporters.

The CITD previously utilized a prior version of the training video, "A Business of Details." Produced in 1997, the video followed a shipment of California Fuji Apples from harvest to the foreign market, pointing out each export detail along the way. Because of the clarity of the materials content no other training video for specialty crop exporters had been so easily understood and widely used. However, while the video had been high impact in its success, with nearly all trainees recalling the key points as demonstrated in evaluative testing, it had also become quite outdated. Due to changing aspects of specialty crop exporting, instructors found they had to spend time explaining changes that had occurred since it was recorded over 19 years ago. Furthermore, evaluations by trainees often stated that the video was very informative, but out-of-date compared to the rest of the training. This trainee viewpoint was corroborated during statewide focus groups.

In an attempt to locate a more current version of similar training support materials, the United States Department of Agriculture, Agricultural Marketing Services had informed the CITD that no updated video was available.

This project builds upon 2009 Specialty Crop Block Grant Program (SCBGP) Project 23: *Export Training for Specialty Crops* which provided export training classes for new-to-export specialty crop producers and marketers throughout California.

One of the training tools used in this prior export training grant was the previously-described, "A Business of Details" video and accompanying workbook. The video had been a key visual element for trainees, easily demonstrating many of the common issues and roadblocks encountered by specialty crop exporters, and how to overcome them. The video was found to be a strong training tool by both instructors and trainees. Since the concept of the training format was proven to be strong in the 2009 SCBGP Project 23, the need to create an updated version highlighting current policy and practice for specialty crop exporters appeared as a clear priority for the CITD. This would allow a proven educational model to continue to provide strong outcomes while reducing the level of clarification and revision needed during the training sessions themselves.

Project Approach

- Advisory Council (AC): The AC was made of five industry experts who provided guidance and feedback throughout the course of the project. This group assisted in development of updated video curriculum, storyboarding of the video, technical accuracy confirmation, identification of expert speakers, and securing partners for training materials dissemination purposes.
- Request for Proposal (RFP) - Video Contractor: The CITD developed and distributed the RFP to more than 15 regional video production companies. Seven companies responded with proposals/bids to complete production work. After the AC scored each proposal, a contract was awarded to produce the project video.
- Focus Groups: Focus groups included industry stakeholders, specialty crop cooperators and industry experts. Meeting were conducted over conference calls with materials for review distributed to the groups via email. The groups completed review and feedback on the original “Business of Details” training video. They also provided review and feedback to new video production.
- Develop Curriculum: Curriculum development has been an ongoing process which has been continuous throughout the project. This has allowed the CITD to incorporate up-to-the-minute changing rules, regulations and trends in its updated materials. The curriculum has focused more on the California specialty crop exporter’s point of view, and has included elements missing from the original video including Agricultural Commissioner inspections, issuance of Phytosanitary Certificates, discussions on Maximum Residue Levels, and banker explanations of how best to get paid. In addition to video updates, curriculum development provided for updates to the video companion workbook to bring it up to date; this included adding resources available for today’s specialty crop exporters which had not been readily available in 1997 (see ‘Develop Workbook’ below, for additional details).
- Video Production: The video production contractor worked directly with CITD staff, the AC, speakers featured in the new footage, the professional narrator, regional trade partners, and the featured expert contractor. This collaborative approach allowed the contractor to storyboard the project, develop a script, capture ancillary footage, interview speakers, and produce final edit of project based on strong and current market and technical input.
- Expert Contractor: The expert contractor provided technical expertise regarding the entire export process of a specialty crop. This individual also assisted in development of curriculum, secured the foreign video contractor in Taiwan (who supervised video production there), and contracted narration services for the video portion of this project.

- Develop Workbook: The CITD reviewed the original companion workbook and removed extraneous material and resources that no longer applied to exporting California specialty crops. After these edits, the project added in new materials, samples and resources that correspond with and expand on the newly developed training video's content. The workbook was developed in a format that can be easily updated to adopt changes to laws and adjust broken links. A downloadable version is available to trainees in a PDF format.
- Web Portal Development: On the www.fresnocitd.org website, a web portal was created to house the newly developed export training video. This web page also includes a downloadable version of the Companion Workbook and resource links for new specialty crop exporters who participate in training. Includes online survey to measure knowledge
- Dissemination: The CITD has 100 specialty partners to cross-link and share this video with the specialty crop community (California specialty crop commodity boards, farm bureaus, chambers of commerce, ports, economic development corporations, industry associations, etc.).

This project did not enhance the competitiveness of non-specialty crops.

The project video and collateral materials were designed to specifically benefit the export of specialty crops. This was accomplished in two ways: First, the updated video specifically demonstrates an export shipment of a California specialty crop (Romaine Lettuce). In this setting, the updated video demonstrates the export processes typically encountered by specialty crops, many of which are unique to these products. Secondly, a training discussion of the unique combination of issues faced by exporters of specialty crops included: phytosanitary issues, Maximum Residue Levels (MRLs), and maintenance of the cold-chain during transportation. No other non-specialty crop products face the same problems; thus, the entire training video will be useful only to specialty crop exporters.

Project partners played a significant role in this project's success which included participation in strategizing activities, providing input based on individual expertise, access to filming at facilities and locations (e.g. processing, packing and port facilities), and review of draft video and print materials in the focus groups. Finally, project partners helped ensure program success by disseminating the project's training materials through their respective websites, sharing them with organizational staff and/or professional members, and incorporating the video and workbooks into their export training programs for California specialty crop producers. This was a unique opportunity to synergize a broad array of groups all focused on a particular goal; expanded and improved specialty crop export opportunities.

Goals and Outcomes Achieved

Objective 1: Increase distribution of training video through the Internet.
Once the video was complete and uploaded to the web, it was crucial to make it widely available to the California specialty crop industry. The project goal was to have the video cross-linked on 100 partner websites by June 30, 2016 and up to 150 websites by December 31, 2016 (long-term). Due to editing of the video taking longer than anticipated, the video wasn't completed until late May 2016. Cross-link goals were not achieved but CITD continues to work with partners and expects cross-links to be available soon. Activities associated with this outcome: Completed video with companion workbook and resources, dissemination with partners, and web portal host.

Objective 2: To increase the number of California specialty crop personnel who view the training video. Starting from a baseline of zero in 2013, CITD projected the following schedule of viewers over the next 3 years. For 2014 the initial focus groups and industry feedback exceeded the 50 views projected by reaching 75 partner views and 10 test export class views. For the second year the CITD was to have 750 more views by June 30, 2016; however, due to editing delays the CITD has not reached that goal yet. CITD will continue to monitor views using its Google Analytics account to capture the 750 views as well as the 2,500 additional views projected to be completed by December 31, 2016.
Activities associated with this outcome: Completed video with companion workbook and resources, dissemination with partners, and web portal host.

Objective 3: To increase the level of export knowledge of the California specialty crop industry.
The target was an overall comprehension value of 80%. Based on AC and Focus Group feedback, it was determined that breaking up the video into modules would disrupt the flow of the video content. The CITD included a survey at the end of the video on the Web Portal for participants to take and record their responses to measure comprehension. The number of survey respondents compared to viewers is significantly less, but all have scored above 80% comprehension.
Activities associated with this outcome: Completed video, web portal host, and evaluation survey to capture and document knowledge increase.

Long-term measures for cross-links of video on partner web pages and views will be measured using Google Analytics. Google Analytics can summarize where the views were originally linked from as well as the number of views of the video.

For the reporting period, CITD met the goals as indicated in the last Progress Report for period of Oct 2015 through Mar 2016 and accomplishments included:

- Completion of the export training video, "A Business of Details"
- Completion of the export training video Companion Workbook.
- Completion of the web portal housing export training video, downloads and resources.
- Survey on web portal to measure and document participant's level of export knowledge.
- Google Analytics is in place to measure where viewer of video originated from and how many views are made.
- Dissemination of video link to partners to cross-link on their respective websites to direct their members/followers to watch video on our site.

Objective 1: Website Cross link	**Baseline**	**Prior to Apr 30, 2016**	**Jun 30, 2016**	**Dec 31, 2016**
Target	0	0	100	150
Actual	0	0	0	0

Due to video editing not being completed until late May 2016, cross-links goals were not achieved due to partners not having enough time to get the request approved and then posted. Cross-links to video are expected to increase, and Google Analytics is in place to identify and document where (which website) viewer came from to view video.

Objective 2: Specialty Crop Views	Baseline	Prior to Apr 30, 2016	Jun 30, 2016	Dec 31, 2016
Target	0	50	750	2,500
Actual	0	85	23	47

Due to video editing not being completed until late May 2016, view have been limited to focus and test groups as well as industry partners. Viewers of video are expected to increase, and Google Analytics is in place to document the number of viewers.

Objective 3: Increase Level of Knowledge	Baseline	Prior to Apr 30, 2016	Jun 30, 2016	Dec 31, 2016
Target	0		80%+	80%+
Actual	0		6	16

The number of survey respondents compared to viewers is significantly less, but all have scored above 80% comprehension. The goal was to score at or above 80% in comprehension.

The major successful outcome of this project was the comprehension level of individuals that had no previous export experience and participated in test groups. All these test subject scored at 100%. Once there is a larger pool of individuals completing the assessment, CITD expects these results will easily meet or exceed the 80% comprehension goal set for this project.

Beneficiaries

Project beneficiaries include all specialty crop producers, processors and marketers in California whose product is exported. Through open distribution on the internet, the video and companion materials are available to all of these as a free resource. The video is used by the following: new-to-export companies (both producers and marketers) exploring export markets; California specialty crop producers wanting to learn more about the considerations of export markets, thus making their product more exportable; experienced specialty crop exporters wanting either to keep up-to-date on current export issues, or have new staff that require training. Specialty crop cooperators can also utilize this video to educate their respective professional members on the intricacies of exporting. In addition, the video has been added to the course curriculum for the CalAgX specialty crop export training series, which reaches an audience of 100 specialty crop exporters annually.

Untold millions of dollars are lost annually in both product value and the time of both private industry and Government officials when a shipment is held in customs due to an avoidable problem. These include lack of proper documentation or certificates, violation of phytosanitary controls, or exceeding maximum chemical residues. This project has helped to eliminate many of these common problems by educating potential exporters on the proper methods of shipping their product to foreign markets, thus saving the California specialty crop industry millions of dollars.

Following the call-to-action to double exports by the National Export Initiative and the weak US dollar, more and more specialty crop producers have continued to seek opportunities to diversify their sales utilizing foreign markets. Global exports of specialty crops have maintained an upward trend through the recession and recovery recently experienced in US markets. This project will support the jobs of over 140,000 Californian's involved with specialty crop trade growth as a result of these expanding export developments. Presenting training through a visual tool will supplement the work of established export training programs and allow participants to readily see all the pieces put together; simplifying the process will make exporting a more inviting alternative, thus establishing more new exporters and export revenue for California specialty crops.

Lessons Learned

One of the positives takeaways from this project is that in working together with professionals from all across the supply chain, the CITD was able to discover the most common challenges that each respective group encountered when it came to exporting. The CITD was then able to proactively address these uncovered issues and incorporate responses and training resolutions into the updated video. The downside of working with so many individuals was the resulting delays in feedback and eventual compilation of the numerous opinions offered; this sometimes complicated the process of deciding what should and should not be in the new video.

Using Romaine Lettuce as the focus specialty crop worked out very well with this project because the processes used in exporting this product cover almost all of the common aspects associated with the exportation of all specialty crops. Additional resources will be added for other specialty crops. The challenge was in coordinating filming based on harvest schedules, orders from Taiwan, shipping schedules and being able to meet with and interview the featured Exporter during one of their busiest times of the year. The CITD was able to minimize interruptions to the Exporter's schedule by coordinating directly with other key individuals involved to scheduling filming appointments, and by compiling pre-interview outlines that provided the speaker with a "cheat sheet" of all the key areas and topics that each presenter needed to address in their response to interview questions.

In terms of dissemination, multiple organizations have been eager to partner and stated their willingness to post the updated video and materials on their websites. This willingness has been complicated by the issues that arise in approving the video upload or links through the processes of each respective organizations. Linked videos must be able to be monitored via the use of Google Analytics, when posted on the host website. While these issues are quickly resolved, the video will be hosted on a CITD paid server whereby video views and downloads can be documents and recorded by incorporating the CITD Google Analytics accounts.

Implementing the project did not produce any unexpected outcomes or results. The video has received great feedback and staff expects the number of views to multiply exponentially as the word continues to spread of the availability of this export training video.

The initial views that the video has had does not yet reach the expected levels, and this is due to not having the video available for public viewing until late May 2016 (planned release was April 2016). Editing and putting together the final version of the video took nearly twice as long as originally projected. CITD expects numbers to increase as it continues to promote.

Additional Information

The web portal hosting the newly produced "A Business of Details" export training video can be found at: www.fresnocitd.org

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 27	**Project Title:** Growing Community Food Systems in Underserved Neighborhoods	
Grant Recipient: International Rescue Committee	**Grant Agreement No.:** SCB13027	**Date Submitted:** December 2016
Recipient Contact: Anchi Mei	**Telephone:** (619) 641-7510 ext. 234	**Email:** anchi.mei@rescue.org

Project Summary
This project was developed to address two insidious nutrition issues that plague low-income communities: obesity and malnutrition. The root problem underlying both these issues is ultimately poverty. Improving nutrition through education alone is insufficient. Rather, Internal Rescue Committee (IRC) has pioneered the Community Food System (CFS) approach, which weaves nutrition education into economic empowerment and community-building food projects focused solely on increasing California specialty crop consumption (such as gardens, markets and farming microenterprise). These projects are cost-effective, durable solutions leading to increased awareness in low-income communities about the importance of consuming fresh fruits and vegetables, while also bolstering the growth of future California farmers and strengthening both local food economies and individual household financial stability.

IRC replicated its CFS model created in an urban San Diego neighborhood in eastern San Diego County in the City of El Cajon. Both communities have deep pockets of poverty and food insecurity; however, El Cajon lacks the political organizing and food justice consciousness of the City Heights community and thus, made it a prime learning laboratory for best practices in terms of CFS implementation techniques. This project developed two very different CFS communities to draw upon in supporting the development of more CFS throughout the region and state.

This project was and still is important and timely for three reasons. First, California needs new farmers and specifically, San Diego County, which is home to the largest number of small-scale farms in the nation, is losing farmers to retirement each year; the average San Diego farmer is 61 years of age. Secondly, rising healthcare costs, due to obesity, impact both family household purchasing power as well as public healthcare costs shared by all Californians. Thirdly, IRC's economic empowerment approach addresses the root problems of poverty through the creation of self-reliant livelihoods.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach
Over the course of this project, IRC improved the nutritional status of over 2,000 low-income beneficiaries. Additionally, approximately 185 community gardeners increased their specialty crop production and consumption. Over $762,517 was generated in revenue for the California specialty crop industry for 20 specialty crop farmers. $165,115 was generated in CalFresh revenue and over $37,051 in microenterprise revenue by urban, small-scale farmers in San Diego County.

This project's greatest success in both the El Cajon and City Heights CFS was in the area of "market gardening". Throughout the project term, IRC saw sustained interest, results and impact with community gardeners who engaged in farmers' market sales. Over 40 low-income individuals either started or expanded their market garden business during the course of this project. These market gardeners not only generated income to support their households but sold fruits and vegetables to many others in their low-income communities at the El Cajon Farmers' Market (ECFM) and City Heights Farmers' Markets (CHFM). This double win-win of increased economic well-being and health outcomes for both the participants and community has become one of the central tenets of a CFS.

Project staff undertook many activities and tasks during the course of this project to achieve these successes. Community garden programming activities included: working with gardeners to develop and implement a garden self-governance program, administering annual garden agreements and year-round enforcement of the garden agreement, site maintenance of community gardens, organizing volunteer work days, addressing and trouble-solving participant conflicts and issues, external relationships with land owners, neighbors and local government for community garden sites, conducting participant evaluations

Farmers' market programming activities included: Operating the ECFM, administering Fresh Fund at both ECFM and the CHFM, on-time financial reconciliation and payment of farmers and vendors, and conducting participant evaluations.

Leadership development activities included: community garden leadership conferences for gardeners to increase leadership skills, the CFS convening to support new CFS development throughout California, and encouraging local farmers' market managers to establish farmers' market nutrition incentive programs.

IRC created and utilized clear accounting and recording practices to ensure that SCBGP funding was only used to enhance the competitiveness of specialty crops. During the course of this project, IRC had other funding for personnel and materials for any activities unrelated to specialty crops.

The following project partners were instrumental in their support of this project: Kaiser Permanente is the land owner of the new El Cajon Community Garden that was expanded upon as a result of SCBGP funding. Kaiser Permanente has not only been generous in their continued leasing of the land to IRC but also in supporting with overall site maintenance, volunteers, press/media and creating special events to celebrate the garden; San Diego County Farm Bureau has been a wonderful partner of the City Heights Fresh Fund program; Ecology Center has been a strong organizational partner in overall Fresh Fund/Market Match programming and funding through their technical assistance to new farmers' market operators; and, Leah's Pantry was also a terrific partner in the development of a healthy cookbook using ingredients from the El Cajon community garden plots as well as the farmers' market. See the cookbook available for free download at http://leahspantrysf.org/cookbooks/

Goals and Outcomes Achieved

To achieve the performance goals and measurable outcomes, IRC completed activities in three areas: community garden management, farmers' market programming, and leadership development.

In the area of community garden management, IRC staff supported over 185 households with individual community garden plots averaging about 600 square feet each. IRC staff facilitated over 60 community garden leadership meetings across both gardens, and met with each of the community gardeners approximately twice a year to review the garden agreement, collect payment and conduct participant surveys.

Market gardeners received a wide range of additional educational services as well as technical assistance. IRC farming staff offered an intensive three-month market gardening training program to 20 new farming participants and also facilitated 13 production-focused workshops taught by local urban agriculture experts. IRC staff provided additional technical assistance for market gardeners by assisting them with Certified Producer's Certificate applications and renewals, as well as fieldtrips to local markets and farms.

IRC's farmers' market program staff worked diligently each week at two farmers' markets to ensure quality service and operations of both the ECFM as well as Fresh Fund operations. Weekly in-office financial reconciliations and coordination of market outreach events were vital to helping the ECFM grow during this project period.

Over the course of this project, IRC improved the nutritional status of over 1,390 individual Fresh Fund recipients. The actual number of Fresh Fund beneficiaries is much higher given that the average number of people in each Fresh Fund household is over two. A conservative Fresh Fund impact estimate is at least 2,000 individuals. Additionally, IRC assisted at least 185 households in the community gardens to increase their specialty crop production and consumption. The average household size of community garden participants is closer to three, and therefore, a conservative community gardens impact estimate is at least 500 individuals. Altogether, IRC's CFS benefited at least 2,500 people in San Diego County compared to the stated goal of 2,000 individuals.

IRC exceeded its original target of 5-10 new specialty crop micro-farmers by assisting in the creation of 12 new micro-farmers during the course of this grant. IRC originally estimated $10,000 in microenterprise sales whereas over participants actually generated over $37,000 in farmers' market sales. IRC also exceeded its original target of growing 50,000 pounds of fresh fruits and vegetables as a result of this project. In fact, CFS participants grew over 150,000 pounds of fresh fruits and vegetables according to the annual Pounds and Dollars survey.

IRC had less success meeting the farmers' market sales target. Over $762,517 was generated in revenue for the California specialty crop industry whereas the original target was $1 million. Additionally, IRC was only able to generate $165,115 of $225,000 in CalFresh revenue spent solely on eligible specialty crops.

One additional program benefit has been the building of IRC's food and farming data/evaluation system over the past three year of this grant. This has been a notable accomplishment for a new program that was in the process of pioneering new projects while also creating standard reporting and operating protocol. IRC has robust financial tracking for all farmers' market and Fresh Fund sales that is reconciled with the Finance Department on a weekly basis. There is documentation of all farmer sales, CalFresh, and Fresh Fund activity. Additionally, IRC has developed an electronic data platform for recording all interactions and assessments with participants called Efforts to Outcomes.

IRC surveys revealed the following progress in participant health through participation in CFS activities:

- 97% said their physical health has improved. 3% said it has stayed the same. 0% said their physical health has decreased or were not sure.
- 92% said their access to healthy foods has improved. 5% said it stayed the same. 3% said not sure.

- 83% said their outlook on life and the future has improved. 12% said it has stayed the same. 2.5% said it has decreased. 2.5% said not sure.
- 91% said their connection to neighbors and the community has improved. 3% said it stayed the same. 1% said it decreased. 5% said not sure.
- 83% said their overall well-being of their neighborhood/community has improved. 10% said it has stayed the same. 7% said not sure.
- 13% said their savings on groceries have improved. 26% said it stayed the same. 47% said it decreased. 4% said not sure.
- 73% said that their household eating habits have improved as a result of this program. 23% said it stayed the same. 1% said it decreased. 3% said not sure.
- 36% said their household income has improved. 59% said it stayed the same. 1% said it decreased. 4% were not sure.

Overall, the major successful outcomes of the project can be quantified by the sales of market gardeners as well as the production of healthy fruits and vegetables by community gardeners. Market gardeners generated over $37,000 in farmers' market sales while community gardeners grew and consumed over 150,000 pounds of fresh fruits and vegetables during the course of this project.

Beneficiaries

During the course of this project, several groups and operations benefited from IRC's accomplishments in building CFS in San Diego County: Success of IRC's CFS model supported community advocacy for new City of San Diego urban agriculture ordinance and AB551: urban agriculture incentives zone; IRC's experience and expertise with the CFS model was critical in assisting the County of San Diego to support community agriculture planning projects across seven cities in San Diego County; Shoppers at local farmers markets, particularly in underserved communities, gained more access to fresh, locally grown produce due to IRC-supported market gardeners

Over 2,000 beneficiaries benefited directly from IRC's CFS projects either through community garden-grown produce or farmers' market programs at El Cajon and City Heights. However, the potential economic impact exceeds just the additional food dollars provided to CFS participants (through production, market incentives and farmers market sales). Studies have shown that low-income households spend additional discretionary income at a higher proportion than higher income households. Therefore, the potential economic impact of the CFS to the local economy would be at least: $37,000 in additional local spending by market gardeners with their increased income, and approximately $50,000 in the local economy through food dollar savings provided by Fresh Fund.

Additionally, many community gardeners have reported secondary health benefits gained from community gardening. These medical benefits include a reduction of diabetes and depression/sleep medication. The improved health of community gardeners can also have a potential economic impact of health savings in the future.

Lessons Learned

SCBGP funding has been an important opportunity for IRC to refine the CFS model based on the experience in replicating a CFS in the community of El Cajon. Two important insights were noted: The "community gardener self-governance" was not an effective sustainability strategy for garden maintenance and management. The pilot allowed to distill the key activities to garden management down to site management towards the goal of "safety and cleanliness". Project staff saw that low-income individuals had a myriad of different issues and that the work of collecting and managing water payments, coordinating repairs in a timely manner, and managing conflict cannot rest of the shoulders of people with multiple jobs, health issues and/or language barriers. However, the pilot was a good experience for several gardeners to see the value of IRC staff to continue coordinating the garden and for IRC to distill staff time and activities for continuing garden operations for participants. During this project term, IRC also saw the limitations of full-time farming for low-income individuals and refugees due to the lack of land access, high cost of water as well as the high-risk, time-intensive nature of full-time farming. Additionally, IRC also saw the relatively high cost of entry for beginning farmers as well as the long road (and/or high level of marketing) required to earn a living wage as a farmer. At the same time, IRC saw that part-time, urban farming was a very viable and beneficial activity for low-income individuals to earn additional income, improve their communication skills, build on their work skills and develop confidence.

IRC met 50% of its CalFresh target. The original target was based on CHFM redemption and over the past three years, project staff has seen CHFM CalFresh sales grow incredibly high whereas ECFM CalFresh use has been quite moderate. Project staff have learned that the economy has improved in the past year and CalFresh redemption has gone down. However, project staff also realized the need for continuous development of new community outreach partners. Finding the right partners and developing partnerships takes time.

As is not unusual in a non-profit, there is staff turnover each year as staff relocate for family reasons and/or return to school for an advanced degree. IRC has learned over the project term to create more staff cross-coverage as well as project protocol and training documentation to ensure continuous service delivery and minimize disruption and losses in productive work time.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

<table>
<tr><td>USDA Project No.:
28</td><td colspan="2">Project Title:
Harvest Program</td></tr>
<tr><td>Grant Recipient:
Ag Against Hunger</td><td>Grant Agreement No.:
SCB13028</td><td>Date Submitted:
December 2016</td></tr>
<tr><td>Recipient Contact:
Lynn Figone</td><td>Telephone:
(831) 755-1480</td><td>Email:
Lynn@agagainsthunger.org</td></tr>
</table>

Project Summary

In the growing counties of Monterey, Santa Cruz and San Benito, there are tens of millions of pounds of surplus specialty crops that would go to waste if it were not for the collection and distribution efforts of Ag Against Hunger (AAH). The Harvest Program collects surplus produce that would normally be wasted, and distributes the fresh specialty crops to food banks throughout California. The biggest issue is that the waste of fresh specialty crops is detrimental to the health and wellbeing of citizens, with 3.8 million low-income Californians who cannot afford food and are classified as food insecure. The project was designed to bring specialty crops to those who needed it most, children, school programs and senior citizens. The availability for cooler overflow for additional specialty crops would help bring specialty crops to those who needed it most, thereby reducing as much waste as possible of fresh specialty crops.

This project was important and timely because there is a direct correlation between food insecurity and health issues such as hypertension, obesity and diabetes. Utilizing additional cooler space for the Harvest Program would expand access to healthy, safe California specialty crops to those who are in need. All the while aiding the growers, shippers and processors to combat specialty crop waste.

The objectives achieved were increased overall consumption of California specialty crops and improved distribution systems from farm to table of surplus specialty crops. AAH is a distribution clearing house of surplus produce. The more space available for coolers, the more efficient AAH will be.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

After approaching several commercial cooler companies, a company was selected and hired as needed throughout the growing seasons. The selected commercial cooler company provided the best price, and was one of the several companies that donated specialty crops to AAH. During the first growing season the overflow space was specifically helpful in the summer months when local in season fruit was in overabundance and the project team was able to get the surplus to schools for their food programs. However; AAH harvest program did not receive enough surplus specialty crops during subsequent seasons to justify the cooling facility expenses.

AAH expected there to be more surplus specialty crops available because more growers and shippers were participating with the program. The effects of the drought continued to decrease the supply of specialty crops grown elsewhere resulting in most of the growers giving less during each year of the grant.

The Program Director (PD) contacted 10 new growers of which four growers provided specialty crops to the harvest program. The specialty crops the four growers provided was prepackaged salad, celery, spring mix, spinach, green onions, carrots, and romaine. The new growers were contacted by AAH board members, and thereafter an arrangement for one-on-one meetings with either the CEO, head of cooling operations, and/or harvesting managers of each of the new companies contacted. The project Executive Director (ED) attended the meetings with board members to describe AAH program and distribution systems. For the grower participants, the project team wrote annual letters regarding how the specialty crops were distributed, and the ED arranged for one-on-one meetings throughout the year to update the growers about the program. AAH cooler manager reached out to other cooler mangers to donate specialty crops as well.

The two trucks originally secured to transport specialty crops from growers donating surplus could no longer be used for the project because the trucks did not comply with California Air Resources Board (CARB) regulations. Therefore, the PD worked to find two used tractor trucks to be donated to the program. AAH had a promising lead with two used trucks, but the trucks were never needed as was anticipated.

The overall scope of the project did not benefit commodities other than specialty crops, and funds were used to solely enhance the competitiveness of specialty crops.

The contributions and role of project partners in the project were the stakeholders of AAH, representing all of the largest growers in Monterey, Santa Cruz and San Benito counties. These stakeholders/growers, shippers and processors directed the ED regarding the collection of surplus specialty crops and were to distribute them.

Goals and Outcomes Achieved

The overall goal of the project was to utilize additional cooler space for the Harvest Program which would expand access to healthy, safe California specialty crops by increasing overall consumption and improving distribution systems from farm to table of surplus produce.

This project would decrease the waste of surplus specialty crops from growers, shippers and processors in Monterey, Santa Cruz and San Benito counties by increasing the amount of cooler space to store surplus specialty crops from the Harvest Program before distribution to food banks in California.

Unfortunately the goals were not met for this project due to unforeseen issues. During the first growing season of the project the effects of the historic drought continued to decrease the supply of specialty crops grown elsewhere, which resulted in the growers giving less fresh specialty crops than anticipated during the peak time (April thru October), preventing the project team in utilizing the grant funds for cooler overflow. Besides the low water amounts, lack of labor in the produce markets had been extremely active which had an effect on the amount of overall specialty crops that normally would come into the cooler. During the second growing season the effects of the drought continued and with the demand in the marketplace for specialty crops, the surplus was much smaller than normal than in previous years.
AAH expected there to be more surplus specialty crops available because more growers and shippers were participating in the program. But the effects of the historic drought continued to decrease the supply of specialty crops grown elsewhere, therefore the need for additional cooler space was not required.

There were not any long term outcome measures in this project.

Project staff were unable to increase and hit the target of increased poundage of specialty crop surplus and make available to food bank partners, due to the slow recovery from this historic drought.

One of the most successful outcomes of the project is that there wasn't any surplus specialty crops that went to waste. All the fresh specialty crops received by AAH were distributed to food banks throughout California and school children in the Salinas Valley.

Beneficiaries

Groups and other operations that benefited from this project were specialty crop growers, shippers and processors in Monterey, Santa Cruz and San Benito counties, local food banks in the tri county area and school children in the Salinas Valley were the prime recipients of the surplus produce.

Over 20,000 people in the tri county area benefitted from this project.

Lessons Learned

Unfortunately, with not understanding how volatile and unpredictable agriculture can be, the potential pit falls of a drought were underestimated. A closer look at future patterns would be of benefit along with a broader use of funds.

One of the results that were an effect of implementing this project, staff have changed data collection and retention protocol. Also, analyzing trends of the agriculture industry and talking to specialty crop produce partners for in-depth information on potential issues that may arise will take place.

Lessons learned with this project would be the importance to consult others in the industry about the pros and cons of a potential project and the viability of such a project. Also, making sure complete data is collected along with a better detail request of funding.

Additional Information

No additional information.

USDA Project No.: 29	Project Title: Cooking Matters in Community	
Grant Recipient: 18 Reasons	**Grant Agreement No.:** SCB13029	**Date Submitted:** December 2014
Recipient Contact: Sarah Nelson	**Telephone:** (415) 994-2164	**Email:** sarah@18reasons.org

Project Summary

California's poverty rate is 23.25% (the highest in the nation), and nearly 10% of Californians have been diagnosed with Type 2 diabetes, typically caused by an unhealthy diet. Only 50% of eligible Californians receive CalFresh benefits (formerly known as food stamps). 18 Reasons and project partners recognize the clear and proven link between low economic status and high rates of diet-related disease, particularly in low-income diverse communities, and the need to reverse the linked trends of food insecurity and diet-related diseases. This project helped over 1,000 low-income families increase their consumption of healthy specialty crops.

The cooking-based nutrition education program, Cooking Matters, offers tools that empower residents to make healthy changes in their diet. Many participants begin their first class by reporting they "never" eat vegetables or "never" cook at home; by the end of the first class, these same participants are enthusiastically eating vegetables they have prepared, and vowing to make the same dish at home. Demand for this program has grown rapidly over the past two years, from 56 courses in 2011 to 120 in 2012. The total courses increased to 200 over the past year.

Project Approach

The project team completed 96 six-week-long Cooking Matters series as part of this project, graduating 1,062 adults and children from the program. This exceeded the goal of 90 series and 1,000 graduates.

Cooking Matters classes meet once a week for six weeks; each class is two hours long, and focuses on a different nutrition topic and cooking technique. Professional chefs and nutritionists volunteer to teach the classes, which are hosted by a variety of partner organizations including clinics, low-income housing sites, schools, food pantries, and community centers. Community health promoters are also trained to deliver Cooking Matters classes in their communities. This program offers community member's valuable training in cooking, nutrition, and facilitation skills, while enabling the program to reach communities more effectively.

18 Reasons worked with over 60 partner organizations to deliver Cooking Matters classes. Host site partners typically hear about this program through word of mouth, and reach out through an application on 18 Reasons website https://18reasons.org/cooking-matters/host. Hosts include any agency or nonprofit offering services to low-income clients. Once a day and time is established for the classes, host site staff members (who already have existing relationships with their clients) recruit participants for the series. Host site partners are required to sign up at least 20 participants, to ensure that each series has 8-15 people graduating from the 6-week series.

An 18 Reasons staff member coordinates each series, bringing all food, equipment, and materials to every class. Instructors (either volunteers or health promoters) use facilitated dialogue and hands-on teaching techniques (for example, using open-ended questions to guide discussion) to deliver the Cooking Matters classes. The first hour of class is dedicated to a nutrition and food budgeting topic; the second hour consists of hands-on cooking instruction and practice that relates to the lesson topics. At the end of each lesson, the class enjoys a healthy meal together and participants go home with a bag of fresh fruits and vegetables and copies of the recipes to practice making healthy meals at home. As the program is designed to build self-sufficiency, graduates can only complete the series once.

The learner-centered courses aim to identify the challenges each participant faces to eating and accessing healthy food, and each series is tailored to the specific needs and questions of the participants. For example, a class of parents of young children might focus on recipes that encourage children to enjoy trying new vegetables, while a class of teenagers might focus on acquiring basic cooking skills they can use to prepare quick snacks and breakfast items. The chef instructor or 18 Reasons staff member chooses each week's recipes based on what participants want to learn, as well as which fruits and vegetables are in season.

Seven Cooking Matters series were held in partnership with urban farm partners; of the 73 graduates of classes held on urban farms, 32 went on to subscribe to weekly farm boxes (a box of fresh fruits and vegetables grown on the farm – similar to a more traditional Community Supported Agriculture program). One of the urban farm partners also began offering weekly farm stands at social service offices, where project staff partnered with them to offer cooking demonstrations promoting California fruits and vegetables.

Fifteen adults and 20 teen community health workers were trained to conduct Cooking Matters classes in their community; the teens went on to teach two Cooking Matters series to their parents, and two Cooking Matters for Kids classes to younger children in the community. The adults taught a total of 16 Cooking Matters series. The project team plans to expand this program to other areas in 2015, training more teenagers as peer educators and engaging them as Cooking Matters instructors for both their parents and younger children.

The evaluation shows that graduates eat more fruits and vegetables and enjoy cooking more than they did before the class.

When staff members shop for Cooking Matters classes, they are careful to track specialty crop purchases separately from other ingredients they may need for that day's recipes. They enter each receipt into an excel spreadsheet with a column for specialty crops and a column for anything else. They are also careful to ensure all recipes focus on specialty crops as the main ingredient, and contain more than 50% specialty crops by weight.

Partnerships with urban farms have been successful in increasing enrollment in their farm boxes by 7% as well as increasing sales at farm stands.

Specialty crop produce for classes were sourced through partner Veritable Vegetable.

Project staff partnered with 30 different host sites who hosted Cooking Matters classes over the past six months. Host site partners included schools, clinics, shelters, free dining rooms, and community centers.

Goals and Outcomes Achieved

The project team partnered with 30 community-based organizations and two urban farms to plan and conduct 96 six-week-long cooking and nutrition classes. Thirty five community health workers were trained and deployed as instructors for these classes, as well as 220 volunteer chefs, nutritionists, and assistants. Class attendance, produce purchases, and enrollment in urban farm weekly farm box programs were carefully tracked. Each graduate completed a pre- and post-test measuring the behavior changes they made as a result of the program.

The overall goal was to complete 90 series with 1,000 graduates. 96 series were completed, with 1,062 graduates. Thirty five peer educators were also trained, which is 20 more than the goal of 15. Project staff worked with two urban farms to offer Cooking Matters classes, as planned, and was able to engage with one of the farms by offering cooking demonstrations at their farm stands in addition to offering classes in the community.

After a course, adults report that 82% are eating more vegetables; 76% are eating more fruits; 91% improved their cooking skills. They are eating at least two cups of fruit per day, 45% more often, and eating at least 2.5 cups of vegetables per day, 46% more often. Eighty one percent made a Cooking Matters recipe at home, and 98% would share the recipes they learned with others.

After a course, 40% of child graduates are more confident that they can make themselves a snack with fruits or vegetables, and 35% are more confident that they can talk to their parents about healthy eating. Eighty percent say they improved their cooking skills.

Urban farms experienced a 7% increase in sales directly due to Cooking Matters graduates signing up for farm box programs operated by the farms.

The overall goal of helping low-income families eat more fruits and vegetables and feel more confident about cooking fresh produce at home was achieved.

Beneficiaries

Fifty one percent of the graduates attending the Cooking Matter classes participate in some form of federal food assistance (CalFresh, WIC, or free school lunch). Sixty one percent of graduates are Latino, and nearly all of them attend classes taught in Spanish by peer educators.

Thirty California specialty crop farmers also benefited from the 14,000 pounds of specialty crops purchased and distributed through the program. Urban farms experienced a 7% increase in sales of farm boxes as a result of Cooking Matters classes and demonstrations conducted at the farms or farm stands operated by the farms.

One thousand sixty two low-income adults and kids graduated from the program; if each participant increased spending on fruits and vegetables by an average of $5 per week as a result of the program, the potential economic impact would be $276,000 per year in increased spending on specialty crops.

Lessons Learned

Project staff learned that teaching people to cook with fresh fruits and vegetables in a hands-on class is a powerful educational tool that can bring about significant behavior changes. Working with community health workers who come from the low-income communities served helps the classes to be even more effective. Partnering with urban farms helps increase community participation in weekly farm box delivery programs, while boosting fruit and vegetable consumption among participants.

Project staff did not expect to work with teen community health workers, but they turned out to be excellent teachers, engaging both children and adults in their lessons.

Additional Information

Attachment 1: Cooking Matters Participant Survey

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 30	**Project Title:** If They Grow it, They'll Eat it	
Grant Recipient: Western Growers Foundation	**Grant Agreement No.:** SCB13030	**Date Submitted:** December 2016
Recipient Contact: Ryan Zilker	**Telephone:** (949) 885-2229	**Email:** rzilker@wga.com

Project Summary

Western Growers Foundation (WGF) worked with the California Department of Education (CDE) to award 100 K-12 schools $1,500 each to grow and sustain a fruit and vegetable school garden. Schools applied for these competitive grants via an online application. Before awarding any funding to the schools, the applicants signed a form committing to only using the funds for fruit and veggetable seeds/plants, garden equipment and professional development. According to the CDE, nutrition is an essential building block for student success. Healthy, active, and well-nourished children are more likely to attend school and be more prepared and motivated to learn. Studies showed children who were taught nutrition while growing vegetables outdoors in their own gardens increased their preference for vegetables. Improving the desire to taste vegetables is a first step in developing healthier eating patterns.

Seventy-five percent of Americans eat less than two servings of fruits and vegetables per day. Today's children may be the first generation of Americans whose life expectancy will be shorter than that of their parents. A recent study by the Center for Disease Control (CDC) and Duke University stated that by 2030, 44% of Americans will be obese. Connecting people to their food source and educating them about the importance of 5 - 13 servings of fruits and vegetables per day is paramount to arresting this trend. By creating 100 edible school gardens, children were taught good nutrition and increased specialty crop consumption. In addition, those adults (both parents and teachers) who were involved in gardening and promoting this message to their children and students were more likely to consume more produce.

WGF and CDE partnered on two previous grants, each offering $1,000 to one hundred preschool centers for edible school gardens; 2010 Specialty Crop Block Grant Program (SCBGP) Project 16: *Garden-Enhanced Nutrition Education Grants for Pre-school* and 2012 SCBGP Project 27: *Child care/Pre-school Fruit and Vegetable Gardens*. This project focused on K-12 and provided $1,500 each. Useful information had been obtained from past grants; like ways to improve accountability, measurability and communication with grantees. Prior to awarding funds, the grantees signed a letter of commitment to participate in follow-up surveys, provide receipts (when possible) and be open to visits. The Association Management System database was incorporated into the grant process. This provided financial reconciliation, contact tracking, mobile capabilities and website integration. This database management allowed for better tracking of the needs and successes of the grantees and helped facilitate efficient communication with them.

Project Approach

WGF worked with a contractor to create an improved online application for schools to apply for the grants. This system allowed applicants to save and come back to their application, upload documents such as a garden budget, W-9 and photos as well as confirm application submission. Project staff worked with CDE to promote the grant opportunity to California K-12 schools via email communications. In total, 179 applications were received and reviewed with the help of the Child Nutrition Assistant at the CDE. Both parties used a scoring checklist to ensure consistency with review. The top 100 highest scoring schools were selected to receive the grants and winners were announced via email and online at http://www.csgn.org/news/california-school-garden-grant-winners-announced. Grant recipient schools were then sent checks for $1,500, a copy of California Gardens for Learning book, Producepedia bookmarks, seed packets, and recipe cards. Upon receipt of the grant packages, the school garden coordinator at each school completed and returned a commitment form to confirm receipt of the grant package and acknowledge agreement to the grant guidelines.

During the project period 10 recipient schools were visited and media was earned in San Diego, Orange County, Shasta and Oakland. WGF visited an additional seven schools for filming and created a video to promote the school garden program and support the specialty crop industry. The video can be viewed at https://www.youtube.com/watch?v=Ip0bNlTpLIY or http://www.csgn.org/california. The video currently has 319 views.

The project did not benefit any other commodities other than specialty crops.

CDE was instrumental in promoting the grant application and also reviewing the applications. A project partner created the online application tool, addressed bugs and trained project staff on use of the tool.

Goals and Outcomes Achieved

The three goals of the project were 1) create new fruit and vegetable school gardens; 2) awareness of how food is grown and awareness of California specialty crop farmers through Producepedia web presence engagement; and 3) increase the number of California students exposed to fresh produce and how it is grown.

WGF received and reviewed 179 grant applications and chose 100 mini-grant recipients. WGF was able to meet the goal of creating 100 new fruit and vegetable gardens with the distribution of 100 mini-grants for $1,500 each. Each grant recipient school had on average 50 students participating in the gardens (~5,000 total) which exceeds the goal of 2,500 students involved in planting/harvesting fruits and vegetables.

WGF was unable to meet the goal of increasing traffic to Producepedia.com because it was impossible to determine where the traffic was coming from and if it could be attributed to this grant project or not; however, project staff are confident that progress was still made on increasing awareness of how food is grown and awareness of California specialty crop farmers through Producepedia.com, though this cannot be quantified.

Prior to the grant project, WGF had funded 600 California K-12 schools with money for fruit and vegetable gardens. At the end of this project WGF can confirm that 100 more gardens were created bringing the total funded to 700 gardens.

Over 5,000 students participated in the school gardens according to data provided by each school. That number exceeds the project goal and improves the impact of this project that much more.

Beneficiaries

Each grant recipient school and their students (approximately 5,000) benefitted from the creation of fruit and vegetable gardens through WGF's grants. WGF estimates that approximately 5,000 students benefitted from the grant and likely the same amount of parents were impacted garnering increased consumption of fruits and vegetables. This project increased the amount of California edible school gardens by 100. Students and their families learned about nutrition and the joys growing and of eating more produce.

The California produce industry represents more than $20 billion dollars. As children learn to enjoy fruits and vegetables through participation in school gardens, they are not only improving their own personal health, but also supporting one of the state's most important industries. Additionally, a child's increased taste for fruit and vegetables often leads to increased consumption of such foods by their parents.

Lessons Learned

Based on the amount of grant applications submitted, it proved to WGF that the interest in school gardens is growing and so is the demand for funding. WGF learned that monitoring web traffic is not a viable option for future grant projects because of the inability to determine source of said traffic. The goal of increasing web traffic to Producepedia was not met because it was impossible to gauge the source of web traffic and attribute it to this particular project.

Additional Information

Media coverage:
Times of San Diego (October 2014): http://timesofsandiego.com/education/2014/10/31/western-growers-foundation-announces-150000-california-garden-grant-recipients-4/
San Diego 6 (October 2014): http://www.sandiego6.com/news/local/12-SD-County-schools-get-edible-garden-grants-281138422.html
Capital Press (November 2014): http://www.capitalpress.com/California/20141105/grants-help-calif-schools-plant-expand-gardens
Orange County Register & Current – December 2014
UT San Diego (February 2015): http://www.utsandiego.com/news/2015/feb/05/vista-high-farm-community-service-honor/
Oakland Post (April 2015): http://postnewsgroup.com/blog/2015/04/15/malcolm-x-wins-grant-support-school-garden/
The Fresno Bee - http://www.fresnobee.com/news/local/education/article20936754.html
Topanga Messenger - http://www.topangamessenger.com/story_detail.php?ArticleID=7554

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 31	**Project Title:** Fresh Food for Native Folks	
Grant Recipient: Hoopa Valley Tribe	**Grant Agreement No.:** SCB13031	**Date Submitted:** December 2016
Recipient Contact: Kimberly Davis	**Telephone:** (530) 625-4284 ext. 110	**Email:** KimmerzDawn@live.com

Project Summary

The Hoopa Valley Reservation is located in a small rural town that had little access to fresh healthy produce and a high obesity and diabetic population. The high poverty rate in Hoopa and the surrounding communities and the fact that there was only one grocery store with a small fresh produce section made it a necessity to come up with a way to make available fresh healthy foods. The aim of this project was to create healthier produce and a farmers market to provide Hoopa and surrounding communities access to these products. With the availability of the crops, the community was able to start making healthier food choices, income was made by the farmers, farms were created by the project (this was not a main goal by it does help the poverty stricken community), and those who suffer with diabetes and struggle with obesity were provided healthier food choice options. With the use of a matching fund vouchers awarded to those who qualified as low-income, families were able to purchase even more healthy food than they originally would have been able to.

In the Hoopa Valley and nearby areas there has been a large rise in obesity and diabetes affecting the community members. The ability for people to access healthy, affordable foods is the foremost reason for this problem. There is one grocery store in the town of Hoopa, which has a small selection of overpriced produce. The majority of the people are low-income families who cannot afford to purchase these foods on a regular basis. Not being able to buy healthy foods, the community is left buying the cheaper foods that are full of sugar. The longer the community is denied access to healthier foods, like specialty crops, the worse the problem will get. The local diabetes program already has reached its limit on the amount of clients it can help. Also there is a large rise in many people attempting to use diet shakes in place of being able to just eat healthier and lose the weight that is causing high risk to their health and well-being.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Six farmer recruitment meetings were held on 1/22/14, 2/27/14, 12/22/15, 12/29/15, 03/09/16 and 03/16/16. The meetings had an average attendance of 15 people per meeting but did well with getting the word out into the community. Informational and recruitment meetings were organized in order for the project director to meet and talk with the local public about the project purpose and the potential farmers responsibilities. Farmer applications, which included project information and rules, were handed out during the meetings for the attendants to complete as well as pass along to others who were interested in the project. The potential farmers and returning farmers had the opportunity to ask questions and meet the agricultural crew that would be working with them on the gardens. Every year of the project showed an increase of farmer applicants and an increase of farmers who participated. In the end, the project had up to 35 farmer applications and 20 farmers currently participating as of the project end date.

The majority of supplies were purchased at the beginning of the grant project. Flyers, posters, and handouts were made to advertise the recruitment meetings, the farmers markets, and matching fund voucher program. These advertisements were distributed out by the agricultural technicians. All supply purchases were conducted by the director. The project director approved all matching fund vouchers awarded. These purchases were made for items that were needed for the grant project in order to enhance the knowledge and use of California specialty crops by the Hoopa community and surrounding community members.

Planting and land preparation took place starting generally every February for the majority of the crops planted and in October for winter crops. Planting consisted of sowing the seeds directly into garden sites or into seedling pots, then older seedlings and saplings (trees and berries) were transplanted during proper season timing and when the seedlings were ready. Normal planting usually started in March and could go all the way into late July or August for some plant species; winter plants were usually planted around November at the latest. Land preparation consisted of ground tilling, plowing, row and mound building with soil media, trench digging, trellis setup, raised box building, raised bed box setup, weed and rock removal, and digging of holes. Inventory of tools, supplies, and seeds were carried out regularly as needed. During growing season, after plants have been sown, the seedlings were watered, weeded, and fed the necessary fertilizer by the agricultural technicians and the director.

Prior to having farmers markets, farmer meetings took place to prepare for the markets. Seven farmer meetings took place on 5/22/14, 7/18/14, 4/23/15, 7/13/15, 8/03/15, 5/18/16 and 5/27/16. The last two farmers meetings took place in order to prepare the farmers for self-sufficiently continuing the farmers markets after the end of the project funding. Farmers markets started late July after the first crops became mature enough to harvest and continued up into the end of October. After the first project year farmer market booths were held as well as full farmer market days. These market booths consisted of the agricultural technician crew and a few farmers who wished to participate, but were not required to. The booths took place during the week and was a way to increase the sale and consumption of specialty crops by those who could not attend the full farmers markets that took place on weekends. Throughout the project 15 full farmers markets that consisted of all the farmers having a table and specialty crops to sell took place and nearly 20 market booths were set up. The director developed surveys that were given out to the public during each farmer's market day. These surveys were collected and later analyzed to show a 5% increase in knowledge and use of California specialty crops by the Hoopa community and surrounding communities.

Only specialty crop commodities benefitted from the project. All grant work, activities, and funds only benefitted California specialty crops.

Project partners include the temporary seasonal employees at Tsemeta Nursery. The seasonal employees, under the directives of the project director, carried out the following activities during the project: Growing of fruit and vegetable seedlings for planting in farmers gardens which consisted of filling pots with soil media mixture, sowing seeds in the pots or directly in the gardens, watering, weeding, and applying fertilizer to the growing seedlings; land and garden site preparation which consisted of ground plowing, tilling, row and mound building with soil media, trench digging, trellis setup, raised box building, raised bed box setup, weed and rock removal, and digging of holes; and transplanting of seedlings, fruit trees and fruit bushes into the raised beds and garden sites that were prepped.

Goals and Outcomes Achieved

This project was meant as a startup project. The aim was to get a farmers market started that would continue long after the grant funding was done. The Fresh Food for Native Folks project is a success. Several farms have been successfully created and the farmers are continuing on with farmers markets. There had been a lot of work during the last six months of the project to help get these farms and farmers well established to be self-sufficient and able to continue to supply the community with fresh and healthy California specialty crops. At least five of the 20 farmers that the project ended with have been a part of the project since the very start and have been holding their own markets since the end of the grant funding in June of 2016. The five farmers have been keeping in contact with all the farmers and have done very well in overseeing the continuation of the farmers markets.

Compared to the initial plan, the project's actual accomplishments were on schedule for all activities except a few. One project activity that was consistently off target was the meetings. The meetings took place like planned but they did not take place during the months originally set. This change was made to help ensure that more people would be able to attend the meetings. Although the majority of the supplies purchased were made during the proposed months, it became clear that supplies and other grant project expenditures were necessary throughout the entirety of the grant project.

The data gathered from the farmers markets during the first year of surveys showed there was little to absolutely no knowledge and consumption of California specialty crops by the Hoopa community and surrounding communities. This was not surprising considering such a market and product did not exist in the area. At the end of the project it was shown that at least 5% of the Hoopa community consumes California specialty crops and know what California specialty crops are. The benchmark goal was to get 190 to 200 people to attend and make purchases at the farmers markets, which would have showed that at least 15% of the Hoopa population was now regularly consuming California specialty crops. That did not happen and the attendance stayed at an average of 61 people attending the markets. Considering the average attendance of 61 people at each farmers market and assuming that the average local Hoopa community household consists of 4 people, it is safe to say that 5% of the local Hoopa community population of 5,100 were purchasing and consuming California Specialty Crops. This is not the outcome that was initially proposed, but it does show that there is now a successful California specialty crop market where there was once none.

There is now a seasonal farmers market in the town of Hoopa where there was once no farmers market. When the project started there was little to no knowledge or consistent consumption of California specialty crops among the Hoopa and surrounding communities. Now at least 5% of the Hoopa community population know of California Specialty crops and now purchase and consume them on a regular basis. The project made 20 successful farms that grow and produce California specialty crops of which five have been with the project from the start and are now continuing to oversee the farmers markets that the 20 farms participate in.

Beneficiaries

The main beneficiaries of this project are the local farmers and specialty crop consumers of the Hoopa community. Other beneficiaries include the obesity patients within the community that now have access to fresh, local specialty crops.

If 5% of the Hoopa community of 5,100 is purchasing and consuming specialty crops, then approximately 250 consumers benefited from this project. The 20+ farmers who participated in the project are also benefiting from specialty crop sales in the community.

Lessons Learned

Positive lessons learned include learning all the hard work that goes into growing California specialty crops. When the project started the director, agricultural crew and farmers had little to no knowledge on how the majority of the crops grew or how they needed to be cared for. Now after working with them for the length of the project, knowledge on how to properly care for them and how to get large harvest from the crops was acquired. These horticulture skills have come to help with knowing what can be planted in the area and what cannot, the proper amount of fertilizer and water needed, and how much space each plant needs to grow. Also the farmers learned their consumer market, helping them know what types of crops to grow more of and what type of crops did not sell well. Farmers market location was another positive lessoned learned. After holding the farmers markets at a few different locals within the town of Hoopa it became apparent that holding the market as close to the center of town where the more people pass through was the best location for higher sales. There were several losses of seedlings, tools and supplies due to theft. The result of these thefts helped the staff learn to keep better inventory of all the supplies and plants for the remainder of the project and to store them more securely. California has been in drought conditions during the entirety of the project which posed a real problem. The lack of water availability had caused complete loss of more than one garden and some crop loss to a lesser extent for others. These conditions helped the staff and farmers to learn water conservation methods, which helped to save water while also still providing enough for crop survival.

A very unexpected but positive result from the implementation of this project was the rise in the number of people growing their own home gardens in the area. A large majority of the customers who attended the farmers markets have stated that since they started purchasing the produce from the farmers market it inspired them to try growing a few of their own vegetables. These crops were usually the more utilized crops such as tomatoes and zucchini. This was not intended but with the need of the obese and diabetic population in the Hoopa community it is a positive result.

The only goal that was not achieved was the benchmark goal of getting 15% of the Hoopa population to purchase and consume California specialty crops. Staff did not account for the fact that this was a new market for the Hoopa area. A more realistic goal should have been considered. Although, eventually the amount of specialty crop consumers in the Hoopa area may reach 15% it did not happen during the short grant project time frame. This could have been avoided if a little more research into the ability and willingness of the targeted consumer had been done.

Additional Information

No additional information.

USDA Project No.: 32	**Project Title:** NCO FoodPREP (Produce + Rural Enterprise for Prosperity) Project	
Grant Recipient: North Coast Opportunities	**Grant Agreement No.:** SCB13032	**Date Submitted:** December 2016
Recipient Contact: Patty Bruder	**Telephone:** (707) 462-1956	**Email:** pbruder@ncoinc.org

Project Summary

Through the Produce + Rural Enterprise for Prosperity (FoodPREP) Project, North Coast Opportunities (NCO) proposed to partner with the Ford Street Project and local specialty crop producers to purchase and process Mendocino and Lake County fruits and vegetables and market them to institutional and retail buyers. The FoodPREP Project was designed to add an essential link to the value chain between growers and institutional buyers by creating the community's first food processing facility, building on existing resources to link specialty crop growers with mainstream markets.

NCO anticipated that FoodPREP would increase farm income for specialty crop producers, because they would have increased access to institutional markets. Farmers who lacked the capacity to clean, process, and package their specialty crops for institutional use would gain market access, while schools and other institutions that lacked the resources to process excess specialty crops for use during winter months would increase their utilization of local crops. Further, clients of Ford Street, which provides transitional housing and substance abuse treatment programs, would gain nutritional knowledge and job skills, learning to clean, cube, freeze, can, or otherwise process specialty crops while fulfilling their commitment to work 20 hours per week in exchange for transitional housing.

Project goals were to: 1) improve nutritional awareness of children and adults and increase consumption of California specialty crops; 2) enhance utilization of specialty crops by improving the efficiency of the processing and distribution systems; and 3) encourage and expand the availability of affordable and locally grown specialty crops through farm-to-fork programs that would make it easier for specialty crop producers to sell to local institutions. These goals were to be addressed through the FoodPREP Project objectives:

- Purchase specialty crops from local producers to process and package foods for purchase by schools and other institutions
- Provide nutrition education, food preparation and processing training, and work experience to 40 homeless people living in on-site transitional housing.
- Develop and distribute at least one branded food product, such as a soup or soup mix, for marketing in retail outlets in the community.

At the end of Year 1, NCO revised the proposed activities because Ford Street was not able to continue its participation in the project. Although this revision resulted in extensive programmatic changes, the project's overall goals remained the same. NCO partnered with a range of community partners to purchase bulk quantities of specialty crops from local producers and use them in presenting food processing workshops in low-income communities. Details are reported in the Project Approach Section below.

NCO has been working to strengthen the local food system for more than 15 years. The FoodPREP Project addressed two important components of the food system by providing a new market for local specialty crop producers while increasing nutritional knowledge, specialty crop processing skills, and specialty crop consumption in low-income communities.

The project benefited from work accomplished through two previous Specialty Crop Block Grant Program (SCBGP) projects, as described below.

The 2011 SCBGP Project 46: *North Coast Opportunities Farm2Fork Project* provided training, equipment, and technical assistance (TA) to specialty crop producers and to schools and other buyers to increase institutional purchasing of locally grown specialty crops. This effort trained 65 school food service staff, and four school districts began buying fresh specialty crops from 12 local specialty crops growers, representing a sustainable 100-250% increase in local farm to school purchasing. An additional nine school districts, three hospitals, seven grocers, and 15 restaurants also began developing their local purchasing capacity through Farm2Fork and regional producers began to benefit from the increased institutional demand for local specialty crops. Farm2Fork increased school demand for local produce and prepared specialty crop producers to sell to this market, allowing them to experience the economic potential of selling to institutional markets. The Farm2Fork Trainer transitioned to become the FoodPREP Project Coordinator, and structures, processes, and lessons learned through Farm2Fork created a solid foundation for implementation of the FoodPREP Project.

The 2013 SCBGP Project 5: *NCO Food Hub Project* was developed to maintain and expand the Lake County Grown online ordering system and to facilitate partnerships that would increase market access for Lake and Mendocino County farmers and buyers. During the course of the FoodPREP Project, this effort became a fully developed online ordering system as part of the 2013 SCBGP Project 5. The online ordering system has played a key role in developing the link between institutional buyers and specialty crop producers. The two projects complemented each other, with the Food Hub Project establishing and operating the online system and the FoodPREP Project ordering local produce through the system for use in project activities.

Project Approach

Year 1: During the first year of the grant, NCO strengthened both individual- and community-level food self-reliance while addressing the needs of Ford Street's highly vulnerable clients by completing the following tasks:

- Working in partnership with the Food Hub Project, NCO recruited 22 specialty crop producers, buyers, and community members to participate in an Advisory Group that met regularly throughout the project.
- NCO entered into an agreement with the Ford Street Project, completed an assessment of the Ford Street kitchen facility, and purchased storage and small ware upgrades.
- NCO's Gardens Project worked with Ford Street to revitalize two Ford Street Project gardens and create a new production garden, growing more than 25 specialty crop varieties.
- During the year, NCO conducted three rounds of trainings (24 trainings in all) covering 12 training topics. A total of 54 people participated in the trainings—49 clients and 5 Ford Street staff. The food-related trainings began with three core classes that were prerequisites for subsequent trainings. These were Knife Skills, Food Safety, and Kitchen Operations. These topics were expanded through separate, more detailed training sessions that covered the use, care, handling, storage, processing, and preparation of specialty crops for healthy family and/or congregate meals. Training was delivered in both a classroom setting and through hands-on demonstration and practice in the kitchen. During the course of the year, half of the participants completed at least three of the training sessions. Although the Ford Street Project did not continue with the project, the organization has continued to deliver an in-house version of the training curriculum.

- The project integrated the processing of local specialty crops and from the on-site gardens into clients' daily work schedule so that meals were prepared using these ingredients, improving the nutritional value of the meals. Ford Street has continued to serve its clients the improved menus that were developed through FoodPREP.
- NCO developed a comprehensive training curricula and training materials covering nutrition education as well as personal and institutional specialty crop processing and cooking skills.
- In fulfillment of the objective of developing and marketing a value-added specialty crop product, NCO partnered with Ford Street to purchase 720 pounds of local apples and sell 182 jars of "apple crisp in a jar" mix using dehydrated apples to local businesses and individuals.
- NCO also developed a demonstration catering program as a social enterprise to further develop skills and generate income to sustain the program. By the end of Year 1, NCO had developed 15 catering-ready recipes and training participants had planned, prepared, and served meals at eight events that ranged from 12 to 40 diners.

Years 2 and 3: During the second and third years of the project, NCO worked with five community organizations to bring specialty crop processing skills to low income communities:

- To identify appropriate partners, NCO prepared a Request for Proposals and interviewed a variety of agencies in Lake and Mendocino County to assess their needs, interest, and capacity to partner with NCO in planning and delivering food processing workshops. Contracts and Memorandum of Understandings (MOUs) were developed with five selected organizations, detailing their responsibilities in conducting workshops using their commercial kitchens and facilities.
- NCO developed a comprehensive training curriculum with a wide range of recipes and meal plans utilizing local seasonal specialty crops. Rather than being organized as a series of workshops, each workshop was a stand-alone food processing lesson.
- NCO conducted assessments of each partner's commercial kitchen and purchased a variety of kitchen supplies to facilitate implementation of the food processing workshops. Providing project partners with appropriate supplies had a significant impact on their capacity to plan, prepare, and process specialty crops for use in their programs (as detailed in Table 3).
- NCO piloted the workshops at Willits Grange in October 2014 and at Ukiah Senior Center in December 2014. In the pilot workshops, participants canned applesauce and pears in honey, made butternut squash soup, and learned tips for storing, preparing, and preserving specialty crops. All local specialty crops used in the pilot workshops were purchased and/or harvested from two local farms and a community garden.
- Full workshop schedules began in April 2015. In all, there were 369 participants in the 89 trainings and workshops offered by the project during the grant period.

Table 1. Workshop summary

Year	Number of trainings or workshops	Number of participants
Year 1	24 trainings	54 (49 Ford Street clients/5 Ford Street staff)
Year 2	41 workshops	198 participants
Year 3	24 workshops	117 participants
Total	**89 trainings and workshops**	**369 participants (290 unduplicated)**

- NCO purchased 3,476 pounds of fresh local specialty crops through the Food Hub to prepare the focused foods for each workshop. These specialty crops, which cost a total of $4,906 (averaging

$1.41/pound), included bulk purchases made through the Food Hub for workshop participants' use in their own kitchens as well as the food purchased for the workshops. During each workshop, produce was weighed, measured in volume, and amounts documented so that recipes could be replicated easily in the future. Each recipe included the amounts of produce needed in order to prepare batches of various sizes, serving up to 50 people. The finished products were measured and accurate yields were documented on the recipes for future use.
- NCO efforts to modify the existing online ordering system enabled the MendoLake Food Hub to become operational during Year 2. The Food Hub ordering system was used throughout the remainder of the project to purchase specialty crops for use in FoodPREP workshops.

The project was designed for the sole benefit of specialty crops, and all project activities related to the grant were focused on promoting sales, consumption, and utilization of local specialty crops. The Food Hub lists and sells only specialty crops, thus ensuring recipes and food preservation activities are using these ingredients. Recipes used in training and workshops featured specialty crops grown in season and used in a multitude of ways. Ingredients used in the recipes were primarily seasonal specialty crops.

The Food Hub Advisory Committee has been instrumental in providing advice and feedback for the benefits and challenges of the online ordering system. The group consists of farmers, local businesses, financial professionals, and representative from the Environmental Health Department.

The Mendocino County Farmers Market Association (MCFARM) has been a major supporter for advertising the workshops and encouraging farmers to sell their specialty crops through the Food Hub.

During Year 1, NCO partnered primarily with the Ford Street Project. Ford Street's contributions to the project included the kitchen facility and access to the target population. Ford Street benefited from the project in numerous ways. Even though they participated as a partner in the project only during the first year, they have continued to use the training curriculum that was developed through the project as well as the recipes that were developed to incorporate specialty crops in client meals. Ford Street is continuing to harvest produce for client meals from gardens developed with the assistance of the NCO Gardens Project. However, Ford Street did not continue to purchase from local specialty crop farmers or create any additional specialty crop products to sell outside their program.

During Years 2 and 3, NCO partnered with five organizations to deliver food processing workshops: Caspar Community Center, Willits Little Lake Grange, Ukiah Senior Center, Lakeport Big Valley Grange, and Clearlake Highland Senior Center. Although similar, each site differed in its needs and structure. Each site provided access to their commercial kitchen, classroom space for the workshops, and, through their membership, assistance with recruiting workshop participants. In two sites (Caspar Community Center and Lakeport Big Valley Grange), NCO contracted with a local trainer to conduct the workshops, while project staff organized and delivered the workshops in the other three locations.

Goals and Outcomes Achieved

The overall aim of the FoodPREP Project was to enhance the competitiveness of specialty crops by completing the value chain between specialty crop producers and mainstream markets through infrastructure and food processing. Activities carried out in pursuit of each goal and outcome are described below.

GOAL 1. Improve nutritional awareness of children and adults and increase consumption of California specialty crops. The project addressed this goal through the food processing workshops described in the previous section, each of which was a stand-alone food processing lesson. By the end of the project, NCO had conducted 89 workshops, with 369 participants. Attendance averaged 8 and ranged from one to 29 people.

Many people attended multiple workshops, resulting in an unduplicated number of 290 participants. Of these, 195 (67%) attended just one workshop, while 48 (17%) attended two workshops; 20 (7%) attended three workshops; 13 (4%) attended four workshops; and 14 (5%) attended five workshops or more. One individual participated in 14 workshops!

The three-four hour workshops were based on specialty crops that were available locally at the time of the workshop, and the lesson plans and recipes were developed to feature those crops. During each workshop, participants were given an overview of the project, information about the crops being used and the farmers that grew them, and instruction on following the featured recipes. With the introduction complete, instructors guided participants through the hands-on kitchen preparation as they learned to work in a commercial kitchen. Food preservation was a key component of the curriculum, so participants were given training on food safety and proper canning techniques, using USDA Canning Guidelines. Various food preservation methods were taught, including canning and freezing, and recipes included jams, pickles, canned fruits, salads, vegetable spreads, sauces, pestos, salsas, and soups. In addition, NCO conducted three workshops that were specifically focused on the use of specialty crops in meeting the nutritional needs of people with diabetes.

GOAL 2. Enhance utilization of California grown specialty crops by improving the efficiency of the processing and distribution systems. Working in partnership with the MendoLake Food Hub, NCO addressed distribution efficiency through the modification, development, and operation of the online ordering system. The ordering system makes it possible for business and institutional buyers to see available local specialty crops in real time, order the produce they need, and have it delivered to their location. NCO addressed processing efficiency through the food processing workshops, which increased the number of people with skills and knowledge related to processing local specialty crops.

GOAL 3. Encourage and expand the availability of affordable and locally grown specialty crops through farm-to-fork programs that make it easier for producers to sell to local institutions. As with Goal 2, NCO's online ordering system made it easier for producers to sell to local institutions, while facilitating purchase of local specialty crops by business and institutional buyers. FoodPREP staff contributed to the success of the online ordering system by helping to train food service staff from schools and other organizations to use the new system.

OUTCOME 1. Sales of locally-produced specialty crops will be increased through the participation of 44 of the 110 local specialty crop producers, and by increasing the number of institutional/retail buyers from eight to 15. FoodPREP purchased specialty crops for workshops through the online ordering system, which makes it possible to identify the producer associated with each purchase. Workshop fees paid by participants enabled the project to purchase specialty crops from a total of 41 specialty crop producers during the course of the project, and four of the five Year 2 and 3 project partners have continued to purchase specialty crops through the Food Hub for operation of their own programs. (The fifth partner, Lakeport Big Valley Grange, buys from the farmers market located a half mile from their location.) Among Year 3 workshop participants, 71% reported that they would "definitely" or "probably" purchase local produce through the Food Hub in the future, and several have already done so.

As a result of the workshop introductions to individual local farmers and to a variety of local food outlets, community members who attended the workshops gained a stronger awareness and appreciation of the local specialty products available and commented on the new skills and resources they had gained. On Year 3 post-surveys, 96% of surveyed workshop participants stated they "probably will" (15%) or "definitely will" (81%) increase their purchasing of local specialty crops. They gave high praise for the workshop content, organization, recipes, quality of produce, and collaborative group learning.

OUTCOME 2. The competitiveness of local specialty crops will be enhanced as producers experience increased market access, including 10% reduction in marketing time, expansion of marketing season by at least three months, and a 15% increase in marketing of surplus and seconds. During the last year of the project, staff conducted surveys of 23 specialty crop producers that sold their produce through the Food Hub for use in FoodPREP workshops. Asked how many times they had sold through the Food Hub, 14 producers (61%) reported that they had sold through the produce two to five times, while nine producers (39%) sold more than five times during the grant period. Producers were asked to report farm business costs (e.g., transporting produce to markets, marketing, and post-production costs) that were impacted by their participation in the Food Hub. Of the 21 producers that responded to this question, all but two reported decreased costs in at least one of the expense areas. The extent of the change in costs varied widely, ranging from 1% to 100%. (Note that, while 21 producers reported cost decreases, not all provided an estimated amount of decrease.) Producers were also asked to report any net gains in farm income that resulted from their participation, as well as the type of farm business activity that resulted in the increased income (e.g., increased sales, higher sales prices, more sales of surplus and seconds). Of the 23 producers that responded to this question, all but four reported small increases in their net income that ranged from 0.1% to 60%. Producers were next asked to report any changes in the amount of time they spent on their farm business as a result of their participation, as well as the types of activities (e.g., marketing, transportation, direct sales) for which the time spent changed. In all, 16 of the 23 producers (70%) reported reduced time spent in at least one activity.

OUTCOME 3. Community awareness of the availability and value of local specialty crops and value-added products made from local specialty crops will be increased. Working in coordination with NCO's other food system programs, the FoodPREP Project carried out a number of community education and marketing activities to increase community awareness of the availability and value of purchasing and consuming local specialty crops. In addition to 16 presentations to community groups reaching 482 people (summarized in Table 2 below), these activities included: articles in local newspapers; print and radio public service announcements (PSAs), and six issues of an e-newsletter, The FoodPREP News. Recruitment for workshops was conducted at food stamp tables at four farmers markets; at local clinics, Public Health and CalWorks; and through PSAs on two radio stations, four newspaper articles, and posting of flyers, social media, and 12 blog posts on the NCO website, NCO Facebook page, Grown Local website and Facebook page, and the NCO Gardens Project Facebook page.

Table 2. Community presentations

Location	Number	Content
Big Valley Grange Board of Directors	3	Overview of project, potential for partnering
Caspar Community Center	12	Overview of project, potential for partnering
Clearlake Highlands Senior Center	9	Overview of project, potential for partnering
Ford Street Project Board	8	Overview of project and progress
Grange Farm School	8	Overview of project, potential for partnering
Hopland Pomo Specialty Foods Show	100	Demonstration, samples of specialty crops
Lake County Farmers Market Board	8	Potential for selling specialty crops
Lake County Hunger Taskforce	10	Overview of project, community needs
Leaders for a Healthy Community (Ukiah)	25	Overview of progress, samples of specialty crop foods
Leaders for a Healthy Community (Ukiah)	15	
Mendocino County Farmers Guild	55	Potential for selling specialty crops
Mendocino County Farmers Market Association	43	Potential for selling specialty crops

NCO Board	17	Overview of project and progress
Willits Hometown Festival	100	Overview of progress, specialty crop samples
Willits Little Lake Grange Board	30	Overview of project, potential for partnering
Willits Senior Center	40	Overview of project, potential for partnering

While the original outcome measures were intended to be achieved during the project period, NCO is confident that these measures will continue to increase into the future (e.g., increased number of participating producers and buyers, and increased community awareness of the availability and value of local specialty crops).

Baseline data collected at the beginning of the project was primarily qualitative in nature; most local specialty crop producers were either unable or unwilling to share specific details related to their income and expenditures. Rather, baseline data collected by the project focused on compiling data on the local specialty crop producers (e.g., where they are located, types of crops they produce, where their produce is sold, marketing strategies) and local specialty crop buyers. Intensive interviews with 16 producers revealed that: 13 sell locally (within 100 miles); seven would like to sell wholesale; seven would scale up and grow more if they were sure they could sell it; and their most successful crops were cucumbers, tomatoes, greens, squash, potatoes, and orchard fruit. NCO also collected post-workshop assessments from participants to assess self-reported knowledge gains, provided previously in this report.

Some of the major successful outcomes of the FoodPREP project was NCO conducted a total of 89 workshops and trainings reaching 369 people with information on specialty crop nutrition and processing and purchased 3,476 pounds of local specialty crops through the Food Hub, from 41 producers. NCO also developed a wealth of training materials and resources that will be an integral part of the continuing program and will also be used independently by project partners, including those listed below:

- A comprehensive training curricula and lesson plans for the specialty crop workshops.
- A binder of 105 tested bulk recipes that is indexed alphabetically as well as by food type, primary ingredients, and season, with each recipe designed for ease in adapting to prepare any number of servings. A binder has been shared with each partner site and NCO is working to create a searchable digital version of the recipes that can be posted online.
- A comprehensive listing of 39 locally available seasonal specialty crops, categorized by months of peak season and months of shoulder season.
- An assessment of 20 potential partners throughout the two-county area for continuation of the project.

Beneficiaries

Specialty crop producers: As described previously, the project purchased 3,476 pounds of specialty crops from 41 local specialty crop producers during the grant period. Responding to surveys conducted at the end of the project, producers reported that they had benefited from the project in terms of decreased operational costs, increased farm income, and reduced time spent on marketing, and transportation, and sales activities.

Ford Street clients: At the end of the project, 20 (69%) Ford Street clients reported that they knew more about cooking healthy food than they did at the beginning of the project, and nearly three-quarters (73%) said they would use what they had learned “quite a bit” or “a lot” to improve their health. In addition, three clients gained employment in the food service sector, two earned Food Manager Certificates, and three earned Food Handler certificates.

Workshop participants: Survey responses from a high proportion of workshop participants show that participants benefited from learning “quite a bit” or “a lot” from the workshops in terms of food preservation techniques (92% in Year 1 and 92% in Year 2), new recipes using local specialty crops (98% in Year 1 and 92% in Year 2), and using local specialty crops to prepare healthy meals (97% in Year 1 and 93% in Year 2).

As previously noted, beneficiaries included the 41 specialty crops producers whose produce was purchased for use in project activities, as well as the 290 participants in trainings and food processing workshops.

Lessons Learned

Although the Ford Street Project initially seemed an ideal partner for implementing the project, it became clear during the first year that the turnover of both staff and clients, and the transitional situation of many clients, made it difficult to conduct trainings with consistency. NCO addressed this challenge by learning to value every opportunity to interact and offer learning opportunities to participants, whether or not the individual followed through by completing an entire training series. Although this approach limited the project’s capacity to standardize the learning experience and collect comparable pre/post data for assessing learning and behavior changes, letting people participate at-will enabled NCO to reach the highest possible number of individuals. To further facilitate participation, NCO condensed the length of the trainings to a three-week package (rather than the planned six-week package) and invited people who had missed a training to participate in make-up sessions that were offered during the last quarter of the year.

Programmatic, budget, and staff changes made it impossible for Ford Street to purchase from local specialty crop farmers. Since most of the canned and frozen commodities used in the Ford Street food program are donated, they did not have the funds to begin purchasing from local specialty crop producers. Ford Street was not able to overcome this barrier. Because one of the primary project goals was to increase the use of local specialty crops, NCO found it necessary to identify additional partners. This transition was facilitated by NCO’s strong community relationships, and the lesson learned was that it can be possible to achieve positive outcomes even when involuntarily forced to change the direction of a project.

In early 2015, as part of the overall process of planning project revisions, NCO conducted a focus group with people who had participated in the pilot workshops. Suggestions from the groups that were incorporated into the full implementation of the project included the following:

- Length: workshops should be three hours, and should be opened with a 30-minute introduction to food safety, a tour of the kitchen, an overview of the recipes, and nutritional information.
- Outreach: To ensure participation of the target population of low-income families, conduct outreach and recruiting through such groups as local clinics, family resource centers, and church groups.
- Workshop topics: Suggestions for the types of foods to be covered during the workshops included roasted vegetables, fruit preserves, pickled vegetables, butternut squash lasagna, fruit pepper jelly, frozen berry medley, herb pesto, salsa, kale chips, herb cubes, dried tomatoes, tomato jam, fig jam, dried fruit, and more.

Throughout the project, NCO learned a great deal about the permitting requirements for processing specialty crops, and successfully navigated this process.

In part because of the mid-project changes in project activities, NCO experienced a number of unanticipated positive outcomes, as described below.

- Because the recipes and types of specialty crops used in the workshops were flexible, coordination with producers enabled them to use this as an opportunity to sell some of their smaller, imperfect, or blemished crops (e.g., apples, peppers, and tomatoes). This type of produce is not accepted by grocery stores and is rejected at farmers markets, so without FoodPREP it would end being composted or fed to animals. This option greatly increased producers' sales of imperfects and, with the convenience of the Food Hub, the marketing costs were minimal.

- Participation in FoodPREP workshops required participants to pay a fee of $20 for purchase of the specialty crops and other ingredients used in the classes. NCO initially planned to allow low-income people to make this purchase using an EBT card, but this did not prove to be possible. As an alternative way of encouraging the participation of low-income people, NCO developed a scholarship program. This had the dual benefit of enabling people to participate for only $5 per class while raising awareness of the program through outreach that was done to explain the scholarship program.
- The Clearlake Highland Senior Center, which joined the project in Year 3, reported an increase of 37% (from 1,513 pounds to 2,413 pounds) in the quantity of fresh specialty crop produce used in senior meals, and a corresponding decrease (from 707 pounds to 54 pounds) in the quantity of frozen and canned produce purchased for senior meals. (Comparison is between July 2015 and May 2016). Furthermore, the number of meals served during the course of the project (from November 2015 to April 2016) rose from 682 meals per month to 1,050 meals per month, an increase of 54%. In a survey of 47 senior center diners, conducted after serving the new specialty crop recipes, almost half pointed to the fruits and vegetables as their favorite part of the meals.
- The Willits Little Lake Grange's commercial kitchen was upgraded in 2010, but had been underutilized until the FoodPREP workshops raised community awareness of the availability of the kitchen and provided training in using the upgraded equipment. Several small businesses are now using the kitchen to process specialty crops for value-added products.
- NCO has begun working to adapt some of the 150 specialty crop recipes developed through the project for the use of schools, ensuring that they meet nutritional and portion size requirements.
- The Expected Measurable Outcome of increasing participation of local farmers to 44 was challenging, but NCO's efforts resulted in achieving 93% of the objective.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 33	**Project Title:** Connecting Agriculture to Schools and Homes (CASH)	
Grant Recipient: California State University, Chico Research Foundation	**Grant Agreement No.:** SCB13033	**Date Submitted:** December 2016
Recipient Contact: Kristin Gruneisen	**Telephone:** (530) 898-6476	**Email:** kgruneisen@csuchico.edu

Project Summary
The Center for Healthy Communities' (CHC) Harvest of the Month (HOTM) and Farmer of the Month (FOTM) programs introduce children to specialty crops and the farmers who produce them. These programs successfully increase students' specialty crop selection and consumption patterns as documented by CHC (formerly CNAP) research (Waite et al, 2012). Although CHC's programs generated a 2-3 fold increase in produce consumed, CHC's funding ended in 2013 and therefore eliminating an effective way to increase consumption of California grown specialty crops in schools and communities. In addition, the Healthy Hunger Free Kids Act requires schools to ensure that students select at least one fruit or vegetable daily. The proposed Connecting Agriculture with Schools and Homes (CASH) project was written in part to assist food service directors to meet this rule with California grown specialty crops.

Regional school districts purchase 0-6% of specialty crops directly from farmers. The CASH project focused on providing support to school districts to increase local purchasing by connecting them with area farmers who were ready to sell to schools. In addition, the CASH project was focused to increase awareness in the rural northern California communities about what products are grown locally and the season in which they are available.

Research shows an inverse relationship between fruit/vegetable consumption and obesity. Increasing fruit/vegetable consumption is critical in project counties where rates of childhood overweight range from 35-41%. In addition, over 2 billion dollars a year is spent promoting food to kids in the United States (U.S.), but less than 1% of that promotes healthy foods. The CASH project promoted local farms to schools and families.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach
The HOTM program was revamped from the prior look and feel to match CASH's specifications with new materials featuring an increased focus on local farmer promotion. CHC's HOTM tasting program is one of the largest in the state, and the rural districts that receive the HOTM program are vocal about their enthusiasm for the program. CHC delivered approximately 15,000 tastings per month to 42 elementary sites for 26 months over the course of the grant period. This equates to 390,000 tastings of locally grown California specialty crops purchased directly from local farmers. The new materials including a HOTM educator newsletter, HOTM family newsletter, FOTM newsletter/video, and stickers were created and delivered each month to the participating teachers and their students. More than 600 teachers and food service staff in 17 school districts also received this information electronically. The monthly email contained additional information and resources selected to enhance the tastings via nutrition education activities, local farmer information and food safety information.

Communication with Food Service (FS) Directors improved over the course of the grant period. CHC staff met initially with FS directors to identify obstacles to local procurement, and then continued to meet with them throughout the project. CHC's other farm to school projects complemented the CASH activities with several regional gatherings that were designed to provide training for food service staff for scratch cooking and local procurement. After these events there was increased awareness of the HOTM program as a method to connect the cafeteria to the classroom. Several districts made an effort to repeat the HOTM products on their menu and in their salad bars. CHC has created a HOTM 2016/2017 schedule for districts to provide a version of the HOTM program as well. For example, Chico Unified School District has a goal of providing HOTM tastings in their cafeterias at 17 sites in the upcoming year, an unprecedented effort in the district. The HOTM program was a terrific anchor for many outreach events and served as a valuable tool for increasing awareness of what is grown in the area during the school year. For example, in Colusa Unified School District, CHC was able to facilitate a Farm Stand Pilot Project via Farmers' Market Promotion Program (FMPP) funding, that sold low cost produce to families and provided tastings of simple recipes using the HOTM featured product. These stands also market the local farmers and the projects complimented each other well.

Teacher and parent surveys were developed, distributed and analyzed during the grant period. While teacher surveys had a significant response, reaching the homes and getting parents to complete either paper or electronic surveys was extremely difficult and unfortunately had very low participation.
CHC worked with area farmers to purchase the HOTM produce. These farmers were promoted via the newsletters. Several districts also highlighted featured farmers on their websites and in their cafeteria. CHC promoted the farmers via social media. CHC met with local growers throughout the grant to improve the HOTM cycle, to set up forward contract purchases and connect growers with school districts. The relationships built during this grant period will continue beyond the funded project. CHC created three "virtual field trip" farmer videos during the project period. The videos were extremely popular with teachers and students and the farmers. Teachers commented often about how much they loved the videos. CHC has made the videos available on the CHC website and also shared DVDs of the videos at the California Farm to School Network Conference in 2015, and National Farm to Cafeteria Conference in 2016. As a result of the videos, one of the featured farmers created a Facebook page to post a video on it and create a social media presence for the farm.

The project solely benefitted California grown specialty crops.

The farmers that partnered with the project were generous with their time for the creation CASH materials. In particular, Dhillon Farms, Lee Family Farm and Citrus Norte Farm featured in the CASH videos during the project, donated a significant amount of time for filming these videos.

Teachers receiving the CASH program tastings and materials provided lessons and valuable feedback and played a key role in connecting kids to in season produce and local farmers.

FS Directors in several districts met regularly with CHC staff. The three districts that allowed CASH staff to collect and analyze procurement records and answer many questions around local procurement, contributed a significant amount of time to the project. There were also several distributors who contributed valuable information during the effort to analyze purchasing records, in particular General Produce and Pro Pacific Fresh.

Goals and Outcomes Achieved

Goal #1: Throughout the project period, on-going interviews were conducted with food service directors, distributors and farmers to identify barriers to and strategies for buying local.

Goal #2: School production records and invoices were obtained as a strategy to measure changes in specialty crop purchases by school districts. However, while production records and invoices measured types of produce purchased, these records did not capture whether or not these were California specialty crops. Furthermore, distributors were unable to provide additional information about these purchases due to the amount of time that would be required. Therefore, CHC was unable to measure changes in purchases of California specialty crops.

Goal #3: Twenty-seven HOTM deliveries were made to schools. Each delivery included a FOTM sheet to highlight to farmer that grew the item. Three FOTM videos were produced to highlight California specialty crop farmers.

Measureable Outcome (MO) #1: Identification of obstacles, strategies, procedures and tools for school district specialty crop purchases: see activities for goal #1.

MO #2: FS directors were provided with strategies (identified by goal #1) and connected with farmers who were able to supply the volume and type of crops food service directors identified to include in their menu cycles.

MO #3: HOTM lessons were provided to approximately 15,000 students per year to encourage the selection and consumption of California specialty crops. FS directors included the featured HOTM item on the menu cycle to encourage consumption of California specialty crops.

MO #4: Teacher surveys were conducted at the end of years 1 and 3.

MO #5: Parent surveys were conducted at the end of years 1 and 3. Nine parents returned completed surveys in year 3.

All outcome measures were to be completed within the grant period. However, outcome measures #2 and #3 could not be measured during the project period as California specialty crops could not be identified using only invoices and production records. Project staff did work with foodservice directors and farmers to enable certain specialty crop purchases (kiwi, mandarins, apples) from California growers.

Goal #1: Increase economic opportunities and local specialty crop sales in Butte, Glenn and Tehama counties by assisting food service directors and farmers in identifying marketing and procurement obstacles and developing strategies, tools and procedures.

Throughout the project period, obstacles, strategies, procedures and tools for school districts to increase specialty crop purchases were identified. A summary of their obstacles to purchase specialty crops has been created and shared with the school districts. The sales increases directly related to this goal were not tracked separately from overall school food service purchases. However, economic opportunities were increased based on connections that were made between farmers and FS directors via FOTM promotion activities and meetings between the CHC Farm to Fork Coordinator and FS directors. In total, $34,883.37 of produce was purchased from local specialty crop farmers throughout the grant on HOTM.

Goal #2: Increase school district purchases of specialty crops by 100%, doubling the specialty crops available to students in response to greater student cafeteria selections as an outcome of participation in the Harvest of the Month (HOTM) program.

Creating relationships between growers and foodservice directors allowed individual purchases to be identified as California specialty crops. However, overall purchases made by school districts could not be categorized as California specialty crop or not based on the data collected (production records and invoices). Conversations with distributors and school food service directors made clear that in order to measure changes in specialty crop purchases, distributors must have tracking systems in place.

Since school districts and distributors couldn't track overall California specialty crop purchases, school district HOTM figures can be substituted. For the 2013 - 2014 school year, there was $10,200.71 spent on specialty crops through HOTM tastings. For the 2015 - 2016 school year, there was $14,457.16 spent on specialty crops through HOTM tastings. This shows an increase of 42%.

Goal #3: Increase sales by marketing at least 20 California specialty crops and farmers to consumers by highlighting farms, growing locations and production practices via Farmer of the Month (FOTM) activities.

During the project period, HOTM was delivered each month to 15,000 students during the school year. Twenty-seven California specialty crop deliveries were made highlighting 14 different farmers and 14 different crops. Some crops and farmers were repeated specifically to strengthen the relationship between the growers and the schools. Three FOTM videos were created and shared with teachers.

Expected Measureable Outcome (EMO) #1: Interviews with foodservice directors on obstacles, strategies, procedures and tools for school districts to increase specialty crop purchases were conducted and responses were documented throughout the project period.

EMO #2 & #3: Six-week periods of food service production records and invoices were collected at baseline and throughout the project period: October 2013 (baseline), February 2014, May 2014, October 2014, February 2015, May 2015, October 2015 and February 2016.

EMO #4: Ninety teacher surveys were completed in year 1 (baseline), 36 in year 2 and 108 in year 3.

EMO #5: Forty six parent surveys were completed in year 1 (baseline) and only nine parents returned completed surveys in year 3.

- Twenty-seven HOTM tastings of California specialty crops were purchased directly from local farmers and distributed to partnering schools.
- Three FOTM videos were created, allowing for ongoing promotion of California specialty crops.
- At the end of the project period, almost all teachers (n=108) surveyed (99.1%) participated in HOTM tastings each month. Over 90% of teachers surveyed either "agreed" or "strongly agreed" that HOTM/FOTM made students more receptive to eating fruits and vegetables, show more interest in

food/farms/nutrition and more knowledgeable about food/farms/nutrition. See attachments for summary tables with complete teacher survey results.

Beneficiaries

The primary beneficiaries of the CASH program included farmers, teachers, students, CHC student interns and food service staff.

Farmers benefited directly by making bulk sales to the program. Many of these growers are primarily direct sale focused and the HOTM program gave them the opportunity to sell to an institutional buyer. Technical support was provided to farmers to assist in preparing invoices to CHC. Two farms began selling directly to schools that received their product via the HOTM program. Several growers received media exposure and three farms now have videos featuring their farm and products. All the farmers that partnered with CHC on the program reported that it was a positive experience, great for sales, and that farmers would participate again.

The school communities benefited in many ways from this program. Children that received the tastings and nutrition materials benefited from this project by being exposed to healthy food and learning how it grows.

Teachers loved the program tastings and educational materials, especially the videos. Many of the districts' food service staff liked the connection with the classroom and also the support to find local farmers who would sell to them.

CHC's student staff and interns gained knowledge about school food service, local foods, and working with farms. Many of these students will enter into food service or teaching in the future, and they gained valuable experience to support local food economies in their future careers.

Thirteen farmers received $34,883 for HOTM crops used in the tasting program, along with promotion to schools and the community.

As school food service starts to spend a significant amount of their food dollars on local California Specialty Crops, new opportunities for farmers will develop, so potential impact could be significant beyond the grant. In addition, providing tastings to elementary school students is educating consumers of tomorrow. If consumers are given the opportunity to educate the palate, thus young growers will seek out local healthy foods when as they grow up and start purchasing and developing healthier eating habits.

Lessons Learned

- CHC's ability to deliver a low-cost HOTM tasting program is unique because of intern staff who receive, process and deliver the HOTM tastings. Most partner school districts are struggling to process produce due to lack of facilities, lack of staff time and motivation, and lack of funding. Having CHC prepare and deliver tastings to 42 sites per month was a very efficient method of providing HOTM to schools.
- Collecting procurement records to extract a % of local purchases is a labor intensive, complicated, impossible task. Working with distributors to provide this information to schools would be a more viable method.
- Short videos are an extremely effective and cost efficient outreach tool for teachers and students. A resource library of FOTM videos would be a great way to promote seasonal California specialty crops.

- The “Ask me about my Farmer stickers” lost appeal with teachers after the first year of the project. Teachers reported that the stickers ended up “everywhere.” Feedback from the farmer received was not many kids made it to the market to find the featured farmer. The stickers were the one component of the HOTM program that would not be recommended in the future.
- Reaching parents via schools is a difficult task. Sending paper surveys and newsletters to homes is not an effective use of funds as there wwere very few responses received.
- Everyone loves the HOTM tasting program – it’s a win for farmers, teachers and kids. While it was low cost at an average of just nine cents per tasting, the repeated tastings have a strong influence on the students and the teachers. Farmers feel connected to the schools and enjoy selling to the program. This program has been a bridge to connecting farmers to school districts. The HOTM program is also a great way for school districts to start their own Farm to School program. CHC will continue to offer technical assistance to districts who attempt to implement HOTM on their own in the upcoming year.

One unexpected outcome of the project was CHC supplying technical support to farmers to market themselves via social media. This resulted from schools and families trying to contact the Farmer of the Month. Once growers realized that having a page on Facebook is like a free website, a few were motivated to set up a page. An additional outcome of the program is that the farmers like the connection with the schools, and after a few years of partnering with the program, they now initiate the conversation about HOTM, and are more inclined to work with schools via CHC’s Farm to Fork Coordinator’s referrals.

Another unexpected outcome of the project was with retail stores. CHC interns called stores in the four counties to find out where families could purchase locally grown HOTM featured produce near them. Several retail stores reported an increase in sales of that item being featured and a few began highlighting local growers whom they were already purchasing from but hadn’t advertised as “local” before.

Collecting procurement records to extract a % of local purchases is labor intensive, complicated, and a nearly impossible task. Working with distributors to provide this information to schools would be a more viable method. Schools using geographical preference in their RFA’s, and requiring vendors to track local purchases and calculate a percentage for them is a more efficient and realistic way to obtain this information.

Additional Information

The FOTM video on Lee’s Family Produce/sugar snap peas can be viewed here: https://youtu.be/lTXFiQRzuKs.

In addition, please see the attachments which include materials accompanying this report.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
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USDA Project No.: 34	**Project Title:** California Hotel Community Crops Project	
Grant Recipient: People's Grocery	**Grant Agreement No.:** SCB13034	**Date Submitted:** December 2014
Recipient Contact: Patricia St.Onge	**Telephone:** (510) 652-7607	**Email:** patricia@peoplesgrocery.org

Project Summary
The California Hotel Community Crops Project (CHCCP) is a project designed to bring healthy and fresh, fruits, vegetables and herbs to residents of an affordable housing development and the surrounding West Oakland community. This is a low income community that is food insecure, meaning residents do not have an accessible source of fresh, healthy fruits and vegetables within walking distance or reasonable price range. The residents targeted are an especially vulnerable population as they were formerly homeless, are living below the poverty level, and many already have mental and physical health challenges related to inadequate nutrition. The People's Grocery program was designed to produce specialty crops from seedlings, to cultivate, harvest and distribute the crops to the aforementioned community members, with their participation and assistance in educational workshops. These workshops share information on cooking, nutrition, and the historical context of how oppression has affected the health and well-being of the primarily African American population. The health disparities are well documented. The California Hotel Community Crops Project is unique in that it is designed to address the root causes of food insecurity, and to engage the community in the production, cultivation, and distribution of healthy foods, thereby enhancing the viability of the idea of bringing a fresh food grocer to the neighborhood and enhancing the competitiveness of locally grown specialty crops.

The California Hotel Community Crops Project provides an example of a local food system in which the local community has access to affordable fruits, vegetables, herbs, and information, and in which residents have agency in their health and well-being.

This project built upon 2011 Specialty Crop Block Grant Program (SCBGP) Project 49. This project produced more varieties of specialty crops and reached more residents of the California Hotel as the occupancy in the building reached capacity in time for the May 15, 2014 grand reopening ceremony. Building on the previous year's 30 hotel residents served through weekly educational workshops, one hundred and fourteen unduplicated Cal Hotel residents and surrounding community members attended Flavas of the Garden workshops over the 26 week series in 2014.

Project Approach
Daily garden activities performed during this project included propagating plants from seed in the greenhouse, transplanting, cultivating, pruning, weeding, managing pests and disease, managing compost operations, and harvesting. Specialty crops produced included lettuce, three varieties of kale, collard greens, arugula, mizuna, mustard greens, turnips, beets, carrots, radishes, green onions, three varieties of chard, spinach, artichoke, parsley, thyme, sage, basil, mint, rosemary, chamomile, cilantro, yarrow, borage, hyssop, snap peas, scarlet runner beans, tomatoes, cherry tomatoes, sweet peppers, hot peppers, potatoes, cucumbers, melons, summer squash, winter squash, chayote, fennel, oregano, plums, figs, raspberries, and honey. Over 50 varieties of specialty crops were produced on ¼ acre of land at the California Hotel in West Oakland.

According to the CHCCP records 72 different residents participated in educational workshops, special events, or volunteered in the garden. All of the workshops and special events featured specialty crops in season and were used as an opportunity to increase knowledge, consumption of, and exposure to specialty crops.

Plant starts were propagated in the greenhouse for sale to the surrounding community for the purpose of encouraging community to grow and consume more specialty crops. In April 2014 approximately 172 plant starts were sold to 43 different people yielding $750. A weekly workshop series called Flavas of the Garden was held on Thursdays from 3pm- 5pm at the garden of the California Hotel. The series ran weekly from April 17, 2014 through October 30, 2014, and culminated with a garden workshop. Topics were centered around California-grown specialty crops, nutrition, health, and how to use medicinal and culinary herbs. Most workshops included a cooking demostration made from specialty crops in the garden. Participants were encouraged to practice preparing foods in healthy ways. 114 unduplicated Cal Hotel residents and surrounding community members attended Flavas of the Garden workshops over the 26 week series.

Three major special events were held during the period which benefitted specialty crops. In October 2013, the annual Harvest Festival was held with local partner City Slicker Farms. Approximately 150 community members were in attendance. 10 educational workshops on specialty crops were offered. In February 2014, the Black History Month celebration honored black and brown farmers by planting 12 fruit trees. Fruit trees planted included apple, fig, lemon, lime, persimmon, and pear. All are expected to produce specialty crop fruits that will feed the community. Participants learned about care of fruit trees, and the nutritional value of the fruits produced. Residents from the California Hotel and the surrounding community participated and food from the garden was served. Over 75 community members were in attendance. In June 2014, the Juneteenth celebration conducted educational workshops including how to make smoothies, how to use medicinal herbs, and a children's activity on recognizing different plants in the garden. 112 community members were in attendance.

Additionally, 12 tour groups visited the garden during the project. 314 people were exposed to the garden and all of the specialty crops produced there. Tour groups included a sixth grade class, a group of sociology professors, alternative spring break college students, and a faith-based group.

It is certain that SCBGP funds were used solely for specialty crop production when staff salaries were dedicated to specialty crop production. Time dedicated to other work was paid for through other funding sources.

All program income comes from and gets reinvested in the greenhouse, which is the widest reaching garden program. Program income was used to enhance the competitiveness of California specialty crops so hundreds of individuals and families will continue to receive access to and information about California specialty crops. The specialty crop plant starts were distributed to West Oakland residents with limited income.

The following partners assisted with this project: East Bay Asian Local Development Corporation (EBALDC), from whom the land is leased and with whom a memorandum of understanding for the services provided in the garden is in place; Lifelong Medical Services, who oversees health care and social services for residents in the Cal Hotel; City Slicker Farms, with whom People's Grocery partnered for the Harvest festival; Bay Localize who helped promote People's Grocery events; Growing Together, who supplied the fruit trees and an educational workshop at the tree planting for the Black History month event; and the many individual volunteers and supporters who have helped in the garden and facilitated workshops.

Goals and Outcomes Achieved

The activities completed for achieving the performance goals and expected measurable outcomes are identified below:

1. Increase consumption of fruits and vegetables for a sample size of 750 participants in the West Oakland community by at least 20% measured by survey responses indicating the level of increase.

   The activities performed in working toward the above performance goal included the propagation, cultivation, and distribution of over 50 varieties of specialty crops on the grounds of an affordable housing development. Participants are an especially vulnerable population, primarily people of color and some who have mental or physical challenges. Residents of the housing development and surrounding neighbors were encouraged to participate in garden activities in order to gain a deeper connection to where food comes from. A weekly workshop series called Flavas of the Garden was planned and implemented. Several special events were held including a Black History Month Celebration, Juneteenth Celebration, Smoothie Day, and Chestnut Street Community Day. Each event was an opportunity to build community, promote specialty crops, and get a pulse on the progress toward outcomes by asking participants to complete surveys. Events were promoted via flyers and community outreach in the building and the surrounding community. In addition to growing specialty crops, great emphasis was placed on individuals sharing knowledge and information, and transforming attitudes and behaviors pertaining to consumption of specialty crops grown locally. Participants in the program received opportunities for practice in growing, harvesting, cooking, consuming, and preserving specialty crops. Additionally, several tour groups who visited the garden had an opportunity to interact with specialty crops. In partnership with EBALDC and Lifelong Medical Services fresh specialty crops were provided for cooking classes and special events as a part of the California Hotel Community Crops Project.

   The activities completed as outlined in the work plan were:
   - Daily garden activities
   - Specialty crop distribution
   - Plant start sales and marketing
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Scheduled and facilitated garden tours
   - Performed ongoing outreach to residents
   - Developed, administered, and interpreted healthy food surveys

2. Increase knowledge of specialty crops for a sample size of 750 participants from the greater Oakland area. Participants will demonstrate three new points learned about specialty crops measured by survey responses indicating types of facts learned.

   The activities completed toward this outcome were:
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Scheduled and facilitated garden tours

- Developed, administered, and interpreted healthy food surveys

Twenty six Flavas of the Garden workshops held during this reporting period were the primary means of disseminating information and exposing people to specialty crops for the California Hotel Community Crops Project. Each provided an opportunity to increase knowledge and practical experience preparing and consuming specialty crop vegetables and herbs. Of thirty six people who completed a survey by the end of July 2014, thirty five reported learning at least one new thing. Two reported learning three or more things. Twenty two additional surveys were completed in September 2014. In these surveys, people were able to identify new things that they learned. Nineteen of the twenty-two reported learning at least three new things.

Special events were held including the Harvest Festival, Black History Month tree planting and Juneteenth celebration. People who attended these events had opportunities to participate in educational workshops including caring for fruit trees, making smoothies solely from specialty crops, and learning about the culinary and medicinal uses of a variety of common herbs found in the garden.

3. Further develop the garden and greenhouse space as a healthy, attractive, and accessible hub for promotion of specialty crops through regular planning and maintenance and increased attendance by the public through nutrition demonstration and community health outreach and events. Regularly identifying resident health challenges and promoting use of specialty crops in the kitchen are essential to this goal.

   The activities completed as outlined in the work plan were:
   - Daily garden activities
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Facilitated garden tours
   - Performed ongoing outreach to residents

   People's Grocery garden staff remains in regular consultation with Lifelong Medical service providers regarding resident health issues and behaviors. The garden is intended to be a safe space for residents to disclose information regarding health and lifestyles. The California Hotel Garden community is built around trust and compassion for shared struggles, and around production, preparation, discussion, and consumption of specialty crops.

   Due to the vulnerable and transient nature of the population targeted for this project, there were barriers encountered in terms of consistency in participation in the programs and in attending events.
   For that reason the 750 residents reached as projected in outcome measure #1 was not documented, nor were before and after surveys completed by the same group to determine increased consumption. Recognizing that a mindset transformation is required, and that it takes time to foster relationships and trust, the work toward this endeavor continues. Through ongoing programming and innovative initiatives the California Hotel Community Crops Project will continue to positively impact the lives of hundreds of consumers through the promotion, consumption and increased awareness and accessibility of California grown specialty crops.

The actual accomplishments and progress toward achieving set targets is outlined below:

Goal: (1) Increase consumption of fruits and vegetables for a sample size of 750 participants in the West Oakland community by at least 20% measured by survey responses indicating the level of increase.

Actual: 40 Health and Wellness surveys were completed: 19 before the end of July 2014, and 21 after. "Before" surveys indicated average servings of fruits and vegetables consumed per day to be 2.7; "After" surveys indicated average servings of fruits and vegetables consumed per day to be 3.4. This is a 26% increase.

Goal: (2) Increase knowledge of specialty crops for a sample size of 750 participants from the greater Oakland area. Participants will demonstrate three new points learned about specialty crops measured by survey responses indicating types of facts learned.

Actual: 53 Garden workshop surveys were completed: 36 before the end of July 2014, and 17 after.
"Before" surveys indicated average new things learned to be 1 (.9);
"After" surveys indicated average #of new things learned to be 5 (4.6).

Goal: (3) Further develop the garden and greenhouse space as a healthy, attractive, and accessible hub for promotion of specialty crops through regular planning and maintenance and increased attendance by the public through nutrition demonstration and community health outreach and events. Regularly identifying resident health challenges and promoting use of specialty crops in the kitchen are essential to this goal.

Actual: The process of further developing the garden for fruit, herb, and vegetable production, as well as increasing outreach efforts in order to reach more members of the community is ongoing. People's Grocery and the California Hotel garden staff continue to assess and re-evaluate the urban agriculture programs for efficacy, and to create new and innovative programs to promote California specialty crops according to the needs of the community. Ongoing communications with colleagues in the medical profession will help enhance the competitiveness of specialty crops by integrating specialty crop products into a medical discussion endorsed by doctors and nurses.

The major successful outcomes of the project are identified below:

- 114 unduplicated residents attended the Flavas of the Garden events.
- 12 tour groups were hosted at the garden totaling 314 attendees.
- 362 people attended special events.
- 40 Health and Wellness surveys were completed: 19 before the end of July 2014, and 21 after.
    - "Before" surveys indicated average servings of fruits and vegetables consumed per day to be 2.7.
    - "After" surveys indicated average servings of fruits and vegetables consumed per day to be 3.4, which is a 26% increase.
- 53 Garden workshop surveys were completed: 36 before the end of July 2014, and 17 after.
    - "Before" surveys indicated average new things learned to be 1 (.9).
    - "After" surveys indicated average # of new things learned to be 5 (4.6).
- Over 50 varieties of specialty crops were produced on the ¼ acre of land.

- Over 250 units of vegetables were distributed.
- Over 250 specialty crop plant starts were sold to community members.

Beneficiaries

The specialty crop industry and residents of the California Hotel were all beneficiaries of the California Hotel Community Crops Project. The competitiveness of California specialty crops grows as people are exposed to specialty crops and begin to understand the health, economic, and environmental implications of integrating more specialty crops into their diets. EBALDC and Lifelong Medical groups are the organizational partners who benefit from the project.

At least 790 individuals interacted with the specialty crops in the garden and directly benefitted from the project. The potential health improvements can potentially be vast as residents have limited access to healthy fruits and vegetables and suffer from high rates of diet-related diseases and other health challenges. By providing specialty crop information the project will potentially have long term positive economic effects for consumers and specialty crop producers.

Lessons Learned

Project staff learned a great deal as a result of implementing the California Hotel Community Crops Project. Positive lessons include learning patience, compassion, and effective communication skills when working with vulnerable populations. Adequate nutrition is related to more than just access. Programs which delve deeper into understanding and addressing the root causes of food insecurity are more effective and can promote positive change. People participate when given incentive and that high frequency outreach is needed to maximize participation.

Having concise surveys which measure attitudes and behaviors, and having a process in place for getting them completed would have yielded more detailed results.

When establishing goals they should be clear, concise, measurable, and realistic. A tool must be in place which accurately measures the goals, and the tools must be utilized in a consistent and controlled way. All of this needs to be in place prior to starting the project. Also having the same staff to develop the goals for the program should be the ones to implement it, which would allow for optimal success.
Unexpectedly, a great interest in using herbs for their healing properties was expressed by residents. Future CHCC projects will further integrate this concept into programming.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
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FINAL PERFORMANCE REPORT

USDA Project No.: 35	**Project Title:** California Farm to School Network	
Grant Recipient: Community Alliance with Family Farmers	**Grant Agreement No.:** SCB13035	**Date Submitted:** December 2016
Recipient Contact: Diana Abellera	**Telephone:** (510) 832-4625	**Email:** Abellera@caff.org

Project Summary

With over 1,000 school districts in California, new Farm to School programs are beginning in every region, and existing programs want a streamlined way of finding resources, sharing successes, and networking with other organizations. To support programs that improve connections between specialty crop growers and schools at various stages statewide, the Community Alliance with Family Farmers (CAFF) proposed to develop a California Farm to School Network (CFSN). The goal was to support California specialty crop growers through creating a unified, organized Farm to School movement that allows a better understanding of the California Farm to School landscape, minimize duplication of efforts, and increase economic viability of local growers.
The objectives were to:
1) Launch and build the CFSN.
2) Foster efficient regional distribution efforts through facilitating at least 30 meetings among growers, distributors, and school districts.
3) Provide training and resources through deploying 12 FoodCorps service members to increase awareness of California specialty crops among K-12 students.

California is a national leader in promoting specialty crops through Farm to School efforts. However, there are hundreds of parallel programs that are creating duplicative resources and working in individual counties rather than regionally. At the 2012 National Farm to Cafeteria Conference in Vermont, dozens of representatives from all over California asked CAFF for more networking and resource sharing opportunities at the state level. CAFF received requests for support from new programs on a weekly basis. Partner organizations also regularly requested help in connecting to growers and technical expertise to solve regional distribution. As a statewide organization with a membership comprised of family farmers, CAFF has worked for over a decade at the state and regional levels to implement Farm to School programs and develop best practices. California needed stronger communications tools and infrastructure to respond to the increasing need for support statewide and in regions where CAFF does not run programs. In addition, the 2014 United States Department of Agriculture (USDA) Farm to School Census found that 350 California school districts have Farm to School programs that already purchase $52 million of local food, and 59% of those districts wanted to purchase more local food. Because schools are required to serve multiple servings of fruits and vegetables in school cafeterias each day, the data shows a great opportunity to direct specialty crop purchases towards California family farmers.

This project builds off of the 2012 Specialty Crop Block Grant Program Project 12: *Linking Nutrition Education with California Grown Specialty Crops Statewide*. CAFF's Harvest of the Month (HOTM) Tasting Kit project on the Central Coast educated over 25,000 students each month on specialty crops and generated nearly $30,000 per year for specialty crop growers. CAFF received the funding in 2012 to expand the program through developing a local procurement toolkit for school (HOTM) programs, launching a HOTM tasting kit program in Sonoma County, and working with 5 partners statewide to link them with local specialty crop sources. The demand for partnership was extremely high, and CAFF had to choose from over 20 interested programs around the state. The project allowed CAFF to support specialty crop producers in regions where CAFF doesn't operate programs; however, demand for technical assistance was much higher than what could be provided at the time. As a result, CAFF decided to launch the California Farm to School Network to share resources developed from the previously funded project, as well as other resources and technical assistance, with Farm to School efforts statewide. The California Farm to School Network complimented and built off of the funded project by creating the communication channels and infrastructure to support all Farm to School programs statewide by connecting them to a variety of resources, including the local procurement toolkit and case studies developed from the previously funded project.

Project Approach

CAFF organized work plan activities under three objectives explained below.
Objective 1) Launch and build the California Farm to School Network (CFSN).
To build the CFSN, CAFF worked with a variety of partners to develop network structure, collaborate on communications channels, coordinate regional efforts, and host a conference. The CFSN was developed in partnership with several organizations that worked together to coordinate efforts around the state. There were multiple committees that formed to accomplish the tasks under this objective.

- The communications working group developed and executed a plan for unifying communications tools and audiences from multiple organizations. As a result the CFSN housed many communications mechanisms: an event calendar, a listserv, a refreshed website featuring bi-weekly blogs, a monthly newsletter, and a series of webinars. Any specialty crop grower, school food service employee, educator, administrator, parent, or advocate in California who had content to contribute about procuring and educating students about California specialty crops in schools was able to utilize these tools to share their resources and information. These communication tools reached 2,772 people with bi-weekly blogs, monthly newsletters, quarterly webinars, and regular listserv activity.
- 10 regional leads (partner organizations that focused on procurement of California specialty crops from farms to schools throughout the state) were the backbone of the CFSN. The regional leads developed and ran programs in their communities to promote specialty crops. The regional leads met quarterly on the phone and annually in person to share approaches to promoting specialty crops, develop evaluation systems and reporting tools, and coordinate opportunities to support California specialty crop growers statewide. In addition, the regional leads conducted outreach to recruit local Farm to School programs to the CFSN, sharing information about the statewide network at their regional events and through local communications.
- The California Farm to School Conference Planning Committee worked to develop and host the 2015 California Farm to School Conference. The committee hired a conference planner, chose the location, created goals, conducted outreach, supported logistics, cultivated conference content, issued the call for workshop proposals, reviewed workshop applications, and hosted the event in May 2015.

All of these activities served to launch and build the CFSN, a now robust communications network and resource center for Farm to School programs throughout California. CAFF staff coordinated all of these efforts among partners working on the CFSN and followed up with conference participants to link them into the CFSN.

Objective 2) Foster efficient regional distribution efforts by facilitating at least 30 meetings among growers, distributors, and school districts.
The CFSN held 38 meetings across 10 regions to improve efforts to distribute California specialty crops from farms to schools. Regional gatherings, as these meetings were called, were hosted by regional leads and supported by CAFF staff. The gatherings brought together local specialty crop growers, distributors, and school food service staff to work together on overcoming regional distribution challenges. CAFF staff visited each of the regions to learn about the unique distribution and Farm to School landscape as well as opportunities the community faced and to share lessons learned from other regions. CAFF worked with each regional lead to identify regional distribution needs and share state level resources and assistance in how to address issues. The format of the gathering varied, depending on the community's needs. For example, in the greater San Diego region, regional gatherings were held quarterly. The stakeholders developed a State of Farm to School Report, created a San Diego County Crop Availability Chart to assist schools in identifying local crops available during each season, and hosted annual Wholesale Produce Showcases for vendors to share their products with the institutional buyers. Finally, CAFF followed up with each regional lead to provide one on one technical assistance as needed in implementing regional buying and selling. In the Central Coast, CAFF worked with the regional lead to help 15 school districts create joint bid language for their fruit and vegetable procurement. One regional lead stated "My involvement in the California Farm to School Network prepared me to approach more school districts with confidence and best practices for sourcing local produce in the cafeteria. I have already seen an increase in local produce purchases and more inspired food service!"

Objective 3) To provide training and resources by deploying 12 FoodCorps service members to increase awareness of California specialty crops among K-12 students.
CAFF and the CFSN developed a partnership with the National FoodCorps program to train and deploy FoodCorps service members that worked at select K-12 school sites in the state to increase awareness of California specialty crops. CAFF made many of the training opportunities available not only to FoodCorps service members but also to the broader CFSN. CAFF collected information from FoodCorps and CFSN members about the topics they were interested in learning about related to Farm to School. An initial survey of CFSN members showed that 70% of people were interested in procurement, 20% were interested in school gardens, 15% in nutrition education and 5% in farm to preschool. CAFF staff responded by identifying speakers with successes in each of the high interest topic areas, developing written case studies in the form of blogs, and delivering webinars. CAFF conducted outreach through the CFSN communications for 8 webinars that focused on enhancing awareness of or access to California specialty crops. Topics and dates are listed below.

Date	Topic	# Attendees
April 1, 2014	Oakland Unified School District's Farm to School Program	79
January 29, 2015	California Food for California Kids, Part I	45
March 19, 2015	California Food for California Kids, Part II	37
June 25, 2015	Harvest of the Month: Innovative Models	127
November 16, 2015	Evaluating Farm to School	53
March 9, 2016	From Board Policy to LCAP: District Policy and Funding Opportunities for Farm to School	30
May 12, 2016	Going to Bid for Local Produce: Lessons from California Schools	52

June 14, 2016	Straight from the Farm: Making the Most of Direct Purchasing in Schools	43

These webinars were delivered for FoodCorps members as well as broader CFSN members. CAFF worked each year to recruit new service members and place them with service sites in various regions around the state. In 2013, 12 FoodCorps service members were deployed around the state. In 2014, the number increased to 15, and in 2015, 18 service members were sent to support Farm to School efforts around California. In total, staff trained and deployed 45 service members to work in Farm to School programs across the state, increasing awareness of the benefits of California specialty crops and helping to increase consumption and sales of California specialty crops in the school cafeterias. For each term, CAFF provided 3 trainings for FoodCorps service members, for a total of 9 during the grant period.

Several mechanisms were used to ensure that funds were used to solely enhance the competitiveness of specialty crops:

- Memoranda of Understanding (MOUs) were signed by regional leads to indicate that their work with the CFSN is solely focused on specialty crops. All regional leads report out to Project Director and Manager when planning and coordinating a regional gathering. These check-ins allow Project Director and Manager to ensure that all regional gatherings solely enhance specialty crops.
- Each FoodCorps service site signed a MOU agreeing that FoodCorps service members are solely working on increasing specialty crop nutrition education and specialty crop procurement in school cafeterias. Project Manager and subcontractor visited each service site to ensure that each of the FoodCorps service members worked solely on specialty crop nutrition education and specialty crop procurement.
- Final budget numbers for the California Farm to School conference indicated that 40.35% of the conference content was dedicated to solely enhancing the competitiveness of California specialty crops, as calculated by minutes of the sessions that are solely focused on California specialty crops. Specialty Crop Block Grant Program funds allocated for the event was only 25%, a smaller percentage than what is allowed at 40.35%. The rest of the conference was covered by registration fees and sponsorships. These numbers do not cover pre-conference activities, as those activities were covered by other sources.

Numerous partners contributed to the success of this project. The hired subcontractor played a major role in helping to coordinate the California FoodCorps service members, coordinate the California Farm to School Conference, and serving on the communications working group. 10 regional leads were critical partners in conducting outreach for the CFSN and hosting all activities under objective 2.
Regional leads were:

- North Coast Opportunities (North Coast)
- Chico State University – Center for Nutrition and Activity Promotion (North Valley)
- Gardens to Grow In / University of California Cooperative Extension Central Sierra (Motherlode)
- Yolo County Department of Agriculture / Valley Vision (Sacramento Valley)
- Center for Agroecology and Sustainable Food Systems (Central Coast)
- UC Cooperative Extension Stanislaus (Central Valley)
- Urban and Environmental Policy Institute (Greater LA)
- Conejo Valley Unified School District (South Central Coast)

- Community Health Improvement Partners (Greater San Diego).
- The 10th region was the Bay Area, which was covered by CAFF staff that served as the official regional lead.

Other important partners volunteered their time to support the California Farm to School Conference, such as the Edible Schoolyard, California Ag in the Classroom, and Center for Ecoliteracy. Western Growers worked with the CFSN to share content on a community calendar, and FoodCorps trained FoodCorps service members at the national level and supported their wages and benefits.

Goals and Outcomes Achieved

Objective 1- Goal: At least 300 Farm to School programs statewide will direct at least $1 million dollars towards local, in-season specialty crops. Baseline: Unknown. Outcome: Final was that at least 46 school districts directed $4,523,624 towards local, in-season specialty crops, exceeding project goals.

In order to achieve this outcome, CAFF had to determine the number of Farm to School programs statewide, access contacts that track data about school district procurement of specialty crops and then collect data about the results. First, staff collected all of the contacts from the California Farm to School Taskforce, California School Garden Network, and FoodCorps. This totaled to about 1,500 contacts, but not a clear number of distinct Farm to School programs in California. Regional leads were also asked to submit lists of their programs, but they were hesitant to share data to protect their contacts.

CAFF tracked this outcome with external data from the USDA Farm to School Census as well as data staff collected during the project period. The USDA Farm to School Census was conducted in 2014 and 2016, and data can be filtered by state and at the school district level. The census collected information about the number of active Farm to School programs, as well as how much food (in dollars) the participating school districts procured from local farms. Only one representative from school food service / child nutrition programs filled out the census on behalf of the school district.

To focus data collection on California specialty crops, CAFF also worked with regional leads to develop a simple and easy to use system for reporting procurement data online from school districts conducting the California Golden Seed Awards. The California Golden Seed Awards was an incentive program that CAFF created and distributed to members of the CFSN to award school districts that were purchasing California grown specialty crops by collecting their data and publicizing the results.

The USDA Farm to School Census found that in 2013, 350 school districts reported that they participate in Farm to School efforts and have directed $52 million towards local food. In 2016, 373 school districts participate in Farm to School activities. These 373 school districts spent $167.6 million in local food. 80% of the districts said they purchase local fruits, and 76% said they purchase local vegetables. However, these numbers do not focus on specialty crops; survey responders use various definitions for local; and the dollar amount self-reported by school districts is uncertain due to reliability of distributor data. CAFF launched the Golden Seed Awards to collect more specific information about the dollars spent on California grown specialty crops. Forty-six school districts contributed data, which showed that in just the 2014-15 year $4.5 million was spent on California grown specialty crops.

In addition, several of the Regional Gatherings resulted in sales of local, in-season specialty crops. $13,000 of snap peas, strawberries, and radishes were purchased collectively among five school districts for Earth Day events. In addition to this, through regional gatherings four school districts continued purchasing relationships, which has already resulted in $40,000 worth of specialty crop purchases in three months.

Objective 2- Goal: 70% of regional leads identify that regional meetings created increased collaboration and efficiencies among local programs. Baseline: 0 regional meetings were held prior to the project. Outcome: 100% of regional leads identified that regional meetings created increased collaboration and efficiencies among local programs.

CAFF conducted an online survey of regional leads in February 2014 to determine needs in meetings across regional programs. Instead of distributing more surveys at annual meetings, CAFF conducted in-person interviews during annual site visits and asked for feedback on how the CFSN has impacted regional leads' efforts to work with schools in procuring California specialty crops and how local programs have benefited from regional gatherings. Data was collected and analyzed for this report.

Baseline was that 0 regional gatherings were held. In the February 2014 survey, regional leads noted that they wish to report out on accomplishments and specific needs related to enhance specialty crops in their respective regions on a rotating basis, which will allow staff to obtain a more in-depth understanding of the status of specialty crop procurement in each CFSN region over time. The survey showed that three regional leads had received more than five inquiries from local Farm to School practitioners about CFSN since the launch of the network, and an additional three had received between 1-4 inquiries. Additionally, regional leads overwhelmingly requested bimonthly conference calls and for the statewide meeting to incorporate a site visit to a regional Farm to School program.

In-person interviews have taken place with all 10 regional leads. All of the 10 interviewed have said that there have been increased collaboration and efficiencies among their local agencies and that local specialty crop purchasing has increased through connections made at regional meetings.

Objective 3- Goal: Over 50% of students participating in FoodCorps Farm to School programs will increase knowledge of California specialty crops. Baseline: 53% of children who were surveyed demonstrated an increase in knowledge about fruits and vegetables. Outcome: At the end of the project, 62% of children surveyed demonstrated an increase in knowledge about fruits and vegetables.

CAFF and partner FoodCorps collected quantitative data to support this outcome. Quantitative data collected in coordination with FoodCorps include a neophobia survey completed by a statistically significant sample of students at all FoodCorps California Service Sites at the beginning and end of the program year, and a Landscape Assessment to be completed at the end of each program year that tracks increasing knowledge of California specialty crops, specialty crop farmers, and nutrition knowledge over time. The information collected using the neophobia attitude assessment tool is used to evaluate the impact that participating in 10 hours of garden-enhanced nutrition education has on students' attitudes towards specialty crops, in particular their willingness to try new fruits and vegetables. In FoodCorps' preliminary review of surveys from the 2015 – 2016 school year, 62% of students in California showed improved preferences for vegetables and/or tried new vegetables. This is compared to 58% across all of FoodCorps service sites nationwide and shows a growth of 9% since the beginning of the project. AmeriCorps requires that FoodCorps service members complete this survey as a part of CAFF required performance measures.

All goals were exceeded. Over 373 Farm to School Programs directed over a minimum of 4 million dollars to California specialty crop growers – exceeding the original goal by 73 programs and over 3 million dollars. 100% of Regional Leads reported more collaboration and efficiencies in programs. 62% of students participating in FoodCorps Farm to School programs measured an increase in knowledge of California specialty crops.

The major successful outcome of the project was that school districts directed at least $4.5 million of their budgets towards local, in-season specialty growers. The CFSN was successful in helping Farm to School programs statewide connect to each other, unify efforts, overcome regional distribution challenges, and enhance economic opportunities for specialty crop growers.

Beneficiaries

The project's target beneficiaries were California specialty crop growers, which benefited economically through increased sales to school districts and through establishing stronger connections to their local communities.

Secondary beneficiaries were California K-12 students, particularly the students in regions where regional leads and FoodCorps members served. 551 school districts participate in Farm to School, reaching tens of thousands of students across the state through increased consumption and knowledge of California specialty crops. These K-12 students benefited from receiving specialty crop nutrition education and increased access to healthy, fresh specialty crops in school cafeterias.

Over 4 million dollars of California specialty crop sales were generated for growers. New purchasing relationships were establishing between dozens of school districts and farms, and these relationships of sales will continue after the grant period.
Over the course of this project, the following numbers of K-12 students were reached:

18,611 students in the 2015 – 2016 school year
21,633 students in the 2014 – 2015 school year
16,816 students in the 2013 – 2014 school year

Lessons Learned

CAFF learned that collecting data about sales of California specialty crops from farms to schools is extremely difficult to track, as many schools prefer to purchase California specialty crops through their distributors. Broadline distributors do not have systems in place for tracking food by farm name and location, and much of the work with regional leads centered on how to develop sustainable systems for tracking this data and working with distributors. While staff made progress in helping distributors set up systems, they also determined that incentive programs for school districts was an easier and more effective way of collecting data statewide about their Farm to School procurement efforts of California specialty crops. The Golden Seed Award was established primarily as a means for collecting evaluation data and to assess the landscape of Farm to School efforts in California.

This project advanced California's efforts as a leader in Farm to School nationally. CAFF shared results of the California Farm to School Network, the California Farm to School Conference, and the Golden Seed Awards with the National Farm to School Network. Other agencies and non-profits have asked CAFF for more information about these programs in the hopes of replicating the efforts in their states.

Additional Information

No additional information.

USDA Project No.: 36	Project Title: Food What—Food for Self, Food for Family, Food for Community	
Grant Recipient: Life Lab Science Program	**Grant Agreement No.:** SCB13036	**Date Submitted:** December 2015
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Project Summary

While Santa Cruz County is rich in agricultural production, low-income Latino youth and adults are disproportionately suffering from obesity and poor nutrition. "Food, What?!" (FW) uses farming and cooking as the vehicle for enhanced nutrition and increased consumption of fresh fruits and vegetables, California Specialty Crops (CSCs) for 975 area low-income high school youth and 300 adults annually. FW does this by operating seasonal programs and large events on a unique youth-run production farm with outdoor kitchen. At FW, teens dive into a culturally relevant meal with CSCs that they have cultivated, harvested and cooked (Food for Self). Youth harvest and package Community Supported Agriculture (CSA) shares to take home for their family, and FW engages parents in a cooking series using the produce (Food for Family). Youth operated a weekly farm stand at a low-income elementary school and organized three major seasonal events on the farm (Food for Community).

Low-income, youth culture centers around fast food, sugary drinks and snack foods, which are contributing factors to obesity and poor health. The 2011 United Way Community Assessment Project (CAP) report shows that in Santa Cruz County: 1 in 3 Latinos' overall health is fair or poor; 1 in 4 low-income youth are obese; and 2 of 3 Latino adults are obese. FW programs counteract these health trends, and research shows students involved in garden-based nutrition education increased their fruit and vegetable consumption by 2.5 servings per day (2011 United Way CAP report).

FW is a youth empowerment and food justice program reaching 1,275 youth and community members using food, through sustainable agriculture and health, as the vehicle for growing strong, healthy and inspired teens. FW encourages healthy food choices and promotes increased CSC consumption through three program focus areas: Food for Self, Food for Family, and Food for Community. This model addresses the health and diet problems described above by: (1) Engaging youth in growing and cooking CSCs; (2) Providing specialty crop produce shares to youth and their families as well as a parent cooking series; (3) Increasing access to CSCs through a farm stand in one low-income school; (4) Implementing 3 seasonal events for youth to engage with CSCs and attend nutrition workshops; and (5) Executing peer-to-peer workshops in county high schools and local non-profits to increase awareness of the relationship between CSCs and health.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The following activities were performed during the grant period:

Administrative set-up and initial coordination for the project: Life Lab Executive Director established administrative processes for monitoring grant progress and fiscal management.

Management oversight of personnel and budget for the project: Life Lab Executive Director met with FW staff to discuss progress on grant objectives and budget.

Spring, summer and fall program planning and goal setting for 2014: The FW team reviewed grant deliverables and set goals for 2014.

Youth outreach and selections for spring Internship: FW Director conducted outreach at schools across Santa Cruz County in the winter of 2014, which led to over 200 applications to FW. From this pool of applicants, the FW Director and Program Manager selected 52 low-income, struggling youth to participate in the Spring Internship.

Farm crop planning for upcoming season to achieve all goals of youth programming, family shares, big events, and community activities: FW Farm and Program Manager did extensive crop planning in the winter of 2014, selecting a wide variety of CSCs to be planted, tended and harvested for all FW events throughout the year. In 2014, more FW specialty crop grown produce was used for large events and community activities than used in previous years.

Implement Spring Internship: Fifty-two youth successfully completed the 2014 12-week spring internship, which ran from March 3-May 12, receiving an introduction to CSC production through weekly 3-hour visits to the FW farm. Spring youth participants were involved with every aspect of CSC production from March-May, including seeding transplants, preparing beds for planting, weeding crops and harvesting spring CSCs. In addition to this farm work, youth spent one hour each week cooking and eating meals full of CSCs—for many youth this was one of their first chances to cook with fruits and vegetables and one of their first effective exposures to hands-on nutrition education that emphasized the benefits of CSCs.

Planning and implementation of the Strawberry Blast event: The 2014 Strawberry Blast, held on May 20, drew over 200 students to the FW farm. Middle-school and high-school students learned about how CSCs are grown while touring a diversified specialty crop farm. Activities focused on nutrition, health, farming, and food justice topics. Students had the opportunity to make strawberry tarts and smoothies, rainbow veggie quesadillas (with chard, onions, cabbage, and broccoli) and strawberry salsa, as well as harvest strawberries from the field. The "Grow Your Own" activity let students plant vegetable seeds in a pot to take home to their families.

Interview and select youth for summer program: Of the 52 spring interns who completed the internship in May of 2014, 30 applied for summer job program positions. Each youth who applies is given an interview that includes coaching on interview tips. Twenty youth and 4 junior staff were selected to participate in the Summer Job Program.

Implement summer program including family CSA and parent workshops on cooking and nutrition: In the main field, the youth took the farm through every stage from winter dormancy into full production over the course of the intensive 7-week summer job program, held from June 16- August 8, 2014. By the time they harvested in the summer and fall, they talked about "our farm" and "our crops." FW youth in 2014 developed a deep understanding of how CSCs are produced, going way beyond a simple introduction to fruits and vegetables and developing lasting connections to California's specialty crop industry.

The youth in the summer program shared lessons and inspiration with their families through the weekly produce and through a family cooking night at FW farm and at a partner farm. Each week, the FW crew harvested a CSA share to take home to their families. The crop plan included the "greatest hits" of the produce world that integrated parent feedback on items most needed in their meals or budgets. This year, great feedback was received that parents used the produce, and this component also ensured that youth could take positive diet change into their home life.

Planning and implementation of Youth Day event consisting of educational workshops that teach youth how to grow, prepare, eat and advocate for CSCs in their community: This year FW partnered with a nearby farm, Pie Ranch, that also conducts youth programming to organize and host Youth Day. FW brought the entire summer crew of 24 youth and junior staff to the all-day event, where youth were given tours of the working farm, ate farm fresh food filled with CSCs and engaged in conversations about the regional specialty crop production economy. Over 100 youth from all around the region came to this year's Youth Day from a wide variety of organizations that serve youth.

Implement summer school low-income farm stand: Because the Santa Cruz City Schools summer school calendar did not align well with the dates of the summer program, hosting the low-income farm stand at Dominican Hospital in Santa Cruz was chosen. For 5 weeks youth sold and promoted CSCs to hospital staff, patients and families. Youth brought produce that they had grown to the stand and learned valuable marketing skills, increasing their potential readiness for jobs in agriculture.

Interview and select youth for fall program: Out of 24 summer program youth, 14 youth applied for 22 positions, some of which were held by multiple youth. The 2014 summer crew was dedicated and enthusiastic. FW follows a graduated model, so each successive element deepens youth knowledge of and connection with CSCs.

Implement fall program and weekly low-income farm stand and peer-to-peer education: In the 2014 Fall Business Management Program, which was conducted from September-November, 14 youth were hired to run various farm-related businesses. All of the fall jobs gave youth extensive training on marketing and handling CSCs. These jobs were organized into the following small crews: 1) a flower crew, which cultivated and sold cut flowers to local restaurants, 2) a harvest crew, which harvested CSCs for sale at the low-income farm stand, 3) a farm stand crew, which promoted and marketed CSCs for 9 weeks at a low-income, school-based farm stand, 4) a farm crew, which cultivated CSCs for FW's catering and produce sales businesses, 5) a school garden "Blast" crew, which helped 14 area schools prepare their gardens to be educational classrooms that highlight CSCs and 6) an event planning crew, which planned, coordinated and conducted outreach for the Harvest Festival event.

This year, 3 youth from the fall program became peer-to-peer "Community Educators," teaching a 3-week series of lessons conducted with 8 classes and youth programs at area schools. The lessons included nutrition education elements as well as tastings of prepared foods made with CSCs. These lessons reached an additional 170 teens in Santa Cruz County.

Planning and implementation of the Harvest Festival: FW hosted the Harvest Festival on October 23, 2014—with over 250 high school and middle school youth attending from across the Santa Cruz County. Youth were involved with every aspect of this event, from planning and promoting to coordinating logistics and conducting workshops at the event. Students attending the event explored California-grown fresh specialty crops on the farm through apple varietal tasting, winter squash varietal tasting, apple pie making, and fresh cider making. In addition to these opportunities to taste CSCs, youth participated in 2 hands-on specialty crop nutrition workshops, which educated them about good diet choices.

Program evaluation, reporting and audit: FW conducted thorough program evaluations of each aspect of the work through evaluation surveys, personal reflections by the youth, and staff observations/notes. At the end of the 2014 programs, the results were tabulated and are currently being used for reporting and planning purposes.

Throughout the year, FW educated youth about CSC production, harvesting and preparation; core elements to the program. Whenever the work focused on other topics, such as job training, youth empowerment or food justice, FW was careful to draw on other funds. FW used other funding sources that supported program elements not related specifically to CSCs.

The University of California Santa Cruz, Center for Agroecology and Sustainable Food Systems hosts Life Lab's programs on its research and education farm. The Center provided partnership support daily in the form of farm land, greenhouse space, agricultural and food systems expertise and volunteers from its student and adult training programs. Live Earth Farm's nonprofit Discovery Program operates farm-based education programs throughout the year. They partnered with Life Lab to bring FW program activities to their site in the spring and summer. Staff including teachers, administrators and directors of the local school systems were valuable FW partners. FW also partnered closely with the United Way program, which advocates for fresh food access in Watsonville.

Goals and Outcomes Achieved

Hands-on involvement in every aspect of produce production—growing, harvesting and meal preparation—throughout a full season; weekly cooking lessons/shared meals in the spring and daily lessons/meals in the summer; produce share for summer youth families; workshops on nutrition and diet; Harvest Festival and Strawberry Blast events which inspire consumption of CSCs.

1) At least 90% of parents completing cooking and nutrition programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Two parent orientation and cooking nights were held at the beginning of the summer 2014 program.

2) One hundred percent of youth will co-lead meal preparation demonstrating comfort with, and understanding of, how to prepare CSCs.

All FW youth co-led meal preparation throughout the spring and summer programs, learning to read recipes and modify dishes to include more CSCs.

3) One hundred percent of families with youth in FW will increase their CSC usage in weekly meal preparation from receiving free youth-grown produce shares weekly.

Twenty four summer program youth took home 1,500 pounds of CSCs to their families in the weekly youth-grown produce boxes over seven weeks. Youth reported increased usage of CSCs at home.

4) One hundred percent of youth attendees to seasonal FW events will taste, cook, or prepare food using CSCs and will attend at least one nutrition workshop.

Harvest Festivals (2013 and 2104) and Strawberry Blast (2014) featured many activities where attendees could taste and prepare food that highlighted CSCs (in particular strawberries, squash, apples and corn). Each event had dynamic, engaging nutrition workshops, and attendees visited at least one of these.

5) Increased access to CFCs by low-income, Latino population through the FW farmstand.

FW farmstands held at Gault Elementary (fall) and Dominican Hospital (summer).

6) Participation in peer-to-peer workshops result in increased awareness of the relationship between CSCs and health.

Three FW youth lead a three-part Community Educator series with 8 classes at 4 sites for 162 students. At Watsonville Community School, Pajaro Valley High School, and Jovenes Sanos (all in south Santa Cruz County) students were predominantly Latino and eligible for free and reduced meals. At YES (Youth Experiencing Success) School in the city of Santa Cruz, the audience was ethnically and socioeconomically diverse teenage youth in recovery from substance abuse.

Though FW did not list this as a measurable outcome for the one-year project, it is known that FW has long-term impacts on FW alumni diets (and their relationship to CSCs). In a 2014 alumni survey, 94% of former FW youth reported that their diets changed because of FW and 88% say they continued to eat healthy long after the program had ended. Because of this, project staff are confident that the FW model supports youth to make real, lasting overhauls of their daily diets.

1) At least 90% of youth completing seasonal programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Ninety percent of FW youth who have been through the spring and summer program reported that they like healthy food more as a result of the program, while 86% said they eat more fruits and vegetables. These numbers suggest major positive diet changes.

2) At least 90% of parents completing cooking and nutrition programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Due to staffing, FW was unable to provide the parent cooking series. Project staff added the equivalent of a parent cooking night into two orientations to the summer program held in Santa Cruz and Watsonville, California, to ensure parents were well-prepared to incorporate the specialty crops they were about to receive into their diets. This event was not evaluated, but parents incorporated FW grown specialty crops into the meal, which was well-received.

3) One hundred percent of youth will co-lead meal preparation demonstrating comfort with, and understanding of, how to prepare CSCs.

All 52 youth in the spring and summer programs co-led meal preparation several times, which made use of many CSCs. Ninety-five percent of FW youth who participated in the spring and summer programs report feeling completely comfortable with a recipe and cooking.

4) One hundred percent of families with youth in FW will increase their CSC usage in weekly meal preparation from receiving free youth-grown produce shares weekly.

All 24 families of FW summer youth received bountiful produce shares with over 1,500 pounds of youth-grown produce throughout the summer. Spring youth would occasionally bring home small amounts of produce to share as well.

5) One hundred percent of youth attendees to seasonal FW events will taste, cook, or prepare food using CSCs and will attend at least one nutrition workshop.

Over 675 students attended the seasonal events in 2013 and 2014. Students prepared, cooked, and tasted a wide range of healthy CSC snacks. Students were given a worksheet for the event that required them to visit various kinds of activity stations, including multiple specialty crop nutrition workshops.

6) Increased access to CFCs by low-income, Latino population through the FW farmstand.

FW distributed approximately 2,700 pounds of affordable, fresh specialty crops through the farmstands in the summer and fall. The farmstands were strategically located in areas accessible to low-income and Latino residents. The summer farmstand was held at Dominican Hospital in Santa Cruz to serve patients and their families. This nonprofit hospital serves majority low-income patients- 64% are eligible for MediCal or MediCare. In the Fall FW held farmstands at Gault Elementary to serve students and their families. The student population is 52% English Language Learners, 66% Latino, and 70% qualify for free and reduced meals.

7) Participation in peer-to-peer workshops result in increased awareness of the relationship between CSCs and health.

The peer-to-peer workshops were successfully delivered to 162 students in December of 2014. This engaging workshop series, led by youth, raised awareness about diet and health among students.

For the outcomes listed above, the evaluations of youth diet change rely on youth reporting perceived comparative changes in their diets at the end of the programs, rather than gathering pre-program baseline data and post-program data and comparing those data ourselves. Nineteen of 21 (90%) of youth who participated in the spring and summer programs and completed evaluations reported that they like healthy food more as a result of the program, and 18 of 21 (86%) youth reported that they eat more fruits and vegetables as a result of the program. Twenty of 21 (95%) youth stated they feel comfortable using recipes and cooking with CSCs after the program. For other outcomes, quantities of CSCs harvested and distributed are based on written harvest and market data sheets that are completed by youth and staff and retained throughout the year.

Numbers of students impacted by peer-to-peer workshops are based on sight count and recorded through the year. Numbers of students impacted by farm events are projected through teachers who report how many of their students will attend, and confirmed by the number of farm maps distributed as each student receives one.

These youth, who have reported positive diet changes (86 – 90%) and feel at ease using recipes that are full of fresh specialty crops (95%) as a result of the project, are often seen as a hard-to-reach population uninterested in health/diet. FW youth were also able to provide their families and community members, many of whom do not have ready access to fresh specialty crops, with over 4,000 pounds of CSCs. With 24 youth taking home specialty crops, an estimated 125 family members were impacted based on the average 5-member family size. It is a challenge documenting the unduplicated customer base of FW farmstands given the volume of people passing through, so, using sight counts, the project conservatively estimates at least an 100 additional unique community members (and their families) accessed fresh specialty crops through the FW farmstands.

Beneficiaries

The following groups benefitted from FW's Program in 2013-14:

- Specialty Crop Industry. FW connected a hard-to-reach youth demographic with fresh specialty crops. FW youth grew, cooked, ate and distributed CSCs. Though youth culture is notoriously not centered on fresh specialty crops, the project deepened their understanding of and connection to CSCs, and resulted in significant immediate increased consumption. The project inspired youth who were not previously committed CSC consumers to internalize preferences and values that will drive lasting behavioral change around fresh specialty crops for themselves and their families. The project will drive greater purchasing of CSCs and increase the CSC industry for the long term.
- FW Youth. 52 low-income, struggling youth from across Santa Cruz County participated in FW's core spring, summer and fall programs. These youth are a diverse group, ages 14-18, with 40% coming from the farming community of Watsonville.
- Youth from local high and middle schools. 845 students from 16 different schools engaged with FW, learning about CSC production, nutrition and the food system. These students attended one of FW's large on-farm events and/or were taught by FW youth in Community Educators workshop series.
- FW Youth Families. 52 families benefitted from their children's involvement with FW, whether it was through fresh CSCs brought home in the summer, the summer program parent orientation dinner, or through their child sharing FW cooking lessons at home.
- Community Members. FW served the broader Santa Cruz County community through the low-income farmstands, various community events, catering jobs and through FW youth leadership.

FW Youth: 52
Youth at Events: 845
Families: 52
Community Members: 100
Increased CSC Consumers: 1,870

Lessons Learned

FW continues to hone the educational and empowerment model each year. The 2013-14 season, the eighth for FW, was an especially smooth and successful one—more youth were reached in the community through seasonal events at the farm; the spring and summer FW crew were extremely successful in getting jobs (some of which were with local food businesses and a farm); the fall flower, produce sales, and catering businesses were busier than ever; and, the 2014 crew worked together beautifully and enthusiastically. Staff made recruitment choices that invited struggling youth into FW who demonstrated a motivation to succeed and a desire to complete the program. This refinement of selection criteria led to this year's reduction in numbers of youth whose program work was disrupted by personal or family struggles.

The farming portions of FW consistently make a strong impression on the youth, 91% of them stated that they learned how to farm at FW. Having the right support (in terms of staffing and funding), the small farm can be tremendously productive.

The only goal that wasn't met was conducting and evaluating a parent cooking series. Because of unexpected reduced staff capacity this summer, a cooking series was substituted with two parent orientation nights which involved cooking specialty crop quesadillas and roasted root vegetables followed by a final summer dinner for youth families that was similarly loaded with CSCs. If reduced staff capacity should happen again, hiring additional, short-term help would be considered with coordination of non-core program elements like the parent cooking series.

Additional Information

No additional information.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 37	**Project Title:** Produce Toolbox: Linking Produce Education and Specialty Crop Distributions at California Food Pantries	
Grant Recipient: California Association of Food Banks	**Grant Agreement No.:** SCB13037	**Date Submitted:** December 2016
Recipient Contact: Stephanie Nishio	**Telephone:** (510) 350-9905	**Email:** stephanie@cafoodbanks.org

Project Summary

California has an extremely high rate of food hardship (20%) and unemployment averaging 10%.[1] Additionally, California's low income population suffers high rates of diet-related illnesses such as heart disease and diabetes. To address these needs, California Association of Food Banks (CAFB) developed the Farm to Family program, which brings donated unmarketable and surplus specialty crops from California growers and packers directly to a network of 44 member food banks. Food banks in turn distribute the produce through partnership with 5,000 charities and pantries to over 2 million people. Many low income people cannot often afford fresh produce or are unfamiliar and uncomfortable preparing certain produce items at home, and so handing out bags of produce is not enough support for behavioral shifts. Educational interventions are needed to increase the probability that clients will purchase, cook, and consume produce. The emergency food setting provides an optimal point of contact to offer education to low income people.

CAFB is uniquely qualified to address these challenges. From 2003-2012 CAFB contracted with California Department of Public Health (CDPH) to lead 22 nonprofit organizations in educating over 224,000 people annually. In 2012, CAFB partnered with CDPH and several food banks to develop a model program that specifically addresses produce education in emergency food settings. After reviewing existing nutrition education practices and research, the team developed the Produce Toolbox curriculum, now called the Produce Education Program (PEP), which was then pilot tested at pantries and rigorously evaluated by an independent evaluation firm. Results indicated that the program successfully increased participants' consumption of and likelihood to purchase fresh produce. PEP is unique in that it can be applied on a statewide level with food banks and food pantries to employ researched-based produce education, while simultaneously reducing food waste and enhancing competitiveness of the specialty crop industry.

California's agricultural industry leads the nation, and yet 1 in 7 Californians, 13.5% of the state's population, experience food insecurity. Ensuring access to healthy food is vital to California's future- our people, our farms, and our economy. Many families are unable to access fresh produce regularly and so can be unfamiliar with preparing certain produce items. Educational interventions are one of the ways to support access to healthy eating. PEP is a successful and accessible educational tool that staff and volunteers at emergency food settings can use to support their clients health.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

[1] Since CAFB's application for this funding in 2013, the food hardship and unemployment rates have decreased to 15.1% and 5.4%, respectively.

Project Approach

YEAR ONE

- Hire Produce Education Coordinator: Produce Education Coordinator was hired January 2014.

- Conduct outreach to food bank members and select five food bank partners for Produce Toolbox program: CAFB requested interested food banks to submit applications which were then evaluated by CAFB staff and a committee comprised of staff from three non-applicant food banks. The selected food banks were: Feeding America San Diego, Los Angeles Regional Food Bank, Second Harvest Food Bank of Orange County, Second Harvest Food Bank of Santa Clara and San Mateo Counties, and West Side Food Bank (Los Angeles County).

- Choose four pantry partner sites for each of the five food bank partners (20 sites total): Each of five food bank partners recruited four pantry partners for a total of 20.

- Provide training in Produce Toolbox curriculum for each group of four pantries (total of five trainings covering 20 pantries) plus ongoing technical support: Training curriculum and agenda were created and trainings were conducted with each group of four pantries.

- 20 pantries conduct 100 produce toolbox sessions on 10 specialty crops to 3200 clients. Pantries choose lessons based on produce availability: Produce Education Coordinator was hired in January 2014, which moved the project timeline back four months. The program curriculum and materials were developed and implemented by June 2014. In year one, 20 pantries conducted 60 produce toolbox sessions on 20 specialty crops with approximately 2100 clients. Twenty specialty crop lessons were developed as opposed to the goal of 10.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 200 pantries: 20,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Convene the CAFB Produce Education Advisory Committee to review specialty crop/Produce Toolbox lesson development and online resources: The committee reviewed and offered feedback on lessons and food bank applications.

- Develop five additional specialty crop/Produce Toolbox lessons: Twenty lessons were developed and translated from English to Spanish. This put CAFB ahead of schedule with developing 20 lessons before 2016.

- Pilot test five new lessons at five pantries: The new lessons were only slightly modified from the ones used in the pilot study. Rather than re-piloting, CAFB focus grouped new lesson components and materials at food pantries and food bank distributions.

- Hire evaluation consultant: An evaluation consultant was hired March 2014 after a request for proposal (RFP) process. Evaluation activities began April 2014.

- Conduct Year One evaluation activities including case and control studies: CAFB and the evaluation consultant conducted case and control study evaluations of participating agencies and control sites. See attached report for details.

- Create a website for sharing specialty crop curriculum, data, and results among project partners: CAFB released a RFP and hired a design consultant. Graphic design efforts were focused on getting lessons and materials finalized. The website was completed by June 2014.

YEAR TWO

- Select three additional food bank partners and four pantries per food bank: CAFB welcomed Second Harvest Food Bank of San Joaquin and Stanislaus, Community Action Partnership of Kern County, and Food Bank Coalition of San Luis Obispo County, and their food pantry partners to the program in October 2014.

- Provide training in Produce Toolbox curriculum for each group of 4 new pantries plus ongoing technical support and annual site visits to 20 existing pantry partners: Produce Education Coordinator trained 10 pantries (four food pantries at both Second Harvest Food Bank of San Joaquin and Stanislaus and Community Action Partnership of Kern, and two food pantries at Food Bank Coalition of San Luis Obispo County) to successfully conduct the program's walk-the-line lessons. The Produce Education Coordinator also provided ongoing technical support to the existing food pantry partners through in-person site visits, conference calls, and email communications.

- Twenty-five pantries conduct 384 Produce Toolbox lessons on 15 specialty crops to 11,980 clients: 25 pantries conducted 312 produce toolbox lessons on 20 specialty crops to 10,000 clients.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 500 pantries: 20,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Produce toolbox training and site monitoring to participating agencies: The Produce Education Coordinator provided Produce Toolbox training for the new food banks and their partner agencies. The Produce Education Coordinator conducted site monitoring visits to partner agencies.

- Develop and pilot test five new Produce Toolbox/specialty crop lessons: CAFB only slightly modified the lessons from the previously developed versions, so instead of re-pilot testing the lessons entirely, CAFB pilot tested new lesson components at food pantries. Food pantries requested recipe diversity and since CAFB was ahead of schedule with lesson development more focus was placed on recipe development. CAFB updated the sweet corn recipe card and lesson plan to clarify that they refer specifically to the specialty crop sweet corn, instead of the commodity.

- Update website for sharing specialty crop curriculum, data and results among project partners: CAFB added recipe cards and lesson plans for six new specialty crop items, bringing the total to 16, and putting the program ahead of schedule. The recipe cards and lesson plans can be found on the CAFB website: http://cafoodbanks.org/pep-materials

- Conduct Year Two evaluation activities, including case and control surveys: CAFB and the evaluation consultant streamlined the programs evaluation tools and coordinated data collection through client surveys. See attached report.

YEAR THREE

- Select four additional food bank partners and four pantries per food bank: CAFB welcomed the Redwood Empire Food Bank, Resource Connection Food Bank, Community Action Agency of Butte County, and Sacramento Food and Family Services and their food pantry partners to PEP.

- Provide training in Produce Toolbox curriculum for each group of four new pantries plus ongoing technical support and annual site visits to 26 existing pantry partners: The Produce Education Coordinator trained four new pantries to implement PEP in Kern, Los Angeles, and San Luis Obispo counties. PEP refresher trainings were provided to partners in Kern, Los Angeles, and Stanislaus counties. Site visits including onsite technical support were completed with partners in Los Angeles and Orange counties; additionally, ongoing technical support through in-person visits, phone calls, and email communications was provided to all pantry partners.

- Forty-two pantries conduct 432 Produce Toolbox lessons on 24 specialty crops to 26,880 clients. Pantries will choose lessons based on produce availability: Twenty-five food pantries conducted 200 Produce Toolbox lessons on 24 specialty crops to 13,000 clients.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 500 pantries: 49,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Produce Toolbox training, and a site monitoring visit: The Produce Education Coordinator provided Produce Toolbox training for the four new food banks and their partner agencies. The Produce Education Coordinator has also conducted site monitoring visits to partner agencies.

- Update website for sharing specialty crop curriculum, data and results among project partners: Lessons for eight new specialty crop items (apples, beets, bok choy, kale, pears, persimmons, potatoes, and turnips) and six new recipes were developed. The website was updated with new materials and the findings from the previous year's evaluations.

- Partner agencies expressed that PEP was not accessible to some of their clients because they speak languages other than English and Spanish. This feedback prompted translations of the PEP materials into Russian and Chinese. Russian was chosen because there are a high number of Russian speaking clients at pantries presently implementing PEP. Chinese was chosen because it is the third most common language spoken as a first language in California, after English and Spanish, among people living below the poverty line.

- Review Spanish translations; translate PEP materials (lessons and recipes) into Russian and Chinese to expand PEP's reach and utility to food banks and food pantries: Spanish translations were reviewed; Chinese and Russian translations were completed and reviewed.

- Conduct Year Three evaluation activities and prepare final evaluation report: CAFB worked closely with the evaluation consultant to evaluate PEP and gather learnings from the field. See attached report.

Only specialty crop commodities benefitted from this project.

Project partners include:
- California's food banks are nonprofit organizations that procure, store, and distribute food to smaller organizations in their communities. They are primarily county-based and range from small food banks in rural communities with few agencies to large multi-county operations with hundreds of agencies, and all are working to alleviate hunger in California. CAFB partnered with the following food banks to implement PEP: Feeding America San Diego, Second Harvest Food Bank of Orange County, Los Angeles Regional Food Bank, Westside Food Bank, Food Bank Coalition of San Luis Obispo, Community Action Partnership of Kern County, Second Harvest Food Bank of San Joaquin & Stanislaus Counties, The Resource Connection, Redwood Empire Food Bank, Community Action Agency of Butte County, and Sacramento Food Bank and Family Services.

- Agencies, which may be known in their communities as food pantries, food closets, and soup kitchens, deliver food they receive from the food bank directly to people experiencing hunger. CAFB partnered with the following food pantries to implement PEP: Fallbrook Food Pantry, El Sol Academy, Newport Church, La Purisima Catholic Church, Native American United Methodist Church, First Unitarian Church, Immanuel Presbyterian Church, Grace Resource Center, All Peoples Community Center, Church on Pearl, St. Anne Catholic Church and Shrine, St. Joseph Center, Peoples Self Help Housing/Courtland Street Apartments, Oceano Family Resource Center, Bakersfield New Life Center, Under Grace/7th day Adventist, Catholic Charities, World of the Pentecost, Big Valley Grace Community Church, United Samaritans Foundation, Nineveh Outreach, St. Josephs St. Vincent De Paul Ministry Brownsville SDA Church, Youth for Change, NCALC, Oroville Gleaners Food Basket, Vineyard Christian Fellowship, and New Covenant.

- CAFB partnered with several organizations to provide healthy, inexpensive, and nutritious recipes to clients: EatFresh.org, Leah's Pantry, the CDPH/Nutrition Education and Obesity Prevention, Share Our Strength, SuperFood Drive, San Francisco Department of Public Health, and United States Department of Agriculture: Team Nutrition.

Goals and Outcomes Achieved

- PEP consists of 1) a 3-5 minute interactive specialty crop education intervention offered to food pantry clients while they wait in line by food pantry staff and/or volunteers; 2) a recipe card featuring the specialty crop being distributed at the food pantry; and 3) a sample of the recipe on the recipe card.
- Year One and Year Two of the program were evaluated with case and control quantitative surveys, comparing clients at food pantries who had the PEP intervention with control groups who did not.
- Year Three of the program was evaluated using qualitative interviews to gather best practices and learnings from pantries participating in PEP.

GOAL: Increase produce consumption among low income food bank clients to improve health, alleviate hunger, and expand the market for California fruit and vegetable specialty crops.

The activities completed to achieve these performance goals and measurable outcomes were the development of PEP materials, overall program, and the training of partner food banks and pantries in how to use and implement the program.

OUTCOME 1: Increase nutritional awareness of specialty crops and their health benefits among low-income clients. Measure: Percent of clients who indicate increased nutritional awareness in post-intervention survey responses. Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 27% increase in nutritional awareness of specialty crops. Target: By 6/30/16, 51% of participants surveyed will indicate an increase in Nutritional awareness of specialty crops and their health benefits.	Results: The intervention group was 25% more likely than the control group, who had no PEP at their sites, to remember the MyPlate food groups and 30.6% more likely to make half their plates fruits and vegetables. In effect, they recognized the nutritional value, and corresponding health benefits of utilizing the featured specialty crop as a significant portion of their meals.

OUTCOME 2: Increase likelihood of low-income clients to prepare and consume specialty crops received from food bank distributions. Measure: Percent of clients who indicate increased likelihood to prepare and consume specialty crops received from food bank distributions. Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 45% increase in likelihood to prepare and consume specialty crops received from food bank distributions. Target: By 6/30/16, 65% of participants surveyed will indicate an increased likelihood to prepare and consume specialty crops received from food bank distributions.	Results: The intervention group was 30% more likely than the control group to have used MyPlate knowledge to prepare more vegetables for their families and 24% more likely to prepare/offer fruits to their families. Among those clients who received recipe cards, 75% either made the exact recipe, modified or changed the recipe, or did both. Approximately 95% of both groups are likely to consume all or most of the specialty crops they received from the food distributions.
OUTCOME 3: Increase likelihood of low-income clients to purchase specialty crops at retail venues such as supermarkets and farmers markets. Measure: Percent of clients who indicate increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets. Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 60% increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets. Target: By 6/30/16, 78% of participants surveyed will indicate an increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets.	Results: Overall, approximately 80% of both the intervention and control respondents were very likely or somewhat likely to buy the featured specialty crop. Although there was not a significant difference between the intervention and control groups on the surface, in Year Two additional questions were asked to find out why people said they were unlikely to buy specialty crops. While there was not a significant difference between the control and intervention groups on most reasons, the evaluation did find that the control group was less likely to not buy specialty crops because they did not like the item.

In summary:

Year One evaluation results indicated that the group that received the PEP intervention was significantly more likely to remember the seven key MyPlate messages compared to the control group. The intervention group was significantly more likely to have used MyPlate knowledge to prepare healthier foods for their families. Two-thirds of the clients who received recipe cards indicated that they used them at home to prepare the exact, or a modified version of the recipe.

Year Two evaluation results support and align with the findings of the year one evaluation. Seventy-five percent of clients who received recipe cards indicated that they used them at home to prepare the exact, or a modified version of the recipe at home.

Successful outcomes of the project include:

- 11 food banks partnered with 25 pantries to implement PEP.
- Reached 282,000 clients through implementation of PEP.
- Increased participants' awareness of MyPlate and the benefits of making half their plates fruits and vegetables (specialty crops).
- Increased participants' likelihood of preparing/offering specialty crops to their families.
- Developed 24 specialty crop lessons and 46 specialty crop recipes.
- Received positive feedback from participants and food pantry staff and volunteers.

Beneficiaries

Clients who received food assistance from partner food banks and their agencies had increased access to specialty crop items through CAFB's Farm to Family program, recipes, and information about the specialty crops they were receiving at the distribution.

CAFB has been contacted by organizations in other states (South Carolina and Oklahoma) interested in implementing PEP.

CAFB has shared PEP model at the United States Department of Agriculture Western Region Office's (USDA WRO) SNAP-Ed summit and Food Distribution Program on Indian Reservations (FDPIR) conference.

PEP reached 282,000 clients through pantries directly implementing the program. (This number does not include out-of-state food banks or entities outside of the SCBG grant who may have accessed materials on CAFB's website.)

Lessons Learned

Successes:
Food banks and food pantries had success implementing PEP and promoting specialty crops

- The packaged and quick nature of the intervention made it possible to take advantage of the time clients spent waiting for the food distribution to start and offer lessons in the line.

Challenges and Lessons Learned:
Capacity

- Staff and volunteers at food pantries typically have high workloads in order to run the food distributions successfully. This made committing consistently to implement PEP challenging.
- There was a higher than expected amount of turnover of volunteers and staff. PEP trainings were needed approximately 1-2 times per year to support program implementation and ensure new volunteers are trained to increase self-efficacy in educators, which led to greater and longer engagement with the program.
- Capacity at sites varied in terms of staff ability to implement the program in the original way intended with small groups in the line before the distribution. PEP needed to be flexible and to accommodate different distribution models sites. For example, distribution flow made PEP presentations in plenary in front of a group more effective at the sites.

- Evaluations were challenging because of the partner sites' capacity. Evaluating the sites using interviews was also challenging because some interviewers were volunteers and had less training than evaluators or produce education coordinator. After hearing sites express the need for flexibility, and having collected two years of control and case survey evaluation data, CAFB adjusted the Year Three evaluation to collect findings from the field based on how partner sites adjusted the program to fit their distribution models.

Predictability
- Partner sites sometimes did not know ahead of time which specialty crop would be coming to them, which led to challenges planning and preparing for the PEP lesson. To mitigate this, CAFB encouraged sites to order enough recipe cards to restock all of the recipe cards available so that they would have the materials and would then be able to easily grab whichever recipes they needed even if they did not find out what the produce item was going to be until just before the distribution.
- Sampling was challenging for partners to commit to if the site did not have a kitchen, extra volunteer capacity, and/or advance knowledge of what specialty crop would be delivered.

Repetition
- There was fatigue expressed around the activities, lessons, and recipes, expressed by some sites who said that their clients got tired of hearing the similar lessons, and had already tried the recipes.
- The MyPlate board was used heavily and wearing out quickly. CAFB switched from foam core to chloroplast and that worked to extend the lifespans of the boards.

Unexpected outcomes
- Food banks and partner pantries expressed more excitement and enthusiasm for the program than expected.
- Food pantries that were not previously receiving specialty crops, or receiving low amounts, received more from food banks and reported clients taking more. In addition, at least one pantry reported getting more local donations of fresh produce once local stores found that they were doing PEP.
- Produce Education Coordinator was invited to present PEP at USDA WRO's FDPIR conference.
- PEP was leveraged to receive a Walmart grant that funded refrigeration units at six pantry sites. After having the refrigeration units for one year, sites reported having increased capacity to accept and store more specialty crops to distribute to their clients.

Outcome measures not achieved
Outcome 3: Increase likelihood of low-income clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.
It appeared that both control and intervention groups were willing to purchase specialty crops at retail venues with the same frequency. Year Two evaluation results showed that clients receiving PEP were less likely to not buy specialty crops because they disliked them than the control group. More research may be needed to better understand this.

Additional Information
Attached is the CAFB PEP Final Evaluation Report

USDA Project No.: 38	Project Title: Bring the Farmer to Your School Program	
Grant Recipient: Sustainable Economic Enterprises of Los Angeles (SEE-LA)	**Grant Agreement No.:** SCB13038	**Date Submitted:** December 2015
Recipient Contact: James Haydu	**Telephone:** (323) 463-3171	**Email:** James.haydu@see-la.org

Project Summary

The California Department of Public Health (CDPH) reports that 38% of California children ages 9 to 11 are currently overweight or at risk of becoming overweight. A recent CDPH needs assessment also showed rates of overweight and obesity were about 20% higher among children from CalFresh homes. A significant cause of these alarming trends is low intake of fresh fruits and vegetables among California children. The CDPH Network for a Healthy California reported in 2011 that only 24.6% of children from CalFresh-eligible households consumed the recommended five servings of fruit and vegetables each day.

The Bring the Farmer to Your School project addressed these negative public health trends by improving nutritional awareness of students, and increasing consumption of California specialty crops. Farmers were trained by a Registered Dietitian to teach curriculum proven to improve nutritional knowledge and healthy behavior patterns among students. The project introduced urban students to the variety of specialty crop career opportunities.

Without significant and timely intervention focused on reversing these trends, California children will continue to increased risk of serious health problems, including heart disease, type 2 diabetes, and certain cancers. Targeted nutrition education focused on school-age children may be the most successful means of affecting long-term positive behavior changes leading toward reduced risk of chronic diet-related disease. According to the Institute of Medicine's (IOM) 2007 study, *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*, "It may be easier to change children's health behavior than adults' behavior. Childhood offers the opportunity to provide the solid foundation needed for healthful lifelong eating patterns." Studies also show clear links between good eating habits and improved academic performance and a more active lifestyle. A comprehensive educational experience that uses food and farming as an opportunity to teach about not only nutrition, but many core curricular areas including mathematics, science, language arts, social studies and history can be an effective approach toward enhancing both student health and academic performance.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Sustainable Economic Enterprises of Los Angeles (SEE-LA) was successful in meeting or exceeding all targeted progress toward goals. The project staff worked closely with the Los Angeles Unified School District (LAUSD) Program Liaison and administrative staff to provide access to LAUSD campuses for specialty crop farmers to conduct presentations. Although the process to provide access was delayed until January 31, 2014, project staff worked to achieve other project deliverables in a timely manner. The Project Coordinator and LAUSD Program Liaison identified 170 Title I schools (project goal is 175) to target for intervention. Schools served 250, 500, or 750 students depending on school size and past participation. At each target school, a Lead Teacher and/or Principal was contacted and recruited to assist with presentation scheduling, coordination, and evaluation activities. Lead Teachers were sent welcome orientation letters in November and December 2013 to begin the process of scheduling specialty crop farmer presentations. Once Lead Teachers expressed interest in participating, the Project Coordinator sent updated scheduling information and verification forms to begin the process of scheduling specialty crop farmer visits for each participating school.

Concurrently, in November and December 2013, the Project Manager and Project Coordinator recruited 15 California specialty crop growers to partner as farmer educators. All specialty crop farmer educators recruited were required to attend a two-hour in-person Farmer Educator Orientation meeting. Many of the farmer educators were already highly adept at teaching school-age children. Through the life of a specialty crop farmer, the program aimed to bring the fields of specialty crop agriculture, nutrition, and health alive for students. Farmer Educator Orientations were led by the Project Manager, Project Coordinator, and LAUSD Program Liaison in January and February 2014. Orientations provided farmers with the most recent nutrition education guidelines from U.S. Department of Agriculture (USDA) MyPlate, as well as a list of specialty crop careers to present to students at each presentation. Farmer educators were also required to offer samples to all students of a wide variety of produce, many of which would be new and unknown to students, and to encourage increased daily consumption of California-grown specialty crops.

From November 2013 – January 2014, SEE-LA program staff worked with the project evaluation consultant to design program evaluation materials measuring success at achieving measurable outcomes. The final student survey was finalized in January 2014, and baseline surveys of 400 elementary students were conducted in March 2014. Follow-up (end-line) student surveys, as well as farmer educator and Lead Teacher evaluations, were conducted in May 2014.

Farmer educator presentations began in late January 2014. A total of 80,355 students at 164 schools received a hands-on, interactive 30 minute lesson about good nutrition as it relates to California specialty crops, and California specialty crop careers from a farmer educator. A total of 316 presentations teaching about nutrition and the importance of increased fruits and vegetables, and basic agricultural concepts were also introduced.

Because all farmer educators are California specialty crop growers, only California-grown specialty crops are provided as samples to students. Farmer presentations were reviewed by program staff to ensure that all content, particularly as relates to specialty crop careers, includes only information about California specialty crops. Evaluation materials also reflect only those produce items and careers which are 100% related to specialty crops.

The LAUSD Teacher Liaison was essential in providing the necessary coordination and communication among and between Lead Teachers, Farmers, Project Coordinator, and other SEE-LA staff. Lead Teachers continued to be responsive to project staff and Farmers, though challenges were again encountered in getting timely communication from some Lead Teachers. Participating Farmers continued to update and improve presentations to include the latest USDA dietary guidelines and information about California specialty crop careers. The project evaluation consultants conducted a first-rate evaluation and report outlined above.

Goals and Outcomes Achieved

As noted above the Project Coordinator worked with the LAUSD Liaison to identify 170 target schools and Lead Teachers to assist with scheduling farmer visits at schools. From January to November 2014, a total of 80,355 students at 164 schools received a hands-on, interactive 30 minute lesson about good nutrition, California specialty crops, and California specialty crop careers from a farmer presenter. Sentient Research worked with Program Coordinator and Program Manager to design evaluation tools (student, teacher, and farmer surveys), and administered pre-tests to students in March 2014, with follow-up post-tests in May 2014.

The outcome measures were short-term, focused on changes in students' knowledge and behavior from pre-test (March 2014) and post-test (May 2014).

The project served 80,355 students, compared to the project goal of 80,000 students. Farmer presentations were conducted at 164 schools, compared to the project goal of 175 schools. Some schools received multiple farmer visits serving additional students from different grade levels.

The project evaluation did not show a clear improvement in students' consumption of fresh fruits and vegetables. However, students' knowledge of specialty crop careers did increase significantly.

Baseline data were collected prior to the *Farmer in the Classroom* program start from March 4th to 14th, 2014 and the follow-up data were collected in those same classrooms two months after the *Farmer in the Classroom* visit from May 7th to 20th, 2014. For each class at baseline and follow-up, the evaluator distributed the survey instrument and provided the same instructions to each class. The evaluator read the questions and response options aloud, as appropriate, as students filled out the survey instrument. Students were asked to raise their hand if they had any questions and were asked to complete the assessment silently without sharing responses aloud to prevent bias. The *Farmer in the Classroom* student survey instrument (see Appendix 1 in Exhibit K – "Student Impact Evaluation Report") was designed to collect a host of measures relevant to program outcomes among elementary school students. The measures included the consumption and appeal of healthy foods such as fruits and vegetables; access to fruits and vegetables in the home; perceived parental consumption of healthy foods based on the reported frequency of parental consumption of fruits and vegetables; and knowledge and interest in specialty crop careers. In addition, students were administered the Food Preference Questionnaire where they were asked to provide a preference rating for a series of fruits, vegetables and herbs. The fruits, vegetables and herbs were those produced by specialty crop farmers participating in the program that the students might have had the opportunity to sample during the farmer presentations.

Participating teacher perspectives on the program were collected as well. A teacher survey instrument was developed and administered during the student follow-up data collection in May 2014.

A summary of the evaluation report's findings is below:

- Student responses did not indicate a 10% increase in all performance measures from baseline (benchmark) to post-measure.
- *Knowledge of California Specialty Crop Careers*: Significant knowledge gains were demonstrated by students on questions related to specialty crop career opportunities with an increase in correct answers from baseline to follow-up on all questions. Students correctly named 14% more specialty crop careers from baseline to post-measure.

- *Food Preference Questionnaire:* Significant increases in preference were observed for lemons, limes, and onions from baseline to follow-up with more students liking these items *a lot* rather than *a little*. Though not significant, other positive trends were seen in the appeal of many fruits and vegetables.
- *Fruit and Vegetable Consumption Preference*: Significant declines from baseline to follow-up were observed for *liking to try new vegetables* and *liking to eat fruits for snacks instead of chips or cookies*.
- *Access to Fruits and Vegetables at Home:* A significant decline was observed in reported access to fruits at home at follow-up compared to baseline. No significant change was seen in access to vegetables at home.
- *Parental Consumption of Fruits and Vegetables at Home:* A significant decline in the frequency of parental consumption of vegetables was reported by students at follow-up compared to baseline.
- *Interest in Specialty Crop Careers:* Significantly less students said *yes* to being interested in a job involving fruit and vegetables when they grow up at follow-up compared to baseline.

A total of 80,355 LAUSD students at 175 Title I schools received a unique presentation from a local farmer teaching about the nutritional benefits of eating more fruits and vegetables and specialty crop farming as a career. Students showed a significant increase in knowledge of specialty crop careers, and significant increase in preference for three specific specialty crops.

Beneficiaries

The specialty crop farmer educators presenting at those schools and students at LAUSD Title I schools were the project beneficiaries. Through this project, farmer educators offered samples of a wide variety of produce, many of which were new and unknown to students, and encourage increased daily consumption of California-grown specialty crops. Students were also introduced to the idea of specialty crop farming as a career, many for the first time.

Fifteen California specialty crop producers offered their teaching services and their produce sampled by students. The project was particularly helpful for smaller scale specialty crop farmers who are new to the industry and may not yet have well-established marketing and sales operations. During the year-long project, 80,355 LAUSD students at 175 Title I schools received a unique presentation from these local specialty crop farmer educators about the nutritional benefits of eating more fruits and vegetables and farming specialty crops as a career.

Lessons Learned

Farmer to School visits were planned to begin as early as November-December 2013, once participating schools had been identified. However, due to delays in the administrative process to allow access to the school campuses, the first specialty crop farmer visit did not take place until late January 2014. For projects involving agreements with school districts or other similar organizations, potential delays in navigating a large bureaucracy should be anticipated.

The two hour orientation with farmer-educators proved to be very effective in introducing the new specialty crop career component. More time with farmers-educators to specify and review their presentation material, both before classroom visits begin and throughout the school year, would be beneficial, although may be difficult to schedule due to the farmer-educators' schedules and travel distances. The "follow-up" lesson plan on specialty crop careers provided to farmer-educators for teachers to use with students proved to be effective in teaching the specialty crop career component of the curriculum. Additional educational materials to teachers to complement the other classroom presentations conducted by farmer-educators would be valuable.

Interestingly, the project evaluation showed the program's most successful impact on students' knowledge was in the specialty crop career-related topics. Consideration should be given to either increasing the amount of time for each presentation to 40 minutes, or eliminating the specialty crop career section to focus on the main project objective, the specialty crop nutrition education component. Another significant outcome measure not fully achieved was the change in student nutrition knowledge and increase in consumption of fruits and vegetables. Since survey data did show a significant increase in students' knowledge of specialty crop careers, it is possible that the new focus on careers detracted from the effectiveness of the nutrition education lessons. For future projects, SEE-LA would plan to either increase the total amount of time for each presentation to 40 minutes, or eliminate the specialty crop career section to focus more on the main project objective, the nutrition education component. Other organizations conducting similar projects should consider limiting the number of objectives in order to focus on one core objective, (e.g. specialty crop nutrition education or specialty crop agricultural education).

Another unexpected outcome was the incorporation of garden education with the farmer-educators' lessons at some school sites. Schools that had school gardens, or were just starting to build one, were significantly more invested in the project goal, and students at these schools seemed to have more foundational knowledge of specialty crops and nutrition education, and were therefore more involved in the farmer-educator's lesson.

One outcome measure not achieved was the number of schools served. The project goal was 175 schools and the actual number served was 164; however, the project goal of 80,000 students was exceeded and more significant than the number of schools targeted for this project. Organizations conducting similar projects should consider which target is more significant for their project.

The program gained exposure to other organizations working on nutrition educated-related issues in LA County and with LAUSD. In particular, the LA County Department of Public Health (LACDPH) Nutrition Education Obesity Prevention (NEOP) program learned of the Bring the Farmer to Your School program due to overlapping programming at a small number of LAUSD schools. NEOP has since approached SEE-LA about conducting similar specialty crop farmer-taught classes to parents of LAUSD students in the 2015-16 school year.

Additional Information

Additional information about the Bring the Farmer to Your School program can be found at http://www.seela.org/bring-the-farmer-to-your-school-program/.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 39	Project Title: Fresno Food Commons Prototype Implementation	
Grant Recipient: Trust for Conservation Innovation	**Grant Agreement No.:** SCB13039	**Date Submitted:** December 2016
Recipient Contact: Karen Schmidt Kvetka Smith	**Telephone:** (805) 798-1629 (415) 458-3665	**Email:** karenjschmidt@sbcglobal.net kvetka@t4ci.org

Project Summary

Fresno County is one of the most productive agricultural regions in the world. Paradoxically it also is one of the nation's leaders in poverty and food insecurity. Fresno has enough food and agricultural expertise to feed its citizens. But the existing system is failing to deliver that food to the people who need it most. There is growing recognition of the need for infrastructure across the food value chain that is designed and scaled to serve local markets with locally produced fresh foods. And there is enormous interest among community leaders in holistic solutions that not only improve food access but also retain and re-circulate wealth in the local economy, create secure, well-paying and dignified local jobs, and steward the land and environment.

This project was designed to address these needs by increasing access to and consumption of locally grown specialty crops by the residents of Fresno County and enhancing the financial and environmental performance of specialty crop growers in the region. Specifically, this project aimed to 1) support the building, acquisition, and/or repurposing of infrastructure to efficiently process crops from small and mid-scale growers in the region for sale to local retail and institutional buyers; 2) expand marketing, wholesaling and retail channels for local specialty crop products in diverse urban and rural neighborhoods; 3) design a training and HR program to equip new and existing specialty crop growers with the management and business skills to be successful Fresno Food Commons partners; and 4) support acquisition of land and other assets for use in local specialty crop production by a community-based land trust.

The need for increased access to fresh healthy food in Fresno is stark and urgent: Fresno is one of the poorest and most food insecure regions of the United States, where 28% of adults live in food insecure households, 12% of the population has low access to grocery stores, 85% of students qualify for free and reduced school meals, and 59% of urban residents are SNAP/EBT recipients.

However, demand for fresh, local, and source-identified products is growing among this population. Food Commons Fresno surveys at eight mobile markets in food deserts conducted during the grant period indicate that low- and middle-income residents here would purchase more fruits and vegetables if they were readily available in their neighborhoods. For many, fast food or small markets with limited, expensive, and low quality produce are their only food access points, and inadequate public transportation is a barrier to purchasing healthier food products.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

Processing

1A. Investigations confirmed the limited availability of mid-scale processing to serve small and mid-size specialty crop growers in the region.

1B. The team explored a number of potential partnerships with third-party small and mid-scale fruit and vegetable processors in Fresno. The project team is in the process of developing a partnership with a farm to adapt and incorporate their fruit preserve operations into Food Commons Fresno (FCF), and is continuing to explore a collaboration to implement a turn-key mid-scale fruit and vegetable processing model that has been successfully developed in other parts of the country.

1C. The project team is developing a business plan for a specialty crop processing facility in conjunction with multi-use community food hub in south Fresno. A direct public offering is being planned as a key vehicle to secure community and institutional investments to fund development.

1D. FCF entered into an agreement with the Public Health Institute/Cultiva La Salud, leveraging funding from Cal FreshWorks, to adapt its packing facility for use in value-added specialty crop processing for mobile vendors. Facility modifications are underway and operations are targeted to begin in the fall.

Produce Aggregation and Sales

2A. FCF successfully launched local specialty crop produce box sales and wholesale specialty crop distribution in May 2015. Produce box specialty crop sales through June 2016 totaled $515,856 and wholesale specialty crop sales totaled $82,948. FCF is purchasing from at least 30 local specialty crop growers and value-added producers, and is actively recruiting additional suppliers.

2B. FCF's wholesale produce e-commerce hub has been fully operational since October 2015 utilizing technology partner Local Orbit.

2C. A variety of multilingual (English, Spanish, and Hmong) marketing collateral materials have been designed, produced and distributed in the community. Project team members regularly speak at community events and forums such as the Organic Stone Fruit Jubilee and Earth Day. FCF is partnering with the Public Health Institute, Cultiva La Salud, Fresno Metro Ministries, the Fresno County Department of Public Health, and Fresno Unified School District to expand marketing and education in neighborhoods with limited access to fresh produce, utilizing public elementary schools as a physical drop site and locus for education and outreach to school and neighborhood workers and families. The project team is actively working with suppliers to build relationships and market products to a growing list of restaurant, institutional and retail buyers. Eight mobile markets supported by other funding have been used to conduct customer surveys and promote produce box sales, as well as to test potential future retail sites.

2D. The project team is planning a retail produce outlet in conjunction with plans for a multi-use community food hub. The team conducted eight mobile markets to distribute specialty crop products in underserved neighborhoods, collect data, and promote specialty crop produce box sales. At the mobile markets 354 surveys about produce buying habits and preferences were completed. The wholesale hub is selling produce in two retail outlets and is exploring partnership with a third site.

Training and Human Resources Program Development

3A. Assessment of training resources indicated that available programs on food safety, food handling, and agricultural practices are sufficient to meet Food Commons' needs in the near-term. Technical assistance and financial support to specialty crop growers on food safety certification, organic certification, production planning and quality control have been identified as future needs.

3B. The team is actively seeking funding and partners to utilize the specialty crop grower guidelines developed earlier in this project to engage regularly with growers on production planning, quality assurance, and continuous improvement of agricultural and conservation practices.

3C. The packing team has undergone initial food safety training and received Serve Safe certification. The team is continuing to work with board members and local and national advisors to codify HR policies and procedures.

Land Trust Development

4A. The project team established a trust board and governance structure and developed an initial strategic plan identifying key acquisition priorities and targets. The project team is actively pursuing two farm acquisition/donations near Fresno, and exploring several other farm acquisition/donation opportunities in the region to secure land for specialty crop production.

4B. Lease agreement templates have been developed, and negotiations are underway to implement the trust's first farmland lease agreement.

This project solely benefited Specialty Crops only.

Thirty-plus specialty crop growers have been FCF's most important partners, providing high quality products and supporting all marketing and education efforts.

- Advise on business and market development.
- Collaborating on outreach and education in low-income neighborhoods and schools.
- Partnering on e-commerce hub development.
- Key advisor on organizational development and community and government relations.
- Supporting the efforts to plan, fund and develop a specialty crop food processing and distribution hub in the divested neighborhood of southwest Fresno.

Goals and Outcomes Achieved

Goal 1: Expand access to healthy, safe California specialty crops at school, at work, and in the neighborhoods of Fresno County residents. FCF successfully launched retail and wholesale local produce businesses that have increased access to healthy local fruits and vegetables by low- and middle-income residents of the Fresno region. Total specialty crops sales over the grant period are just under $600,000 and growing. Over 25,000 produce boxes have been delivered to over 1,500 customers in the region, and at least 10,000 additional residents are being reached by the marketing, outreach and educational materials. Activities included launching and promoting a produce box delivery business, developing multilingual marketing and education materials, conducting presentations, outreach and market surveys at mobile markets and community events, and conducting focused outreach and produce box host site development in low-income neighborhoods in partnership with public elementary schools and community organizations.

Goal 2: Enhance the marketability and competitiveness of specialty crops through the development of local markets for Fresno and San Joaquin Valley producers. Over 30 different specialty crop growers are selling their products through local FCF channels, with sales approaching $600,000 to 1,500 retail customers and more than 30 institutional, restaurant and wholesale customers. Activities included developing e-commerce hubs for both retail and wholesale sales and order fulfilment; launching a packing facility; conducting marketing, outreach and promotions to recruit restaurant, institutional, retail market, CSA and other wholesale customers in addition to direct retail customers; and evaluating needs for small to mid-scale processing capacity to serve local growers and local markets, and commencing development of a commercial kitchen facility to meet that need.

Goal 3: Expand stewardship practices and invest in the next generation of specialty crop producers in Fresno County and the San Joaquin Valley. The project team worked with over 30 specialty crop growers including young and disadvantaged small farmers to improve their product quality, production planning and market readiness and to communicate the benefits of organic and sustainable agricultural practices to customers and potential customers through print, electronic and video materials, thereby increasing understanding of and demand for their products. The project team also developed a nonprofit land trust that is working to secure land and other food production assets that will support farmland stewardship and sustainable agricultural practices to meet community food needs into the future.

FCF has the infrastructure and systems in place to continue growing sales of local specialty crops, increasing the number of residents buying local specialty crops, and increasing the number and market readiness of local specialty crop growers participating in this value chain. The long-term goals include increasing the local market for specialty crop growers in the region by an estimated $20 million per year (currently at $600,000), training at least 50 farmers and food system workers each year (currently at 30 farmers and 15 food system workers), and increasing access to affordable fresh produce for at least 20,000 Fresno residents (currently selling to over 1,500 households and reaching at least 10,000 with marketing and outreach activities).

FCF has achieved all of the goals for the grant period with the exception of measure 3.1, the number of farmers participating in Food Commons Fresno training or certification programs. Through the project, staff have directly engaged with 30 specialty crop growers during the grant period and the supply base is growing, but it will take another year or more to reach the target of 50 participating growers.

Performance Measure 1.1: Increase sales of source-identified Fresno County and San Joaquin Valley specialty crop products in participating neighborhoods, including neighborhoods with limited supermarket access.

Benchmark: Not previously collected.
Baseline: $18,000 (1 participating grower).
Target: Increase of 15% comparing the first month with the last month of the project.
Progress: $599,207 (3,229% growth; 30 participating growers to date)
Discussion: FCF is continuing and steadily growing produce box sales and wholesale specialty crop sales to restaurants, retailers and institutional customers.

Performance Measure 1.2: Increase the number of retail and food service outlets selling source-identified Fresno County and San Joaquin Valley specialty crop products.

Benchmark: Not previously collected.
Baseline: 0 new outlets.
Target: Increase of at least 10 outlets from first to last month of the project.
Progress: 20 new outlets
Discussion: Current outlets include 10 restaurants, 2 retailers, 4 Community Supported Agriculture (CSA) businesses, and 4 institutional buyers.

Performance Measure 1.3: Increase the number and acreage of producers growing specialty crops for sale to local retail markets (in addition to farmers markets and other direct sales).

Benchmark: Not previously collected.
Baseline: 0.
Target: Increase of 25 farmers and at least 200 acres first to last month of the project.
Progress: 29 growers / 300+ acres added
Discussion: Data on acreage of suppliers is incomplete at this time; actual acreage is likely substantially higher.

Goal 2: Enhance the marketability and competitiveness of specialty crops through the development of local markets for Fresno and San Joaquin Valley producers.
Performance Measure 2.1: Increase sales of specialty crop products by participating specialty crop producers in local markets.

Benchmark: Not previously collected.
Baseline: $18,000 (1 participating grower to date).
Target: Increase in sales of 15% for participating specialty crop producers.
Progress: $30,844 (171% growth) (20 participating growers to date)
Discussion: Assisted in the startup of the Gnarly Carrot market in North Fork, CA. Assistance included help with Food Facility plans submitted to the Madera County Environmental Health Department and access to local specialty crops. Previously, the farm had a membership store. The Gnarly Carrot opened 4/1/16. FCF also began selling produce in April to an Asian market, and are selling to four retail CSAs and buying clubs.

Performance Measure 2.2: Provide new local buyer contacts established by local specialty crop producers.

Benchmark: Not previously collected.
Baseline: 0.
Target: Provide at least 5 new local contacts for purchases reported by participating growers.
Progress: 20
Discussion: Since launch in May the hub is delivering specialty crops from at least 29 growers to 20 local restaurant, institutional and retail buyers.

Goal 3: Expand stewardship practices and invest in the next generation of specialty crop producers in Fresno County and the San Joaquin Valley.
Performance Measure 3.1: Number of specialty crop producers participating in Fresno Food Commons-related training and certification programs.

Benchmark: 0 (pre-start up).
Baseline: 0
Target: 50 by year 3.
Progress: 8 participating producers, 9 pending
Discussion: At least 29 new growers are now supplying specialty crops to FCF and will be evaluated using the grower standards protocol.

Over the course of this grant FCF sold nearly $600,000 in locally grown specialty crop products from 30 different growers in the Central Valley region. Delivered over 25,000 produce boxes to over 1,500 customers/households in the region, including many low- and middle-income families in neighborhoods with limited access to fresh, high quality fruits and vegetables. With demand for local high quality produce steadily growing, we expect the number of participating specialty crop growers, the number of consumers reached, and retail and wholesale sales to double or more over the next 18-24 months.

Beneficiaries

Beneficiaries of this project include specialty crop growers in the Central Valley who experienced increased revenue and market presence from the project's sales and marketing activities, and residents of Fresno who experienced increased access to fresh high quality local produce.

Beneficiaries included 30 specialty crop growers directly participating in our market channels, with total revenues of almost $600,000, and over 1,500 retail and wholesale customers with increased access to fresh local produce. The project team expects revenues to reach $1.5 million over the next 18-24 months, with attendant economic and health benefits continuing to grow.

Lessons Learned

Perhaps the most important lesson from this project was both the time and effort that was required to find the right people to staff and implement the project, and the value of investing that time and effort to recruit and train those people. The project required people with a combination of business and interpersonal skills, flexibility to adapt to constantly changing circumstances and challenges, and passionate commitment to the project's goals and principles. Although the recruitment process meant a slightly slower ramp up on project implementation, taking the time to find the right people paid off enormously in the form of a highly effective and thoroughly engaged and committed team that outperformed on virtually all measures and are positioned to continue growing the project's impacts well beyond the conclusion of the grant.

The project team also learned, not surprisingly, that an undertaking of this size and complexity inevitably takes longer than expected, that plans have to be adjusted on the fly both to deal with unforeseen issues and to take advantage of unforeseen opportunities, and that investing up front in extra capacity and infrastructure

One of the best unexpected outcomes of this project has been the strong interest and support in the work from the residents in the low-income neighborhood where the first facility was located. The initial produce packing team was hired almost entirely from the neighborhood in response to "Now Hiring" signs posted in the window. These team members have become some of the greatest advocates and ambassadors, enlisting their family members, friends, and neighborhoods schools and churches to participate in learning about, buying and consuming more locally grown fresh fruits and vegetables.

Engagement of more farmers in training and certification requires resources and expertise that went beyond the scope of this project. It would be beneficial to see dedicated funding and partners to provide the training technical assistance that will enable a greater number and diversity of small farmers to participate in the local supply chain and market channels.

Additional Information

Please see the attached.
Visit the website at: www.foodcommonsfresno.org.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 40	**Project Title:** Developing Farmer to Consumer Relationships in the Faith Community of the North San Francisco Bay Area	
Grant Recipient: Interfaith Sustainable Food Collaborative, a project of Trust for Conservation Innovation	**Grant Agreement No.:** SCB13040	**Date Submitted:** December 2016
Recipient Contact: Kvetka Smith	**Telephone:** (415) 458-3665	**Email:** kvetka@t4ci.org

Project Summary

Approximately 50% of Sonoma County farmers earn less than $10,000 in farm income. The project facilitates economic development by assisting them with access to direct markets through connections with faith-based groups. Many North Bay farmers markets are saturated and have waiting lists for farmers who want to sell their products. The project developed local marketing relationships connecting producers, including beginning and small-scale farmers, to a new-base of consumers that are concerned about production practices.

Several national religious movements are encouraging local congregations to support purchasing of local food. Many faith groups are already working on food access issues through food pantries and meal programs. This project was designed to facilitate relationship building and resource sharing to ensure local farms and faith groups do not have to reinvent the wheel as they facilitate purchases of specialty crops.

At the same time, many local families are in need of ready access to affordable, healthy food. According to the Sonoma County Food System Alliance's Food System Assessment released in July 2011, an estimated 50,000 Sonoma County residents, or 9.5%, live below the Federal Poverty Level (FPL) in 2010. The California Budget Project found that the minimum income needed to make ends meet for a family in Sonoma County in 2007 ($77,069 for two working parents and two children) was 3.5 times higher than the FPL. The real poverty rate in the project area is likely significantly higher than the official statistics indicate, meaning many families who have incomes above the FPL face tough choices when it comes to buying healthy food versus paying for other basic necessities such as rent, transportation, utilities, and medical care.

This project was needed to help the large number of farmers in Sonoma and Marin Counties to increase sales. Strong local economies and healthy families are the backbone to a successful food system and communities. By increasing direct marketing outlets for specialty crop producers, the project works to increase economic development and increase healthy food access, therefore supporting vibrant food system and communities in the North Bay Area.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

To achieve goals, project staff performed outreach, developed materials, collected baseline data, facilitated networking through conferences and roundtables, provided technical assistance, negotiated agreements between farmers and faith-based groups, and collected data on impacts. Project staff recruited farmers and faith-based groups to be active participants in the project. The Interfaith Sustainable Food Collaborative (IFSC) made calls and held follow-up meetings to assist faith-based group leaders coordinating CSA or farm stand relationships with local specialty crop producers. Project staff also organized three annual conferences, and 22 separate roundtable training workshops, to recruit farmers and faith-based groups to be active participants in the project. Technical assistance was given to faith groups to facilitate agreements with farmers; provide resources; and provide mediation assistance to help launch site-specific projects. Evaluation was integrated throughout and included surveys, key informant interviews, focus groups, and event evaluations. A resource guide on lessons learned regarding direct marketing via CSA drop-sites and farm stands was developed and made available on a demand-response basis.

All project activities were focused solely on the sale and marketing of California specialty crop products. The Project Director, the finance team, and the Executive Director reviewed all expenses to ensure that all funds were used to solely enhance the competiveness of specialty crops.

Project partners included faith-based groups, private farm businesses, non-profit agricultural advocacy organizations and technical consultants. The project as a whole promoted specialty crop working partnerships between faith-based groups and local farms. Congregations hosted marketing sites for specialty crops including CSA "drop-sites" and farm stand sales locations as described elsewhere in this report. Beyond these partnerships that were fundamental to the project, there are many ways partners contributed. At least 20 different congregations hosted conference or roundtable training events at their sites. These were consistently provided at no cost to the project. At least 8 farm partners attended workshops to make presentations to explain the mechanics of CSA programs in general and specifics to their operations. Workshops typically had one or more farmers participating to make sure the faith-based groups understood the farmer perspective. Several farms participated in more than one workshop. Community Alliance with Family Farms (CAFF) held events for local farms looking for direct marketing opportunities. Farms to Grow, Inc. helped the project team identify African American farmers for culturally appropriate CSA and farm stand produce. MIPS Computation worked with the project team to design a mapping system on the ISFC's website to show which congregations are engaged in specific food system activities, such as CSAs and farm stands. 18 faith-based groups hosted project roundtable discussions. 8 specialty crop producers presented and marketed their farm to faith-based group representatives at project roundtable discussions.

Goals and Outcomes Achieved

Project staff have been successful in advancing all project goals through outreach, technical assistance, trainings, annual conferences, and developing resource materials. To date, project staff have identified 29 farms and 57 faith-based groups that have interest in establishing direct marketing relationships promoting California specialty crops. Highlights from the two year and nine month grant period include: 22 trainings organized with over 250 attendees; 29 farms and 44 faith-based representatives given technical assistance by project team; and 13 CSA and 12 farm stand sites established or developed.

Goal 1 was to increase specialty crop marketing by promoting customer relationships between producers and the Northern California faith-based community.

Objective A was to conduct outreach to at least 20 faith-based groups regarding opportunities to host on-site farm stands or Community Supported Agriculture drop-offs. Project staff reached more than 600 faith-based groups in Sonoma and Marin Counties to encourage distribution of direct marketed specialty crops and to promote the Conference and roundtables held during the reporting period via email, calls, and direct mail.

Objective B was to promote opportunities to provide CSA drop-offs and farm stands to at least 100 local farms. Project staff promoted opportunities to provide CSA drop-sites and farm stands to over 400 local farms. From this outreach, which included targeted emails as well as calls and farm visits, the project team identified 28 farms interested in partnering with faith-based groups to market specialty crops.

Objective C was to facilitate 16 CSA farms gaining 300 new member subscribers by establishing relationships between farms and religious institutions. Project staff facilitated 5 (Laguna Farm, Singing Frogs Farm, Foggy River Farm, Full Belly Farm, and First Light Farm) CSA farms gaining or retaining 101 new member subscribers by establishing relationships between farms and faith groups; this includes the team establishing or developing 13 CSA drop sites at faith-based sites. Please note that 5 farms served multiple faith-based sites through their CSA programs. In addition, 200 families received access to local fruits and vegetables through farm stands. Some faith groups that expressed interest in hosting a CSA drop-site ultimately did not advance CSA projects. Often, this was due to lack of volunteer or staff capacity to organize and manage a project. 11 of 13 faith-based CSA sites are still operating and one plans to begin CSA drops after the close of the project period.

Objective D was to establish or develop 12 farm stands at faith community sites to facilitate purchases from congregants from local farmers. Project staff established 12 farm stands at faith community sites to facilitate purchases from congregants from local farmers. Some faith groups that expressed interest in hosting a farm stand ultimately did not advance farm stand projects. This was similarly due to lack of volunteer capacity to organize and manage a project, or other factors beyond the control of project 'champions' at specific sites. Five of these sites are committed to continue developing and will begin farm stand sales after the close of the project period.

Goal 2: Advance training, technical assistance, and networking to facilitate direct sales of specialty crops to faith-based institutions.

Objective A was to develop educational materials in the form of fact sheets and a workshop curriculum to assist faith-based groups with decisions about establishing and managing on-site CSA programs. Project Staff developed educational materials in the form of fact sheets and workshop curriculum to assist faith-based groups with decisions about: sales of specialty crops; food sampling and commercial kitchen use; and establishing and managing on-site CSA or farm stand programs. The ISFC team finalized two "How-To" tool kits on CSA and farm stand projects with local farms including a list of specialty crop producers seeking direct marketing relationships with faith-based sites. Materials were circulated to all conference and roundtable attendees, and provided as part of technical assistance on a site-specific basis.

Objective B was to develop educational materials in the form of a fact sheet and workshop curriculum to assist farmers with decisions about establishing and managing CSA relationships with faith-based groups. Project staff refined and circulated educational materials, including fact sheets on Supplemental Nutrition Assistance Program (SNAP) licensing and farmer utilization of SNAP redemption that is essential for farmers running CSAs or farm stands serving the SNAP-eligible population. Project staff developed a sample Memorandum of Understanding (MOU) for CSA farms doing produce box drops at churches and other faith-based sites.

Objective C was to organize six roundtable discussions for 20 faith-based group leaders interested in promoting local food access by offering on-site CSA's, or farmstands. Project staff organized 22 roundtable discussions for 253 farmers and faith-based group leaders interested in promoting local food access by offering on-site CSA's, or farmstands. This significantly exceeded the target goal for the number of workshops. The roundtable workshops highlighted successes and challenges from several different perspectives and models for hosting and operating a farm stand or CSA drop site. Combined, the 22 events attracted 253 individuals representing 80 different congregations and 6 farms. The workshops featured speaker representatives of: farms including What's Up Farm, Laguna Farm, First Light Farm, Valley End Farm, Green Gulch Farm, Foggy River Farm, Tierra Vegetables and Singing Frogs Farm; faith-based groups including Village Baptist Church, Bethlehem Lutheran, Congregation Shomrei Torah, and First Presbyterian Church of San Anselmo; and the USDA's Federal Nutrition Service. The roundtable discussions in the last twelve months of the project evolved to be more targeted trainings as the project team attempted to focus CSA drop-site and farm stand development in more rural, less populous locations in the project area (such as Monte Rio, Tomales, and Cloverdale).

Objective D was to provide technical assistance to at least 40 farmers and faith-based group representatives to facilitate direct marketing of agricultural commodities. Project staff provided technical assistance to at least 29 farms and 44 faith-based group representatives to facilitate direct marketing of agricultural commodities.

Farms that received technical assistance include:
Roots of Creation, Bloomfield Organics, Natural Gardening Company, Cielo Azul Farm, Paul's Produce, What's Up Farm, Russian River Vineyards & Farm, Quarter Acre Farm, Ortiz Brothers, Laguna Farm, Singing Frogs Farm, First Light, R. Kelley Farm, Foggy River Farm, Scott Family Farms, Oaks of Hebron, Valley End Farm, Green Gulch Farm, Tierra Vegetables, Sonoma Heritage, Frog Hollow Farm, Shooting Star CSA, Happy Acre Farm, Rancho Piccolo, Full Belly Farm, McKinley Family Farm, Feral Heart Farm, Grace Farms, and Coyote Family Farms

Faith based groups that received technical assistance include:
United Church of Cloverdale, Greater Powerhouse COGIC, Wat Lao Saysettha, Village Baptist Church, Faith Lutheran Church, Windsor Presbyterian Church, Episcopal Senior Services, Congregation Beth Ami, Bethlehem Lutheran Church, Center Spiritual Living, Congregation Kol Shofar, Congregation Shomrei Torah, First UMC San Rafael, Holy Spirit, Islamic Center of North Marin, Redwood Forest Friends Meeting, San Francisco Theological Seminary, Sebastopol United Methodist Church, St. Paul's Episcopal Church of Healdsburg, Unitarian Universalist Congregation of Marin, Good Shepherd Episcopal Church, United Methodist Church of Sonoma, First Congregational Church of Sonoma, Catholic Charities of Santa Rosa, Hessel Church, First Missionary Baptist Church, Redwood Adventist Academy, Sleepy Hollow Presbyterian Church, Congregation Shir Shalom, St. Vincent De Paul Church, Wat Mahabuddhaphumi, Santa Rosa Alliance Church, St. Theresa, St. Philips, Sonoma Lighthouse Church, St. Andrews Episcopal Mission, St. Andrews Presbyterian Church, Cross and Crown Lutheran, First Presbyterian San Anselmo, Osher Marin JCC, Rodef Shalom, St. Vincent Church, Vineyard Hills, Sonoma Jewish Family and Children Services.

Goal 3 Promote CSAs, Farmers' Markets and Farm stands; and project services to 30,000 consumers affiliated with faith groups.

Objective A was to promote local opportunities to sign-up with local CSA's to at least 7,500 individuals affiliated with 10 faith-based groups in Sonoma and Marin Counties by placing articles in congregational newsletters. Through targeted calls, multiple email campaigns, placing articles in congregational newsletters, and media coverage circulated via the Santa Rosa Press Democrat, Sonoma County Gazette, and La Voz, project staff promoted local opportunities to sign-up with local CSAs or host farm stands to 54,900 individuals affiliated with over 500 faith-based groups and readers of at least 6 public media outlets serving Sonoma and Marin counties. Opportunities to purchase produce through CSAs and farm stands were promoted through media coverage of project related work from: local NPR affiliate KRCB, Solutions Magazine, the Santa Rosa Press Democrat, Petaluma Argus Courier, the Sonoma County Gazette, and La Voz; these outlets have a combined circulation of over 45,000.

Objective B was to promote the conference to at least 40 faith-based groups in Northern California with a focus on Sonoma and Marin Counties. The three annual conferences were promoted to over 500 faith-based groups in Northern California with a focus on Sonoma and Marin Counties. Project staff were able to promote the 2016 conference to over 600 faith-based groups due to a new partnership with the Interfaith Council of Contra Costa County and its 110 member following.

Goal 4: Evaluate impacts of farm to consumer relationships developed through the project.

Objective A was to develop an on-line survey to evaluate project impacts to be completed by farmers and faith-based group representatives in order to improve future programming. Objective B (above) was to promote and administer the survey to all farmers, faith community representatives, and CSA subscriber members affiliated with the project. Project staff developed and promoted three on-line surveys to over 600 faith groups and 410 local farms to evaluate project impacts and identify direct marketing opportunities. In total, the surveys were completed by 44 farmers and faith-based group representatives in order to improve project planning. Results included: 10 new faith groups expressing interest in establishing a direct marketing relationship with local specialty crop producers; and 9 newly identified specialty crop producers expressing interest in establishing a direct marketing relationship with local faith groups. Project staff used survey data to provide technical assistance to faith groups and farms expressing interest in having a CSA or farm stand relationship with local specialty crop producers.

Objective B was to conduct two focus groups, one with faith community program representatives and one with participating farmers to identify opportunities to improve programming and educational resources. The focus group with faith community program representatives was held in fall 2014. This was conducted in Spanish which was key to understanding issues of mono-lingual Spanish speakers participating in the CSA program at St. Paul's Church in Healdsburg. Findings from the focus group are discussed in the Lessons Learned section of this report and include the need for cooking demonstrations to increase knowledge of culturally appropriate ways to prepare produce from the CSA boxes including beets and other vegetables. Due to scheduling issues related to seasonal activity and geographic distance of participating farm partners, project staff chose to do key informant interviews instead of focus group serving farmers. Project staff met directly with farmers in spring 2015 and again in winter 2015 to assess programming issues that could benefit outreach or implementation work for the remainder of the project period. This included meetings with representatives of First Light Farm, Singing Frogs Farm and Laguna Farm.

Objective C was to conduct 12 key informant interviews with faith-based group leaders to assess trends regarding attitudes towards and participation in CSA's, farmstands and farmers markets. Feedback from program representatives was collected one on one by project team members and partnering lay organizers.

Twelve individuals were interviewed including: representatives of 6 faith-based partners, 2 CSA program clients and 4 farmers. In addition, ISFC staff supported one of the project sites, Village Baptist Church, distributed a survey to clients to identify opportunities to improve programming. The modest-size congregation received 15 responses which was a strong response.

To summarize: it is important to ensure CSA's provide culturally appropriate produce offerings; in some cases a farm stand will be a better fit than a CSA for low-income customers; and in congregations organized in a hierarchical manner, it is important to get buy-in from lead clergy early in the process of starting a project.

Objective D was to develop a lessons learned article in order to facilitate smooth operation of future faith-based community relationships with farmers. The lessons learned article was developed in the final quarter of the project. It was included in the IFSC's July 2016 Newsletter and the CSA Toolkit. In addition, the article is available through the ISFC's website www.interfaithfood.org.

Although planned outcome measures for the project were not long term, the CSA and farm stand relationships that exist between local specialty crop producers and local faith-based groups and their members will continue. Based on 101 CSA customers retained reflects approximately $58,176 in income for six of the partnered farms annually beyond the life of the project. Further, there are long-term impacts of the project that are difficult to quantify including: stronger knowledge of an appreciation of local farms, seasonal produce, and health benefits due to consumption of specialty crops.

The outcome measured was dollar volume of products marketed to faith-based institutions and their members through the project. Project staff projected establishing at least 12 new farm stands and 101 new CSA subscribers. Baseline was zero farm stands and 4 CSAs. To date, the project has established 13 CSA sites. The 101 customers have a positive impact on the partnering farmers' revenue of approximately $58,000 per year. In addition, the 12 farm stand sites result in an estimated 200 farm stand purchases of approximately $10 per purchase. Farms sites: First Pres San Anselmo, St. Paul's, Islamic Center, Bethlehem Lutheran, First UMC San Rafael, Kol Shofar, Shomrei Torah, Friends Meeting House, SFTS, Windsor Presbyterian Church, Catholic Charities, Village Baptist Church, Sleepy Hollow Presbyterian, Redwood Adventist, Episcopal Senior Housing, Wat Lao, Faith Lutheran, St. Andrew's Episcopal, and Shir Shalom.

Major successful outcome of the project include: 13 CSA and 12 farm stand sites marketing local specialty crops were developed. 604 families purchasing specialty crops at CSA and farm stand sites. One "How-To" Tool Kit guide was developed for faith-based groups interested in marketing California specialty crops through CSA.

Beneficiaries

Beneficiaries included specialty crop farmers in Sonoma and Marin counties that depend on direct marketing and local consumers including low-income families who seek access to healthy produce. Outreach served 400 farms from the Certified Producers lists obtained from Agricultural Commissioners in targeted counties, and the project team promoted 28 specialty crop producers interested in marketing partnerships with local faith-based groups.

At least 8 specialty crop producers received increased revenue due to sales from partnerships established or developed through the project. At least 5 of these producers had relationships with more than one congregation. The number of consumers benefitting from consumption of local specialty crops through the project is approximately 604, assuming 4 individuals served per 101 households participating in the CSA programs and 200 purchasing at farmstands. In addition, approximately 54,000 consumers benefitted from awareness of opportunities and information about local CSA's and farmstands described in the media.

Lessons Learned

One key lesson learned during a focus group held for CSA participants in fall 2014 was how important the cultural appropriateness of the specialty crops are to consumers purchasing produce at faith-based sites. The project team learned from CSA participants that it is not enough to provide fresh or affordable produce if the participants get produce that is not a regular part of their cooking culture. Similarly, the project team found that if participants do not know what the produce is then they probably do not know how to cook it; thus, cooking demonstrations and/or taste tests can be a small but crucial piece to the success of the marketing and increasing sales of California specialty crops.

As the project advanced, project staff recognized that fewer introductory roundtable workshops were needed, and more of the problem-solving for project site organizers at the early stages of planning. This led to customized, focused agendas at some congregations including those located in Cloverdale, Monte Rio, and Tomales. In addition, the staff learned that depending on the faith-based group and the national religious body it is affiliated with, outreach and organizing should target different individuals. More specifically, in congregations organized in a hierarchical manner it is important to bring the lead clergy in to project planning early on. However, in other congregations lay leaders serving as volunteers have the authority to advance projects without significant involvement from the clergy. Unexpected outcomes included a better understanding of how income levels of targeted consumers impact the suitability of farmstands instead of CSAs. Project staff found that, in some cases, a farmstand was more appropriate for a congregation serving a high percentage of low-income people.

All key goals were achieved. Subscription numbers for CSA membership were below those projected due to factors including: some targeted congregations had more low-income participants and required SNAP purchase incentives. Project staff now secured 2 year funds to provide SNAP incentives. Other factors included that some local residents wanted to participate in the CSA in the winter or 'school year' but the farm they had selected only offered a summer and fall program. Finally, changes in leadership, both at the volunteer and staff level, impacted the ability of several congregations to launch programs on schedule or at all.

Additional Information

Argus Courier 4/19/2013 Article:
http://interfaithfood.org/static/media/uploads/argus%20courier%20article.pdf
Press Democrat 6/14/2016 Article:
http://interfaithfood.org/static/media/uploads/pressdemocrat_fini_article_june2016.pdf
Other materials are available via website: www.interfaithfood.org.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 41	**Project Title:** Oak Park Farmers Market	
Grant Recipient: Sacramento Neighborhood Housing Services, Inc.	**Grant Agreement No.:** SCB13041	**Date Submitted:** December 2015
Recipient Contact: Sharon Eghigian	**Telephone:** (916) 452-5356	**Email:** sharon@nwsac.org

Project Summary

The Oak Park neighborhood and surrounding areas have been identified as "food deserts" with a high volume of convenience/liquor stores and relatively low access to affordable, locally grown produce. Oak Park is a low-income, ethnically diverse neighborhood of 16,000 residents. According to recent census data, more than 65% of Oak Park households have an income of less than $35,000 a year.

The purpose of this project was to leverage and increase benefit for specialty crop farmers of the Oak Park Farmers Market through increasing specialty crop sales, increasing the number of specialty crop vendors, and increasing the market's customer base, including Cal-Fresh Electronic Benefit Transfer (EBT) customers. The project built on past success to continue the expansion of a specialty crop "Word of the Week" promotion, in which customers learned the word and nutrition facts about that week's specialty crop.

The project was important and timely because the Oak Park Farmers Market had the opportunity to reach new customers, including low-income customers moving towards self-sufficiency, and support increased and long-term consumption of locally grown specialty crops. The project also provided opportunities for the market's specialty crop vendors to further develop relationships with current and new customers.

Through the 2011 Specialty Crop Block Grant Program Project 41: *Oak Park Farmers Market*, NeighborWorks Sacramento provided the specialty crop promotion approximately 10 times during the 2012 and 2013 market season. The current project was enhanced by providing the specialty crop promotion weekly (May through October) for the 2014 and 2015 market season. Increasing the number of times that the specialty crop promotion was provided at the market helped to attract new customers and continue to increase Facebook traffic.

Project Approach

Goal 1: Increase access and sales to locally grown specialty crops in the low-income community of Oak Park and the surrounding communities.

- Activity - Implement a targeted marketing plan to reach 100 potential new specialty crop vendors.
    - Through a combination of visiting local farmers markets, making cold calls, and being introduced to specialty crop vendors through current relationships with specialty crop vendors, project staff made contact with more than 500 potential specialty crop vendors during the grant period. The Manager culled down a list of several thousand farmers to a list of 400 potential specialty crop vendors, and continues to reach out to and build relationships with many of these vendors.

- The Farmers Market Manager participated in the California Small Farm Conference in 2014 in order to learn more from other Farmers Market Managers about marketing, recruiting vendors, and new regulations impacting specialty crop farmers.

- Activity - Follow-up with 50 potential new vendors via phone, e-mail, and face-to-face meetings
  - Project staff followed up with more than 250 potential specialty crop vendors through phone calls, e-mails, visits, and provided applications to more than 100 specialty crop vendors during the grant period.

- Activity - Participate in 8-12 visits to specialty crop vendors
  - During the grant period, project staff participated in four visits to specialty crop vendors at farm sites. The target number of visits was not completed due to staffing issues. Using other project staff to complete these visits was not a strong option, as the Farmers Market Manager had the knowledge necessary to review farmer operations and to check for farmer and product integrity issues (i.e. wholesaling produce).

- Activity - Add and retain 4-6 new specialty crop vendors
  - During the grant period, project staff added four new specialty crop vendors. The Oak Park Farmers Market had a total of 11 specialty crop venders during the 2015 market season. During the grant period, the Farmers Market Manager increased focus on recruiting new specialty crop vendors through follow-up with potential vendors and visiting local farmers markets.

Project staff have learned that an increase in customer sales goes hand in hand with adding more vendors. Additionally, increasing the Oak Park Farmers Market customer base would also allow an extended market season. In 2014, the Oak Park Farmers Market season was extended from October to November.

Goal 2: Increase pounds of specialty crop produce sold at the market by 150% (from 60,000 lbs./year in 2012 to 150,000 lbs./year by 2015)

- Activity - Specialty crop “Word of the Week” promotion
  - Through this promotion, customers received $5 in coupons to be spent on the purchase of specialty crops only. NeighborWorks Sacramento secured funds from another source to pay for the specialty crop coupons. Project staff ensured that specialty crop coupons were only used for specialty crop vendors by printing "for fruits and vegetables only" on the weekly coupon, and by educating vendors and customers about the promotion. There have not been challenges with monitoring coupon usage. During the market hours of operation, signage was used to ensure that both customers and vendors understood which vendors (i.e., only specialty crop vendors) could accept the specialty crop coupons. Outreach for these specialty crop coupons included posting the specialty crop each week of the market on the Oak Park Farmers Market Facebook page, and “boosting” the page to reach more people on Facebook. Project staff also promoted the specialty crop promotion by distributing flyers monthly in English and Spanish to the Sacramento Food Bank, local WIC clinics, social service centers, and by e-mailing approximately 150 people each week. In addition, there were advertisements in the spring and summer editions of the Sacramento Natural Foods Co-op Reporter, a quarterly newspaper.

- Specialty crop farmers self-reported estimated sales of approximately 75,000 lbs. of specialty crops during the 2015 season. Project staff have determined that these numbers underreport the actual pounds of specialty crops sold and that tracking growth in EBT sales is a more accurate representation of growth in specialty crop sales. Total EBT sales grew by approximately 15% in 2014, and 5% in 2015.
    - Specialty crop farmers self-reported 2015 dollar sales, including EBT sales, were approximately $140,000. Using an average of $1 per pound of produce, and estimating that 80% of sales were sales of specialty crops, approximately 112,000 lbs. of specialty crops were sold in 2015.
    - Specialty crop farmers self-reported 2014 dollar sales, including EBT sales, were approximately $142,000. Using an average of $1 per pound of produce, and estimating that 80% of sales were sales of specialty crops, approximately 114,000 lbs. of specialty crops were sold in 2014.

The Oak Park Farmers Market sells non-specialty crops. In order to ensure that SCBGP funds were used to solely enhance the competitiveness of specialty crops only, project staff tracked numbers for every market week for specialty crop farmers in several areas, including: pounds of produce sold, types of produce sold, numbers of specialty crop coupons redeemed, EBT sales and WIC sales.

Project staff are not using specialty crop funds for any activities that are not related to increasing the competitiveness of specialty crops. Outreach efforts were tracked for the specialty crop promotion, and project staff measured the increase in traffic on the market's Facebook page in order to measure awareness of the promotion of specialty crops; the Oak Park Farmers Market Facebook page has over 3,000 followers. Project staff used time sheets and narrative report back-ups to document time spent conducting efforts to reach specialty crop farmers and for specialty crop outreach. Project funds continued to be used to directly and solely enhance the competitiveness of specialty crops.

Goals and Outcomes Achieved

Goal: Increase retention rates of specialty crop vendors participating at the Oak Park Farmers Market

Performance Measure: Number of specialty crop vendors participating each week and total number of specialty crop vendors participating during the season.

Target: By 2014, the average weekly number of specialty crop vendors will be increased to 19 and by 2015 the average weekly number of specialty crop vendors will be increased to 24.

Result:

- The average weekly number of specialty crop vendors in 2014 was nine.
- The average weekly number of specialty crop vendors in 2015 was seven.

This goal was not met due to several factors:

- There has been an increase in Farmers Markets in the Sacramento area. During the last three years, two new Farmers Markets have opened on the same day and time. Both are located within two miles of the Oak Park Farmers Market. Another farmers market opened less than one mile away, and operates on Thursday evenings. Another new farmers market opened in November 2014 on Sunday mornings; this new market is less than three miles away. Each of these Markets draws a portion of the Oak Park Farmers Market's customer base. One of the project goals was to increase access to specialty crops to low-income families living in a low-income area, which has been successful, as indicated by an annual increase in EBT sales; however, competition for new vendors has become greater.
- The Oak Park Farmers Market typically recruited smaller farmers who may have had capacity issues preventing participation in the market consistently. Project staff recognize that capacity building takes time, and the desired results may be realized later as a result of this project.
- The drought conditions in California in 2014 and 2015 severely impacted the ability of the market's smaller farmers to grow crops. Several of the farmers who hoped to participate in the market through the end of the 2014 and 2015 seasons were not able to do so.
- Due to staffing, the Farmers Market Manager was not able to complete the level of outreach and follow-up with vendors that were planned for the 2014 season.

Goal: Increase access and sales to locally grown specialty crops in the low-income community of Oak Park and the surrounding communities.

Performance Measure: Cal-Fresh, EBT, and WIC sales of specialty crops.

Target: By 2014, will increase Cal-Fresh EBT sales to $1,300/week and by 2015, will increase EBT sales to $1,500/week.

Result:

- 2014 Cal-Fresh EBT sales: average of $1,350/week
- 2015 Cal-Fresh EBT sales: average of $1,370/week

This goal was met in 2014, but fell slightly short in 2015. The growth that was expected in 2015 did not occur due to several factors, including less participation by vendors impacted by the drought, and less than anticipated growth in customer base, due to the increased number of farmers markets in the Sacramento area.

Specialty Crop Promotion: Project staff promoted specialty crops by posting information about the “Word of the Week” on the Facebook page beginning in May and running weekly through October for both 2014 and 2015. Project staff provided $5 dollars (5 x $1 coupon) per family, educated coupon recipients about the nutritional value of each specialty crop "Word of the Week", provided recipes with that week’s specialty crop, and explained why the Oak Park Farmers Market was running the promotion. The coupons were only good for that market day. The specialty crop vendors turned in the coupons each week to the Farmers Market Manager and were reimbursed the following week. Both customers and specialty crop farmers have indicated that the Specialty Crop Promotion has helped with building customer loyalty. Project staff anticipate that these customer/vendor relationships will continue to grow.

During the grant period, the Oak Park Farmers Market redeemed $7,205 in specialty crop coupons in 2014 and $5,205 in specialty crop coupons in 2015. This translates to approximately 14,500 pounds of specialty crops purchased through the Specialty Crop Promotion.

NeighborWorks Sacramento did not achieve the project goal for the anticipated increase in vendors for 2014 and 2015. The expected outcome for the average number of weekly vendors by the end of the grant period in 2015 was 24 specialty crop vendors each week. Actual average number of specialty crop vendors per week was 7 in 2015.

Project goals for the anticipated increase in pounds of specialty crops sold in 2014 and 2015 were not met; however, as noted below in the "Lessons Learned" section, project staff believe that specialty crop vendors did not accurately report the pounds of produce sold. This is true for a variety of reasons, including challenges in understanding how to complete the weekly sales sheet, changing poundage numbers for carton/crate size, and difficulty accurately tracking that information during the hectic market day. Since the EBT sales numbers have continued to rise, project staff believe that actual poundage numbers are higher than what specialty crop vendors report back at the end of the market day.

Weekly data was collected during the market season on the following: cash sales, EBT sales, specialty crop redemption, pounds of produce sold, number of vendors participating, and WIC sales. This data was gathered for each vendor. Project staff gathered data in categories of specialty crop vendors and non-specialty crop vendors and used data from each market year as a starting point for measuring increases in pounds of produce sold and EBT and cash sales.

EBT sales have continued to grow over the course of the project. The EBT sales at the Oak Park Farmers Market increased approximately 15% in 2013 and 2014 and approximately 5% in 2015.

Beneficiaries

This project benefitted the specialty crop industry by increasing the volume of specialty crops sold at the Oak Park Farmers Market. Specialty crop vendors that participated at least once during the 2014 and/or 2015 market season benefitted from the completion of this project. Many of these vendors are beginning and/or socially disadvantaged farmers. The project also benefitted families in the primarily low-income community of Oak Park and surrounding neighborhoods in Sacramento by increasing their access to locally grown fresh produce. Low-income families that participated in the EBT incentive and specialty crop incentive were able to stretch their limited dollars to purchase more healthy food for their families.

NeighborWorks Sacramento made the decision to open the Oak Park Farmers Market in a low-income area to increase food access for lower-income families and to support healthy economic development in the area.

The groups that benefitted from this project include the specialty crop industry, with increased knowledge of specialty crop nutrition and benefits through the specialty crop "Word of the Week" promotion, a total of approximately 25 specialty crop vendors that participated at least once during the 2014 and/or 2015 market season of May through October, and the approximately 600 people per week that shopped at the Oak Park Farmers Market during the market seasons of 2014 and 2015.

Lessons Learned

The Oak Park Farmers Market completed its sixth year of operations in October 2015, which coincided with the end of this project period. Outcome measures were based on projections of continued growth and expansion. Project staff did not anticipate the impacts of the drought, and the impact of several new farmers markets opening within three miles of the Oak Park Farmers Market. These markets are located in more affluent neighborhoods, which helps increase the stability of their market sales. By contrast, approximately 30% of the Oak Park Farmers Market sales are through EBT sales.

Project staff were also challenged in gathering accurate information from vendors for cash sales and pounds of produce sold each week. Project staff worked diligently to improve this process and make it as easy as possible for vendors to provide this information (i.e., developing forms, meeting individually with vendors at the end of the market to gather information). It was determined that the market's EBT sales were the most accurate gauge of sales and produce sales.

As noted previously, the impacts of the drought and the increase in new farmers markets impacted ability to fully meet project goals, namely increasing and retaining specialty crop vendors and increasing produce sales.

Additional Information

There is no additional information to report.

USDA Project No.: 42	**Project Title:** The HEAL Project: EAAT (Engaged Active Agricultural Tasters)	
Grant Recipient: The HEAL Project	**Grant Agreement No.:** SCB13042	**Date Submitted:** December 2016
Recipient Contact: Amy Bono-Kruckewitt	**Telephone:** (650) 918-2422	**Email:** Amybk@thehealproject.org

Project Summary

The addition of Engaged Active Agricultural Tasters (EAAT) to The HEAL Project (THP) programs will actively engage students in the production, preparation and consumption of California specialty crops (CSCs) as a regular school-day activity, encouraging kids, their parents and siblings to become life-long consumers of CSCs. Schools are in a unique position of not only conveying information about health and the importance of consuming lots of fruits and vegetables every day, but also providing regular opportunities for all students to practice the essential skills to do so. By integrating a weekly lesson into the school day that actively involves very young public school students in the growing, harvesting and creative preparation of CSCs, EAAT can counter the pressure for kids to consume highly processed, sugary, fatty snacks, and instead become life-long advocates and consumers of CSCs.

Children and their parents are subjected to marketing of sugary drinks, fatty snacks and highly processed foods; the negative health outcomes are well documented. California's (CA's) small farmers do not have access to marketing apparatus to deliver alternative messaging nor do school districts or teachers. EAAT will relate CSC produce with current research that shows healthy eating and regular physical activity play a crucial role in preventing heart disease, cancer and stroke; the three leading causes of death among adults 18 years or older. Engaging students from a very young age in healthy eating and regular physical activity has proven to help lower their risk of obesity and related chronic diseases during childhood.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

Activity: Deliver EAAT tasting at THP and Coastside Children's Programs Summer Camps
Description: Tastings delivered during the 2014, 2015, and 2016 summer camp sessions.

Activity: Deliver EAAT tastings at school events, health fairs, and other community venues such as Boys and Girls Clubs
Description: THP expanded tastings to four new community venues: Moonridge Community Center, Pillar Ridge Community Center, The Boys and Girls Club of Half Moon Bay, and Half Moon Bay Library. THP participated in health fair tastings at New Leaf Market in 2014/15 and school events such as graduation night in 2015/16.

Activity: Deliver to 2nd & 3rd graders: two schools: weekly garden-based lessons on health, agriculture and environment, addressing CA science and health standards
Description: THP delivered weekly garden programming at Hatch and Farallone View Elementary Schools throughout the grant time period.

Activity: Purchase health department-approved food carts
Description: Pacific Coast Farmers' Market Association generously donated two health department approved food carts to THP. Carts have been and will continue to be used for food prep and tastings at the San Mateo County School Farm.

Activity: Secure safe-food handling certification for all staff/volunteers
Description: All staff handling food for EAAT tastings have received their food handlers permit.

Activity: Design program to demonstrate and distribute healthy snacks within classroom sessions
Description: THP hired an EAAT coordinator in the fall of 2014 to design, schedule and lead tastings at various school sites and community venues.

Activity: Secure calendar clearance for THP Graduation/Family Night/year
Description: Grad nights were held in January of 2015 and 2016

Activity: Solidify relationship and buying plan with Farmers' Market Management/Operator – Issue MOU for CSC coupons and purchasing agreements
Description: Plan in place with two cooperating entities.

Activity: Farmers' Market Coupon Training for Coastside Farmers' Market, Pacific Coast Farmers' Market and East Palo Alto Farmers' Market farmers regarding SCBGP eligible produce
Description: Annual trainings provided

Activity: Develop and integrate new curriculum that includes info/demos on CSC food prep, nutrition, history, and economic significance
Description: Every EAAT Tasting completed in a classroom or on the farm provides the following background information about the CSC: nutritional significance, how to prepare it, brief history, and economic significance to CA. This information is disseminated verbally and occasionally with the support of posters, power point presentations or hand-outs.

Activity: During market season, create produce purchasing plan through Farmers' Markets to identify best produce and price
Description: THP staff shop for produce at certified Farmers' Markets that are closest to their respective homes and purchase from a number of different vendors.

Activity: Award travel stipends to a total of 20 eligible schools for farm site visits for 2014/15 and 2015/16
Description: THP awarded travel stipends to a total of 43 individual classes from 7 different schools from September 2014 – June 2016.

Activity: Provide CSC samples to students and their families during at least two school events at participating elementary schools
Description: THP provided CSC samples to students and their families at THP Program graduation night for 3rd grade students at Hatch and Farallone View Elementary Schools in 2015 and 2016.

Activity: Negotiate MOU with one school for expansion to additional site in 2014/15

Description: In 2014/15 THP expanded tasting sites to include El Granada Elementary. In 2015/16 THP expanded to include Pilarcitos Alternative High School in tastings.

Activity: Develop all CSC specific surveys, develop survey administration protocols, monitors survey administration, data collection and conduct data analysis. Write reports based on data.
Description: Surveys have been developed and administered. Results of surveys used in generating reports.

Activity: Develop and manage cooking demonstration(s)
Description: THP Farm instructor manages cooking demos on farm, THP Instructor at Farallone View (FV) Elementary manages cooking demos at FV, and EAAT Coordinator manages tastings and cooking demos at Hatch Elementary, El Granada Elementary School, and other community sites.

Activity: Oversee survey development, monitor survey administration and ensure data collection and entry protocols are established and followed. Analyze survey results and provide annual pre/post test reports.
Description: See results of surveys in next section

Activity: Additional labor required for EAAT CSC planting, growing, harvesting and deliveries. Also monitors and corrects student planting.
Description: Farm laborer was hired and assisted with the above mentioned activities in 2015 and 2016

This project did not benefit commodities, only specialty crops.

Project Partners:
Coastside Farmers' Market made in-kind contributions including: The provision of booth space at the Half Moon Bay Farmers' Market and administrative support for THP farm stand

A farmer generously donated 2.5 acres of farmland for the establishment of the San Mateo County School Farm, where students participate in EAAT tastings/cultivation of CSC's.

Cabrillo Unified School District provides in-kind support in the form of office space to THP administrative team and classroom and garden space for THP educators.

Parent Teacher Organizations provide matching funds for the support of THP's Intensive Garden Programs (IGP) at Hatch and Farallone View Elementary Schools.

Goals and Outcomes Achieved

The main activities completed to achieve the performance goals are as follows:

1) Leading classes from across San Mateo County on farm field trips where students engaged with growing, harvesting, preparing and tasting California Specialty Crops.
2) THP Intensive Garden Programs held at Hatch Elementary and Farallone View Elementary. During the school year IGP classes are offered to approximately 350 students in 2nd and 3rd grades get the opportunity to prepare and sample CSC's, sampling a new CSC every week.
3) EAAT tastings held at other school venues and community locations, such as El Granada Elementary, Pilarcitos Alternative High School, and the Boys and Girls Club of Half Moon Bay.

For each of the 3 outlets for EAAT programming listed above, participating students were given a voucher packet worth $10 (initially $5, but bumped to $10 in project year 2). The distribution of vouchers was meant to provide an incentive for students to shop at the Farmers' Market and increase the likelihood of becoming a regular shopper, thereby uplifting the CSC industry as a whole. The hiring of an EAAT tastings coordinator helped to streamline the efforts of program implementation.

For a sample population of each of the program groups listed above a survey was given to determine attitude and behavioral changes related to CSC's to determine if multiple exposers to CSC's produced a more favorable attitude towards consumption.

Outcomes were measurable within the duration of the project and will continue to sustain and grow beyond the grant period.

Total number of students who participated in EAAT programs during the entire funding period: 13,452
THP significantly exceed their goal of reaching 1,450 students annually. THP was able to meet their goal of providing EAAT tastings on a weekly basis to 350 2nd/3rd grade students enrolled in THP's Intensive Garden Programs. Due to increased field trip numbers throughout the duration of the grant program and due to the new venues THP offered EAAT programming, THP was able to reach many more students than initially projected.

The overarching goal of this program was to increase enjoyment, understanding and consumption of CSC fruits and vegetable creating life-long consumers/advocates. THP believes this goal has been met. While it remains to be seen if participating students will become life-long consumers/advocates, THP believes they provided valuable programming at a critical time in students' development of food preferences that helped introduce students to CSC's in a fun, engaging way. Please see below for results of a self-survey that looked at attitudes and beliefs about consumption of fresh fruits and vegetables before and after participating in EAAT programming.

Goal: 25% increase in voluntary post-curriculum participation in THP-sponsored garden/farm-based extramural programs. The largest increase in post-curriculum participation that THP has seen is in summer camp enrollment. Enrollment more than doubled since summer camps started in 2014, with an overall increase of 133%. An overwhelming majority of student registrants are coming from schools that have been exposed to our programming through farm field trips, EAAT tastings, or IGP classrooms.

Goal: Sales of approximately 20 CA growers at four Farmers' Markets to THP students and families will increase significantly in the 1st year. $16,353 in voucher money has been redeemed by CA growers from eight different markets over the course of the project. Thirty-one individual CA growers saw increased sales due to the voucher program at the two Coastside markets, Half Moon Bay and Pacifica.

Attitudes and behaviors self-survey of farm field trip participants:

Question	**Pre (% who agree)**	**Post (%who agree)**
I like trying new fruits and vegetables.	63%	76%
I think fresh food from a farm tastes good	56%	78%

Question	Pre (% who agree)	Post (%who agree)
Visiting a farm makes me want to eat more fresh fruits and veggies	41%	53%
I ask my family to buy fresh fruits and veggies	47%	71%
Eating fresh fruits and veggies will make me healthier	82%	91%

As stated previously, the overarching goal of this program was to increase enjoyment, understanding and consumption of CSC fruits and vegetable creating life-long consumers/advocates. In a survey of students who participated in THP garden intensive classes, 53% believe that because of what they learned in THP programs, they choose to eat more fruits and vegetables at home. 43% reported that they ask their parents to buy more fruits and vegetables for their family to eat. Of the 350 students enrolled in garden intensive programs that equates to 186 and 151 students, respectively. 79% of students reported that they enjoy trying new fruits and vegetables. In a survey of parents of students who participated in THP garden intensive classes, 62% believe that since their child's participation in THP classes they have noticed their child eats more fruits and vegetables at home and 52% believe that since their child's participation in THP classes their whole family eats more fruit and vegetables at home. This data was gathered at graduation night, after students had been exposed to weekly tastings for an entire school year.

The numbers listed above highlight the successful outcomes of this project by showing that there has been an overall increase in students' enjoyment, understanding and consumption of CSC fruits and vegetables.

Beneficiaries

All participating schools and organizations benefitted from the completion of this project. Schools and organizations benefitted from the addition of hands-on nutrition based programming to their existing curricula.

CSC growers benefitted from the completion of this project through increased sales in CSC's from THP voucher program to a new group of customers and from the direct purchasing of CSC's for the purpose of EAAT tastings.

Total minimum number of unique farmers who saw an increase in sales due to purchases for EAAT Tastings and voucher redemption: 60
Total number of project dollars spent directly on CSC's: $10,740
Total number of dollars received by CSC growers in the form of vouchers: $16,353

Due to limited administrative resources, THP was unable to track data on how many individuals went to the farmers market to use vouchers and then became returning customers.

Lessons Learned

Due to much staff turn over during the duration of this project, THP had difficulties maintaining continuity of tracking. In the future it would be beneficial to have very clear and easy to navigate tracking protocols from the very beginning so even if staff turns over, the data that needs to be collected will be easier to collect.

The voucher program proved to be very challenging to develop and administer. From developing the vouchers to getting vendors on board and trained to accept them, to assembling and distribution, to tracking. Each step was very labor intensive and required more administrative time that THP's small office staff was prepared for. While the vouchers did encourage students to visit the Farmers' Market, it was not the most efficient way given the limited resources of THP.

Consolidating shopping trips for EAAT tastings proved to be efficient and timesaving. Several staff members who were responsible for leading EAAT tastings would rotate shopping days. When it was a staff person's week to shop, they would purchase CSC's for EAAT tastings at a Farmers' Market nearest their house and bring it to the THP office Monday morning to distribute to the rest of the staff. This made it so that not every staff person needed to carve time out of their schedule every week to go to the Farmers' Market to purchase crops for tastings.

Because of this project, THP was able to branch out to populations not usually seen in regular THP programming. Boys and Girls Club, Pilarcitos High School and El Granada Elementary welcomed EAAT programming as a way to enrich curricula for their students. In general, the support of the SCBGP allowed THP to reach more students than ever before, and increasing enrollment in farm field trips and summer camp programs. With this increased enrollment in fee based programming,

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Overall THP believes goals and outcome measure were achieved with this project.

Additional Information

Half Moon Bay Review articles about EAAT program:
http://www.hmbreview.com/community/a-lesson-in-taste/article_d59f5222-135e-11e4-a6ca-001a4bcf887a.html?mode=print

http://www.hmbreview.com/food_and_drink/students-stir-up-healthy-food/article_2e92ce84-38bc-11e6-9e83-ab3a7b09e703.html

http://www.hmbreview.com/community/celebrating-autumn-through-education/article_44a2f85e-9932-11e5-85b1-7bd494184abd.html

The Daily Journal article about THP programming, including EAAT:
http://www.smdailyjournal.com/articles/lnews/2015-10-12/school-farm-promotes-healthy-eating-heal-project-offers-experiential-learning-for-county-students/1776425151684.html

A link to THP website explaining EAAT program:
http://thehealproject.nationbuilder.com/programs

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 43	**Project Title:** Online Irrigation and Nitrogen Management Tool for Cool Season Vegetables	
Grant Recipient: The Regents of the University of California, Oakland Cooperative Extension	**Grant Agreement No.:** SCB13043	**Date Submitted:** December 2016
Recipient Contact: Wendy Ernst	**Telephone:** (530) 754-3944	**Email:** OCG@ucanr.edu

Project Summary

California is the main producer of cool season vegetables (CSV), such as lettuce, cole, and spinach crops for the United States. CSV produced on the central coast are valued at $2.13 billion annually, and critical to regional and state economies. These crops require high inputs of water and nitrogen (N) fertilizer to reach economical yields and market quality. Nitrate discharges from CSV production has contaminated surface and ground water supplies in these regions. Since the adoption of the Agricultural Discharge Order by the Central Coast Regional Water Quality Control Board in March 2012, growers have come under increased water quality regulations, and may face future restrictions on the use of N fertilizer. To meet these water quality objectives, growers will need to improve both irrigation and N management of their crops.

This project expanded a new online tool, CropManage (cropmanage.ucanr.edu), aimed at helping growers efficiently manage N and water to maximize production of CSV and minimize environmental impacts to ground and surface water. CropManage (CM) makes use of available weather, soil, and crop data to provide in field decision support to growers in using water and N fertilizer efficiently for producing CSV. Growers can access CM online using their smartphone, tablet and office computers. Water and N fertilizer recommendations provided in CM are based on research done by the University of California (UC) research and timely, site-specific data. Currently, CM is calibrated and piloted for commercial lettuce production. In order to become a fully useful tool for commercial vegetable producers, CM needed to be expanded to the range of vegetable crops grown on the central coast. This project addressed the goal of environmental stewardship and conservation by assisting vegetable farmers in reducing inputs of N fertilizer and water, thereby conserving and protecting the safety of ground water supplies.

This project built upon the 2011 Specialty Crop Block Grant Program Project 16: *Improved Tracking of Transpiration Coefficients in California Specialty Crops*, which evaluated the accuracy of using the weather-based irrigation recommendations of CM and the National Aeronautics and Space Administration (NASA) Satellite Irrigation Management Support (SIMS) in replicated field trials. The results of these trials demonstrated that following CM and SIMS guidance reduced water use by 30% relative to standard irrigation practices for broccoli and lettuce, while maintaining crop yield and quality. The potential for nitrate leaching was also minimized by reducing the amount of water applied to these crops. The current project built on these results by: 1. Adding additional commodities to CM to address the entire CSV system; 2. Adding a N fertilizer decision support tool; and 3. Linking CM to NASA SIMS, which should result in a more comprehensive and easier to use web tool for managing water and N fertilizer.

Project Approach

The main objective of this project was to expand CM to include additional CSV's, such as broccoli, cauliflower, cabbage, and spinach, and adding new capabilities such as linking to Landsat satellite information through the NASA SIMS system.

Task 1: Collect supplemental plant development data (canopy development, rooting depth, N uptake) for CSV crops (broccoli, cauliflower, cabbage and spinach). Collection of data from commercial vegetable fields to supplement previous data collected was completed. Biomass, canopy cover, and root depth data were collected from three commercial fields of broccoli, cauliflower, cabbage, and spinach. Tissue samples were analyzed for N content by calculating the N uptake at various stages of development of these crops.

Task 2: Develop algorithms for crop coefficient, root development, and N uptake models for CSV. Algorithms were developed for the water use coefficient (Kc), root development, and N uptake for all CSV crops of the proposal. Algorithms for CSV crops were added to CM. Enabling CM users to track and receive decision support for the water and N use for these CSV. Algorithms were evaluated in field trials described in task 6.

Task 3: Evaluate accuracy of SIMS fractional cover and crop coefficient estimates for CSV fields using existing Normalized Difference Vegetation Index (NDVI) ground -truth data. This task was completed using previous canopy data collected at commercial vegetable sites between the years 2011 and 2013. To conduct the comparison, polygons were identified in each satellite image that corresponded to the actual field where ground measurements were taken. A total of 31 field sites and 76 SIMS canopy estimates were used for the analysis. The correlation between SIMS and ground measured estimates of canopy cover was highly statistically significant with an R^2 value of 0.87.

Task 4: Enhance SIMS fractional cover and crop coefficient algorithms for CSV. Based on the results of the SIMS analysis, project participants revised models used in SIMS for estimating the canopy cover of CSV crops. Specifically, the project team statistically fit quadratic polynomial equations to satellite and ground estimates of canopy cover by crop type. Regression fits for the various crop types ranged from 0.86 to 0.98 (Table 1). These equations could be used to improve the estimates of canopy cover from SIMS LandSat NDVI data.

Table 1 summarizes coefficients fit to equation 1 which estimated fractional cover based on SIMS LandSat satellite NDVI data for various specialty crop types grown on the Central Coast.

$$Fs = A \times G^2 + B \times G + C \qquad [1]$$

Where Fs = fractional cover estimated with SIMS, G = fractional cover determined on the ground with a NDVI digital camera, and A,B, and C were fitted coefficients.

Table 1. Summary of coefficients fit to quadratic equations relating satellite and ground estimates of canopy cover for CSV and strawberry crops

Crop type	N	A	B	C	R^2
peppers		-0.336	1.1378	0.0725	0.96
lettuce		-0.718	1.4272	0.1031	0.86
strawberry		-0.5666	1.2519	0.1718	0.93
broccoli		-0.6587	1.4634	0.1271	0.98
cauliflower		-0.6585	1.2626	0.1825	0.88
cabbage		-0.1924	0.8148	0.2764	0.98
cole crops		-0.5666	1.2619	0.1718	0.93

n = number of sample comparisons, R^2 = regression coefficient

Task 5: Conduct software development for linking CM and SIMS tools. The UC programmers developed a WebAPI (application protocol interface) that allowed linkage with the SIMS tool. In addition, the California State University of Monterey Bay (CSUMB) collaborators developed a WebAPI for SIMS that allowed CM to attain estimates of canopy cover from LandSat Satellite images of commercial vegetable fields.

Task 6: Field test linked CM/SIMS tools in commercial CSV fields**.** Three commercial field trials were conducted during the last reporting period that compared CM guided approach to managing water and N fertilizer to the growers' standard practices. Trials were conducted in two commercial broccoli fields and one spinach field. Data was summarized.

Task 7: Conduct two workshops/trainings for growers and industry representatives on using CM tool. Results and progress of the project were presented at nine educational meetings between October 2014, and March 2015. A total of 458 participants attended these meetings which were held in Davis California, Woodland California, Fresno California, Reno Nevada, and Lynden Washington. In addition, trainings on using the CM tool were conducted in Watsonville, California on January 26, 2015 and in Salinas, California on March 31, 2015. The three hour workshops provided step-by-step training on using the CM tool for managing water and N in CSV. Approximately 70 participants attended these two workshops.

Task 8: Evaluate CM performance outcomes. Programmers for CM added capabilities to monitor the number of water and fertilizer events that users entered per month into the decision support tool. This capability allowed the project team to track user activity. CM use steadily increased during the last 5 years. CM provided more than 1,000 decisions per month during the peak of the growing season.

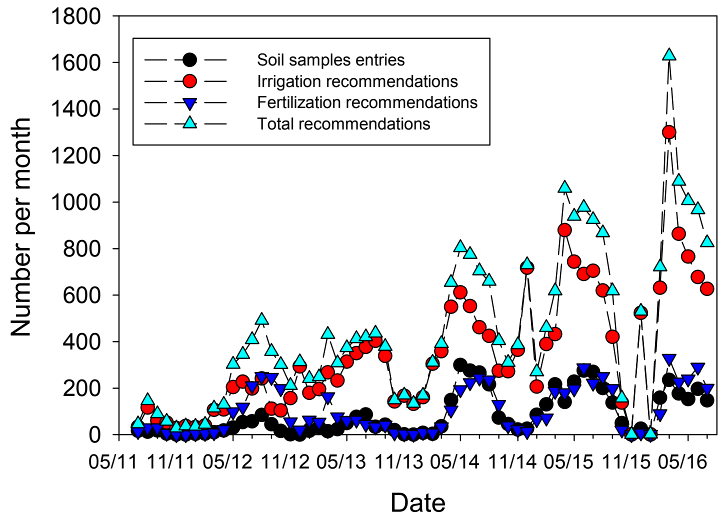

Figure 1. Monthly recommendations and soil sample entries in the CM database

This project solely benefited specialty crop commodities.

CSUMB and NASA partners were responsible for linking SIMS to CM. The Senior Research Scientist and Adjunct Faculty with CSUMB also led the data analysis comparing SIMS estimates of crop canopy cover to ground estimates.

Goals and Outcomes Achieved

The performance goal for this project was to quantify that CSV growers were improving water and N fertilizer management.

Activities completed: The project leaders conducted three trials in commercial CSV fields to demonstrate potential fertilizer and water savings that could be achieved by using the CM tool to guide fertilizer and irrigation management. CM software was augmented to track usage of the online tool for making fertilizer and irrigation decisions. Growers who used CM were surveyed to determine how they had changed their fertilizer and water management practices. Additionally, an independent nonprofit agency surveyed growers who used CM to determine the usefulness of the software for improving irrigation and N fertilizer management.

The adoption of CM by central coast CSV growers was a long term goal of this project. There were more than 1,000 registered users. During the project, three field demonstration trials, two workshops, and more than ten presentations were completed in order to promote the use of the CM tool.

Field trials conducted during the project demonstrated that N fertilizer could be reduced by an average of 30% while maintaining yield and quality of CSV. This result met the target for the expected measured outcome outlined in the projects original proposal. Based on surveys of growers, user registration, and attendance at workshops, it was estimated that 5% of the CSV growers on the central coast used the online CM tool to help guide their fertilizer and irrigation decisions. This result met the short term benchmark of the project.

However, the project team hoped to continue to increase the use of the tool during the upcoming years through further outreach and improvements in the user interface.

As shown in Figure 1, CM provided approximately 400 fertilizer and water recommendations per month during peak production season before beginning this project. Use of CM steadily increased during the life of the project, providing as many as 1,400 recommendations per month during the same period in 2016.

The CM online decision support tool for fertilizer and water management was expanded to include broccoli, cauliflower, cabbage, and spinach. Field trials conducted during this project demonstrated that fertilizer N can be reduced by an average of 30% without significant impacts to yield or quality. CM registered users increased by approximately 40% during the project duration. Lastly, growers using CM reported reducing fertilizer N use by 20 to 30%.

Beneficiaries

The beneficiaries of this project were CSV growers and shippers, and water users in the coastal valleys of California. CSV were produced on 331,633 acres on the coast and were valued at $2.13 billion annually. In Monterey County alone growers planted approximately 100,000 acres of broccoli, cauliflower, cabbage, and spinach with an estimated value of $860 million.

This project directly benefited the 1,015 registered CM users by increasing the number of vegetable commodities supported by this online decision support tool. The project also helped growers who used the CM tool to reduce fertilizer N by as much as 30% compared to their use of N before the project was implemented.

Lessons Learned

The user interface for the CM software needed to be continually updated to match improvements in technology. Computer programming costs greatly increased during the project which required a shift in project funds to cover the extra costs. Grower adoption of online apps such as CM could be improved by providing an intermediate application that can streamline the user interface so that navigation within the application and data entry is simplified for field workers and farm managers.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 44	Project Title: Creation of a Water Quality and Nutrient Management Training Program for California Strawberry Growers	
Grant Recipient: California Strawberry Commission	**Grant Agreement No.:** SBC13044	**Date Submitted:** December 2016
Recipient Contact: Jason W Sharrett	**Telephone:** (805) 264-5250	**Email:** jsharrett@calstrawbery.com

Project Summary

Agriculture is a significant contributor to impaired water quality in California's central coast region. The California strawberry industry which produces 88% of the United States' strawberries is the largest agriculture industry by value on the central coast. New water quality regulations affecting the region's growers in 2012 require the implementation of best management practices (BMPs) to reduce the negative impacts of agricultural production on water quality. Recent evaluations by experts from the University of California Cooperative Extension (UCCE), Monterey County, and California Polytechnic State University, San Luis Obispo (Cal Poly SLO), identified irrigation systems on many strawberry farms indicate poor distribution uniformity (DU) from inefficient system design and management practices. Some irrigation systems in these studies had DUs lower than 60%. Since strawberry growers in California utilize drip irrigation systems for application of fertilizers, inefficiencies not only waste water but also increase leaching of nutrients. Most irrigators on strawberry farms have no formal training in irrigation system operation, and training opportunities are extremely limited. Additionally, surveys of strawberry growers indicate most irrigation systems are designed and installed by on-farm employees with limited or no formal training on system design. To address these deficiencies, the California Strawberry Commission (CSC) developed and delivered a statewide-bilingual irrigation and nutrient management training program comprised of four classes that cover the basics of irrigation system management, basic system design principles, irrigation scheduling and fertigation management. This program is designed to equip strawberry growers and irrigators with the knowledge and skills necessary to establish and operate efficient strawberry irrigation systems to conserve water, apply nutrients effectively, and enable growers to comply with the new and emerging water quality regulations.

The timeliness of this project could have not been more perfect. The grant was approved in 2013, the same year in which a drought emergency was declared for the entire state and continues to persist today. In particular, strawberry growers in the Pajaro Valley and the Oxnard/Ventura area have experienced reductions in available water, increases in the price of water, and an overall decline in the quality of the irrigation water. The onset of the drought highlighted the importance of good water management as well as the need for training for the irrigators and ranch foreman. This was evident in the level of participation and demand for the classes during 2014 and 2015.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The following summarizes the activities performed during the grant period:

- Preprogram needs assessment: The CSC Grower Education Team completed this task by developing and implementing a project called Strawberry Water Assessment and Management Project (SWAMP). The goal of SWAMP was to assess the current state of water and nutrient management on strawberry ranches and determine the industry training needs related to irrigation and nutrient management. This project was designed and implemented by a team of irrigation and water quality experts assembled by the CSC grower education team. Through a collaborative process, the team successfully evaluated 15 ranches for the irrigation system DU. The team also carried out interviews with farm managers that communicated the results of the DU evaluation and explored the irrigation and nutrient management challenges and the training needs for the participating companies. The findings from this project helped to prioritize the training topics and serve as a baseline for the evaluation of the program effectiveness

- Curriculum Development: Project staff worked with project partners from the University of California Cooperative Extension (UCCE) to develop the training curriculum, hands-on demonstrations and decision support tools to address the irrigation and nutrient management challenges identified through the pre-project needs assessment. As a result, a total of four classes were developed. Each class was designed to last about four hours and includes both classroom and field based activities that highlight the BMP's that mitigate the common challenges with irrigation and nutrient management in strawberry production
    - Class 1- Irrigation System Operation and Troubleshooting: This class focused on the best practices related to irrigation system management which included activities and demonstrations that introduced the participants to standard operating procedures for managing and monitoring pressure/flow as well as steps to take when troubleshooting system performance.
    - Class 2- Irrigation System Design: This class focused on introducing participants to the irrigation design process which included an overview of the system components and the decision-making process, field demonstrations of common irrigation design challenges, as well as demonstrations for designing for common scenarios found in strawberry production. Some activities included field demonstrations that highlighted the core design principle as well as group activities that focused on designing irrigation blocks for strawberry production.
    - Class 3: Irrigation Scheduling for Strawberry Production: This classes taught participants how to make decisions related to when to irrigate and for how long. Participants learned about the concepts of evapotranspiration (Et) and soil moisture monitoring and how to use that information to make effective scheduling decision during different stages of crop development. Salt management was also a major topic in this class.
    - Class 4: Fertigation Management for Strawberry Production: This class covered the basics of plants nutrition, processes and procedures for calibrating injection equipment, and procedures for calculating injection time and rate. Field exercises reinforced these concepts and prepared participants for implementation on their ranches.

- Hosted trainings: 35 bilingual classes covering the above topics were offered throughout the strawberry growing regions including Watsonville/Salinas, Santa Maria and Oxnard. 700 individuals from 106 strawberry companies participated in the trainings during the grant. Of the participants, approximately 70% were irrigators, 25% ranch managers and 5% other.

- Field based interviews of workshop participants: Field visits/interviews occurred with a sample of program participants during the beginning of year 2 and were repeated during the last three months of the project. These field visits focused on collecting information regarding the implementation of pressure management practices that were shared as part of Class 1. The information collected during these visits served to establish a baseline of practice implementation for program participants as well as a means to measure the extent of practice implementation as the project progressed. Data from these activities serve to report on the overall outcomes for this project and will be reported later in this report.

- Follow-up DU analysis: Performance of 17 strawberry irrigation systems were evaluated in Watsonville/Salinas, Santa Maria and Oxnard districts. These studies were performed on 11 ranches that participated in the training classes and six ranches that did not participated in the trainings. Data from these follow-up evaluations have been analyzed and compared to the pre-program study to determine the extent to which the training programs is improving irrigation system management in the industry.

This project only benefited growers of specialty crops, specifically strawberries.

Partners in the project and their contributions are as follows:

- UCCE Monterey County - Supported the pre- and post-program assessment, curriculum development, and implementation of all the trainings.
- UCCE Ventura - Facilitated trainings in Ventura County and helped to develop curriculum for the irrigation scheduling class.
- Hanson Ag Center - Allowed free use of the facilities for all trainings in Ventura County.
- Hartnell College - Allowed free use of their Ag Technology campus for training in Salinas.

Goals and Outcomes Achieved

Activities that were completed in order to achieve the performance goals and measurable outcomes defined in the approved project include the following:

1. Performed a pre-program analysis of the DU on 15 strawberry ranches. This analysis evaluated the design, performance and operation of the drip systems. The data from this study served to set the baseline performance as well as identify areas that should be focused on for the training program.

   During the last six months of the program, project staff and consultants completed a follow-up DU evaluation on 17 ranches. For this round of evaluation, 12 of the evaluated ranches had participated in the training and five ranches had not participated. Results from this evaluation were compared to the study completed in 2013 to measure the impact the program had on the program participants. For both the pre- and post-program assessment, ranches were chosen at random.

2. Field visits/interviews with a sample of program participants occurred during the beginning of year 2 and were repeated during the last three months of the project. These field visits focused on collecting information regarding the implementation pressure management practices that were shared as part of Class 1. The information collected during these interviews/observations served to establish a baseline of practice implementation for program participants as well as a means to measure the extent of

practice implementation as the project progressed. Data from these activities serve to report on the overall outcomes for this project and will be reported later in this report

The outcome measures set forth in the project were limited to the timeframe of the proposal. Nonetheless, as with all educational and training program it can be expected that information and practices will be implemented on an ongoing basis into the future. As an example, many of the participants during the last 12 months of training may not be able to implement the recommend practices until the beginning of a new cropping cycle.

- The goal of this program was to equip growers with the with the knowledge and skills necessary to establish and operate efficient strawberry irrigation systems that conserve water, apply nutrients effectively, and enable growers to comply with water quality regulations. From a program design standpoint, this program was able to develop the core curriculum, target it to the right audience and deliver it directly to 700 strawberry industry employees from 106 companies during the course of the project. This accomplishment falls short of the original target that called for participation from 280 farms reaching 70 percent of the California strawberry industry. While the project fell short on the participating companies, the actual % of strawberry acres impacted from the project was at least 70%. There are an estimated 400 strawberry growers, however, more than half of those growers have ranches of less than 25 acres. The majority of the participation in the program occurred with companies who have multiple ranches and control a greater percentage of strawberry production in the state. In retrospect, the participation indicator should have been acres impacted rather than the number of companies that participated.

- Project staff also planned and carried out two program monitoring activities to measure the extent to which the program participants changed behaviors as a result of participation in the training program. The first activity was a needs assessment at the beginning of the project to establish the baseline performance of strawberry irrigation systems by using DU as the metric. Then towards the end of the program, a similar study was completed to measure the impact the program had on the company. The second activity called for performing field based interviews of a sample set of program participants after the training to measure the extent to which the companies were adopting the practices shared in the training classes. For the field interviews, the primary focus was on the information share during the pressure management class since this was the most highly attended class with the clearest set of practices that could be implemented on any ranch and required less skill to implement.

  The project outcomes and results follow:

  - Outcome #1: California specialty crop strawberry farms participating in the training program will indicate improved DU of irrigation systems through implementation of BMPs for drip irrigation system design and operation.
    - Benchmark: 90% DU for irrigation systems that participate in the program.
    - Baseline Results: From the SWAMP study that was completed in first months of the project, it was established that the average DU for the 15 evaluated ranches was 83%. This number is higher than 75% average that was provided by the UCCE based on their own studies. As a result, project staff decided to reset the target DU from the 85% to 90% for ranches participating in the program.
    - Follow-up results: The average DU for the 17 ranches that were evaluated at the end of the project was 83%. This is exactly the same DU as was measured during the initial SWAMP

study. Of the 17 ranches that were evaluated, 12 participated in the training program and 5 had not participated. When comparing the average DU for these two populations, the average DU for the non-participating group was nearly 7% lower than for the group that participated. It is also worth mentioning that the DU varies significantly from the beginning of the season to the end of the season. For the initial baseline study in 2013, the evaluation was completed in January, very early in the production season. Due to some scheduling delays in the project, the follow-up DU study was not able to be completed in the Oxnard region until mid-May towards the end of their production season. As expected, ranches in Oxnard showed a much higher rate of plugging than was measured in the initial study. Plugging is a common problem that impacts irrigation systems as the season progresses. If a system exhibits plugging, then the DU tends to be very low. Despite the four additional months, the average of 78% for the ranches in Oxnard in 2016 was exactly that same as 2013. If plugging had not been a problem, the average DU would have likely been closer to 86%. This would represent a significant improvement in the irrigation systems for that region.

- Outcome 2: California specialty crop strawberry farms participating in the program will increase implementation of BMPs for irrigation system operation. The primary indicator for this outcome is the percent of participants that are monitoring pressure using the BMPs shared during the first class. This includes using a single, reliable pressure gauge with a Schrader valve adapter to measure pressure at the irrigation block valve with every irrigation.
    - Benchmark/Target: To increase BMP implementation on 90% of the farms participating in the program.
    - Baseline: At the beginning of the project only 17% of the surveyed farms fully implemented the pressure monitoring practice while 58% implemented some elements of the practice but not all. The remaining 25% did not implement any part of the practices.
    - Follow-up Results: For the 11 ranches that participated in the training and were surveyed in 2016, 41% were fully implementing the pressure monitoring protocol after participating in the irrigation training. This represents a 60% increase over the baseline but falls well short of the very optimistic target of implementation by 90% of the participating rans. Of the six non-participating ranches, not a single ranch fully implemented to pressure monitoring protocol.

The most successful outcome of the project was when the results from the two outcomes are compared. The DU of the five ranches that participated in the training and implemented the practices on the ranch, their average DU was 89%. This is well above the overall average of 83% when looking comparing the performance of all the ranches. This suggest that the practices that are the focal point of the trainings are targeted at the right practices that achieve improvements in irrigation system performance and that targets set for system improvement are realistic. The challenge moving forward will be to look at the reason the different participants are not implementing the practice and provide the support necessary at the ranch level to overcome those challenges.

Beneficiaries

The direct beneficiaries of the program were the approximately 400 California strawberry growers and irrigators. Efficient irrigation systems lead to cost savings for growers by conserving water and nutrients. Through participation in the program, growers will be able to comply with current and emerging regulations. Specific groups and other operations that benefitted from the completion of this project's accomplishments are described below:

- Irrigators (70% of participants)
  - –The average strawberry irrigator is:
    - Only speaks Spanish
    - 38 years old
    - 11.5 years on the job
    - 5.7 years of education
    - Responsible for an average of 121 acres of strawberries
    - Works a 12-hour day
  - Strawberry Ranch Managers - 20% of participants
  - Growers (Owner/Operators) – 5% of participants

Over the course of the project, 700 individuals from 106 strawberry companies participated in 35 classes.

Lessons Learned

Project staff learned that:

- Bilingual training is key: The trainers have to speak Spanish. Interpretation is simply not an effective way to engage a group of irrigators. During the first year of this project, some trainings were presented in English and interpreted to Spanish by an interpreter using headsets and some training were presented 100% in Spanish. Without fail, the classes that were presented in the native tongue of the participant generated more discussion and questions from the participants. After the first year of training, project staff worked with consultants to make sure all content could be presented in Spanish. Then based on demand, project staff would organize a training for English speaking participants.

- Get out of the classroom and into the field: Interactive-hands-on training is critical for these topics and audience. The majority of irrigators that participated in the trainings have very little formal education but have decades of experience in farming. Therefore, it is imperative find ways to teach the complex subjects of irrigation and nutrient management in a way that is meaningful, engaging and respectful of their life experience. This program was successful at this by providing a mix of hands-on training coupled with in class activities/presentations. More than half of each of the four classes were taught using a demonstration irrigation system that was designed by project staff and consultants to highlight the core challenges as well as the best practices that were the focus of the training program. While this style of training is certainly more labor intensive, it is necessary to cover these subject in a way that will engage the participants.

There were some unexpected outcomes that were an effect of implementing this project, which follow:

- A model for training in the state: The irrigation and nutrient management training program has attracted attention of other industry groups, academia and farm advisors. Project staff receive requests to speak at meetings or to host a training somewhere in the state. There has also been some discussion among farm advisors across the state to use the model of training developed through this program to create a statewide training curriculum for irrigators and ranch managers. The bottom line is that there is a real need for the type of training that was developed in this grant. While project staff are somewhat limited to working within strawberries, the curriculum developed will be made available to anyone that is interested.

The project team was able to achieve most of the tasks and activities for the grant but did not necessarily fully achieve the outcomes that were set forth at the beginning of the grant.

- More meaningful metrics: More focus on the acres implementing the practice rather than the number of companies participating. This is a direction all of the CSC training programs have been moving in during the last couple years. As the strawberry industry is consolidated, the number of companies are decreasing while the acreage for each company is increasing.

- Timing: Timing is everything for this type of training. Project staff constantly ran into barriers with scheduling training due to the complex nature of the production cycles throughout the state. Project staff found it much easier to get a group from one company to meet for a day than to get them to commit to four classes over two days at a central location.

- Provide follow-up support: This program reached a broad range of strawberry companies throughout California. While some companies implemented some of the practices from the training, the project did not achieve the desired level of implementation. Some reasons for this could be the inability for the participants to apply what they learn from a demonstration system (theoretical system) and apply that to the system on their ranch or more simply could be that the boss was not at the training and has not told the irrigator to do it. These reasons and many others were discovered while doing the follow-up irrigator surveys and DU studies. These follow-up visits almost always generated questions or some desire for clarification on the practices taught in the training. This presented an excellent opportunity for the project staff to review the BMP's from the training and use the irrigators' own system to demonstrate the practices. This type of follow-up not only helped the irrigator but also helped to establish dialogue with the grower and/or ranch manager that may not have attended the training, and provides an opportunity to share practices taught in the training and how they can benefit from implementing them. In any future training, this component will be built into the program design.

Additional Information

Website to access training presentations and decision support tools. http://tools.calstrawberry.info/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 45	**Project Title:** Temecula Valley Winegrower Research and Demonstration Project	
Grant Recipient: Rancho California Water District	**Grant Agreement No.:** SCB13045	**Date Submitted:** December 2016
Recipient Contact: Justin Haessly	**Telephone:** (951) 296-6942	**Email:** haessly@ranchowater.com

Project Summary

The Temecula Valley Winegrower Research and Demonstration Project (Project) was a pilot project that focused on the use of technologies for implementing Regulated Deficit Irrigation (RDI) as a best management practice in Temecula Valley winegrowing operations. The purpose of the Project was to help local winegrape growers understand how RDI could help them to enhance their water use efficiency while improving the quality of their red winegrape varieties. The Project included research that 1) quantified the amount of water required for producing high quality red winegrapes in the Temecula Valley, and 2) monitored soil salinity under varying irrigation conditions to gauge its effects on red winegrape quality. The Project also included demonstration to local growers of the methods employed for implementation of effective RDI programs.

Rising imported water costs threaten the economic viability of regional winegrape vineyards. The cost for Rancho California Water District (RCWD/District) to purchase imported water has more than doubled since 2004; the cost has been passed through to vineyard owners who experienced a rate increase of 109 percent over the past decade. This increase significantly outpaces the growth in value of the regional winegrape crop (up 55 percent over the last 10 years), and poses a difficult business challenge for growers. Adoption of RDI practices promoted through implementation of the Project could decrease water costs for growers, thereby helping them to remain in business.

Another potential challenge for regional vineyards involves water quality. Increases in salinity of water provided by RCWD are likely due to a change in source blend. Historically, half of RCWD's imported water demand was met using California Bay-Delta imports; however, this source has become limited due to drought and environmental restrictions. As a result, a blend of Colorado River water with higher amounts of salinity is used. Research indicates vineyard performance is adversely affected by salty irrigation water, and in theory, long-term implementation of RDI practices could contribute to increase salt deposition into soils. Therefore, the Project examined salt content within the vineyard research areas where RDI was implemented to determine whether or not soil salinity increased during the Project timeframe.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

One vineyard site was chosen as the location for Project implementation. A single irrigation block from the site was divided into three sub-blocks, each of which was retrofitted to include an automatic meter reading (AMR) sub meter, a control valve, and an automatic irrigation controller. Wireless telemetry technologies were installed within each sub-block, including soil moisture and salinity monitoring probes. Each sub-block represented a different research treatment, and was irrigated according to a different RDI method:

1. The first treatment was irrigated at 50% of evapotranspiration (ET) throughout the growing cycle

2. The second treatment was irrigated at 50% of ET between fruit set and verasion, at 10% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.
3. The third treatment was irrigated at 10% of ET from fruit set to verasion, at 50% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.

Wireless telemetry technologies installed in the test blocks were used to remotely track water consumption, soil moisture data, and soil salinity data for each of the research treatments. Weekly site visits were conducted for assessment of irrigation system performance, for determining irrigation frequency requirements, and for collecting data related to vine growth and fruit quality. Upon harvest, fruit from each of the treatment blocks was used to make wine for determination of wine preference.

The overall scope of the project did not benefit commodities other than specialty crops.

The Project partners included RCWD, Riverside County's University of California Cooperative Extension (UCCE Riverside), South Coast Winery (SCW), and the Temecula Valley Winegrowers Association (TVWGA). Following are the contribution to the Project made by each of these partners:

RCWD: As Project Manager, RCWD directed implementation of the Project. Specific contributions of RCWD included identification of the research site, oversight of irrigation system installation/retrofits at the research site, implementation of RDI irrigation methods for each research treatment, tracking and analyzing water consumption at the research site, scheduling and conducting demonstration activities.

SCW: As Project partner, SCW provided one acre of mature Tempranillo grapes within their existing vineyard operation for conducting the research, and provided a staff member who, for the first year of the Project, participated in the collection of vineyard research data. In addition, they provided testing services for quantifying winegrape quality, fermented and bottled finished wine from each of the research treatment areas, and provided testing services for wine phenolics (i.e. the measurement of phenolic compounds in finished wines). SCW also presented the results of the Project research at the Wine Innovation and Quality Conference held in Napa, CA in both 2014 and 2015. Another very significant contribution to the Project by SCW pertains to the role they played in publishing a two-page written article about the Project in the July 2016 edition of *Wine Business Monthly,* a publication for wineries and growers, titled *Winemakers Trials: Deficit Irrigation Early in Season Saves Water and Improves Red Grape Quality.* *(http://www.winebusiness.com/wbm/?go=getArchives&pubYear=2016)*

UCCE Riverside: As Project partner, UCCE Riverside participated in the design of the research study and enlisted the assistance of the University of California Davis for helping with the design. UCCE Riverside provided input on how the Project should be implemented, analyzed data collected as part of the study, and participated in one of the demonstration workshops. UCCE Riverside also provided a Staff Research Assistant who, for the second year of the Project, participated in the collection of vineyard research data.

TVWGA: As Project partner, TVWGA allowed the Project team to present the results of the Project at their annual Temecula Grape Day event. In addition, they assisted with the advertisement of demonstration workshops.

Goals and Outcomes Achieved

The activities that were completed in order to achieve the Project's performance goals and measurable outcomes include the following:

Identify Research Site
RCWD identified South Coast Winery's vineyard as the location for where the Project would be implemented. Further, RCWD worked with SCW and the University of California Davis to identify a one-acre block of Tempranillo grapes as the specific area within the vineyard that would be used for research purposes.

Retrofit Site for Research Capabilities
RCWD hired a contractor to retrofit the irrigation system within the block of Tempranillo grapes chosen for the research to accommodate the research study design. RCWD also hired a separate contractor to install wireless telemetry devices within the research area for enabling the remote collection of Project data. Lastly, RCWD staff installed water sub-meters for each of the research treatments.

Conduct the Research
RCWD partnered with South Coast Winery and UCCE Riverside to conduct the research. RCWD implemented the RDI schedules, monitored soil salinity, and analyzed water consumption for each research treatment. Both SCW and UCCE Riverside participated in the collection and analysis of vineyard data throughout two growing seasons including stem water potential, shoot growth, canopy shaded area, and harvest weights. SCW performed laboratory analysis of fruit quality prior to harvest. These data included total acidity, pH, and Brix. Lastly, SCW created finished wines for each of the research treatments and conducted blind taste tests to measure preference for the wines created from each research treatment.

Conduct Demonstration Workshops
A total of four workshops were conducted, two of which took place in Temecula, CA, and the other two in Napa, CA. In Temecula, CA, RCWD, SCW, and UCCE Riverside presented the results of the Project at Temecula Valley's annual Grape Day Festival in 2014, and at RCWD Headquarters in Temecula in 2015. In Napa, CA, SCW presented the results of the research at both the 2014 and 2015 Wine Innovation and Quality Conference.

Outcomes projected for the Project include: 1) decreasing winegrape growers' investment in crop production through decreased irrigation water purchases, and 2) increasing the value of their crops (i.e. wine quality improvements) through implementation of RDI strategies. While the Project proved that these outcomes were possible on the property where the research was conducted, it is going to take time for the winegrape growers within the Temecula Valley to learn how to implement regulated deficit irrigation and to adopt the strategy as a best management practice. RCWD will continue to provide outreach about RDI to the local winegrape growing community to encourage its adoption through dissemination of information and through implementation of more projects that demonstrate the implementation of RDI through use of emerging technologies.

The goals established for the Project included: 1) researching the minimum quantity of water required for producing high quality specialty crop red winegrapes in the Temecula Valley, 2) monitoring soil salinity under varying irrigation conditions to gauge its effects on red wine grape quality, 3) demonstrating to local growers methods used for implementation of effective RDI programs, and 4) transferring knowledge gained through the research to the regional winegrowing community through a demonstration effort consisting of three workshops. Following is a summary of the work that was performed to support these goals:

Research Water Quantity
One vineyard site was chosen as the location for Project implementation. A single irrigation block from the site was divided into three sub-blocks, each of which was retrofitted to include an AMR sub meter, a control valve, and an automatic irrigation controller. Each sub-block represented a different research treatment, and was irrigated according to a different RDI method:

1. The first treatment was irrigated at 50% of ET throughout the growing cycle.
2. The second treatment was irrigated at 50% of ET between fruit set and verasion, at 10% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.
3. The third treatment was irrigated at 10% of ET from fruit set to verasion, at 50% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.

Wireless telemetry technologies installed in the test blocks were used to remotely track water consumption. Weekly site visits were conducted for assessment of irrigation system performance, and for determining irrigation frequency requirements.

Monitor Soil Salinity
Soil salinity was monitored within each of the research treatment areas through use of soil probes in conjunction with wireless telemetry technology and through collection of soil samples that were sent to a laboratory for analysis.

Demonstration & Knowledge Transfer
Demonstration and knowledge transfer were accomplished through the completion of four workshops, two of which were conducted in Temecula, CA and two of which were conducted in Napa, CA.

The Project's expected measurable outcome was improved viability of the region's winegrape economy. This outcome was to be achieved through decreasing winegrape growers' investment in crop production and increasing the value of their crops through implementation of RDI strategies. The targets were to decrease the investment in crop production, achieve a 29% reduction in applied irrigation water and to increase crop value by 25% through wine quality improvements. The research conducted as part of the Project showed that through implementation of RDI, application of irrigation water could be reduced and wine quality could be improved.

Reduced Application of Irrigation Water
In 2013, the year prior to the Project implementation when RDI was not being used as an irrigation strategy at the property where the research was conducted, water use at the property was 1.09 acre feet per acre (AF/acre). In 2014 and 2015, within the portion of the property where the research was implemented, water use was reduced. Actual water use for the research area was variable depending on the RDI treatment used.

The following table shows water use for each of the research treatments during 2014 and 2015 and how it compared to water use during 2013:

Year	Treatment	Water Use (AF/Acre)	% Change From 2013
2014	Sustained RDI	0.94	-14%
	Post-veraison RDI	0.80	-27%
	Pre-veraison RDI	0.81	-26%
2015	Sustained RDI	0.86	-21%
	Post-veraison RDI	0.65	-40%
	Pre-veraison RDI	0.69	-37%

For the pre- and post-veraison RDI treatments implemented during 2015, the target for reductions in irrigation water applications was exceeded. Overall, the water consumption data shows that the targeted 29% reduction is achievable for growers who adopt RDI as a management practice.

It is likely that the adoption of the practice among Temecula Valley growers will be a long-term process that will extend beyond the term of the grant agreement. For this reason, it is difficult to measure precisely the water savings that occurred beyond those realized at the research site as a result of the Project. However, the Project team did perform a comparative analysis of usage between the year prior to Project implementation (2013), and the two years following Project implementation (2014 and 2015) among winegrape growers within the Temecula Valley to whom the Project results were advertised to identify changes in water use that may be attributable to the Project efforts. The following table shows aggregated water use for Temecula valley winegrape growers during 2014 and 2015 and how it compared to water use during 2013:

Year	Crop	Water Use (AF/Acre)	% Change from 2013
2013	Winegrapes	1.69	N/A
2014	Winegrapes	1.82	+8.4%
2015	Winegrapes	1.49	-11.4%

These water use data were obtained from meter reads taken from water meters that serve winegrape growing properties. These usage data were adjusted for differences in weather and total irrigated acreage between each of the growing seasons. The data shows that there was an 11% decrease in usage in 2015 (the year when most of the outreach regarding the Project took place) when compared to 2013. However, the data has its limitations.

Because some of the water meters serving winegrape growing properties also supply water to winemaking facilities and ornamental landscapes, true vineyard water use at those properties could not be isolated from total water use including facilities and landscapes. In addition the effects of drought regulations imposed during the Project period on water use could not be quantified. Despite the limitations of the data, the Project team, based on information it does know, is confident that the Project had a positive effect upon water use efficiency within the winegrape growing community.

It is RCWD's goal to assure all growers within the Temecula area that RDI is the best irrigation practice. Therefore, RCWD will continue to advertise the results of the research and to encourage the adoption of RDI well into the future.

Wine Quality Improvements & Increased Crop Value
For the wine quality research component of the Project, three different wines were fermented under identical conditions from the grapes harvested within the researched block of Tempranillo grapes. Each of these wines corresponded to a research treatment (i.e. a different RDI strategy). In addition, wine was made from an adjacent block of Tempranillo grapes that was irrigated according to the grower's normally implemented irrigation schedule. These four types of wines were made following the 2014 and 2015 harvests.

For both the 2014 and 2015 harvest years, these wines were served to wine makers from all over the State of California during a blind taste test. In both years, the preference among the wine makers was overwhelmingly in favor of the two research treatments for which the most aggressive forms of RDI were implemented (i.e., the least amount of water was used). Additionally, the least preferred of the four wines was that made with the grapes harvested from the block of grapes adjacent to the research trial, which had been irrigated according to the grower's normal irrigation schedule.

In terms of increased crop value, neither the grapes used to make these wines, nor the wines themselves were sold at market, so it was not possible to measure increases in dollar value for the research block. However, the winemaker who makes the Tempranillo wines indicated that they could charge 25% more for the wines that were preferred during the blind taste tests. Other methods that could be used to measure changes to the value of local crops that resulted from implementation of the Project include: 1) taking a survey that asks growers to provide crop value information, and 2) using data from the Riverside County Crop Report to ascertain changes in the value of Riverside County winegrapes on a dollars per ton basis. It was learned during Project implementation that the first option is not a viable one since winegrape growers will not reveal contracted crop value amounts for proprietary reasons. The second option could be used; however, the 2015 Riverside County Crop Report is not yet available. In its endeavors to continue the research beyond the term of the grant agreement, RCWD will look at effective ways to measure changes in crop value.

The major successful outcomes of the Project include:

1. The Project research proved that high levels of water savings could be achieved through implementation of RDI.
2. The Project research proved that winegrapes grown using less water and more aggressive forms of RDI produced finished wines of better quality within the researched areas.
3. While the results of the Project were intended to be advertised primarily to winegrape growers within the Temecula Valley, they ended up being featured at the prestigious Wine Quality and Innovation conference in Napa, CA for two consecutive years. In addition, a discussion of the results was published in *Wine Business Monthly*, the industry's leading publication for wineries and winegrape growers. This extra advertisement resulted in outreach being conducted beyond the scope of the Project, which could lead to statewide benefits.

Beneficiaries

The Project is designed to result in more efficient water use and water savings among RCWD's agricultural customers. Furthermore, increased water use efficiency and water savings in one customer class benefits all RCWD customers through improved District-wide water supply reliability. Therefore, the beneficiaries of the Project include all of RCWD's 44,430 customers including its agricultural, residential, commercial, and landscape customers. In addition, since the Project results have been presented to winegrape growers from different parts of the State of California, the Project beneficiaries include water users statewide.

At a minimum, the beneficiaries of the Project include all of RCWD's 44,430 customers including its agricultural, residential, commercial, and landscape customers. All of RCWD customers benefit from the Project because efficient water use and water savings in one customer class (i.e. agricultural customers) benefits all customers through improved District-wide water supply reliability and rate stabilization. In addition, since the Project results have been presented to winegrape growers from different parts of the State of California, the Project beneficiaries include water users statewide.

Lessons Learned

Overall, the Project team learned that the regulation of grapevine water status throughout the lifecycle of the vine is an important tool to use for the management of winegrape and wine quality. The project team learned that RDI has no short-term detrimental effect on grapevine development or grape quality in the Temecula region and that the red wine made from grapes grown under RDI conditions were actually preferred by winemakers.

The Project was originally intended to benefit only water users within RCWD's service area; however; interest in the Project grew beyond this area and into the northern part of California. The results of the Project were presented twice, once in 2014 and once in 2015, at the Wine Innovation and Quality Conference held annually in Napa, CA. In addition, an article was written and featured in the July 2016 edition of *Wine Business Monthly*, the wine industry's leading publication for wineries and winegrape growers, detailing the results of the Project. Because of the expanded area to which the results of the Project were demonstrated, it can be said that it has benefited winegrape growers throughout the State of California.

The original intent of the Project was to conduct research on RDI, advertise its results to local winegrape growers, have them adopt RDI based on the positive research results, and then measure the water savings and crop value benefits achieved by those growers who adopted RDI. The Project team learned that the expectation for growers to adopt RDI within the two-year Project term was overly optimistic. Convincing local winegrape growers to adopt RDI is going to be a long-term effort that will extend beyond the duration of the Project. For this reason, RCWD will continue to advertise the results of the research and to encourage the adoption of RDI well into the future.

In addition, the RCWD will continue to conduct research on RDI, the results of which will also be used to encourage the adoption of RDI by local winegrape growers. These future research efforts involve the deployment of sap flow monitoring devices and associated software in Temecula Valley vineyards. The devices will be used to further research the effectiveness of the three methods of RDI that were implemented as part of the Project, and to advertise the effectiveness of the RDI methods in increasing water use efficiency and enhancing finished wine quality. The idea behind this continued research effort is to find better and more accurate ways to quantify vine water deficit for the purpose determining more precise irrigation frequency and runtimes as they pertain to RDI implementation (i.e. better RDI). The hope is that through implementation of the devices, water use efficiency can be increased beyond the levels realized within the Project's research block and finished wine quality can be further improved. Through this longer term research and demonstration effort, the RCWD anticipates that more local winegrape growers will adopt RDI practices.

Additional Information

No additional information.

USDA Project No.: 46	Project Title: Improving Water Quality in California Nursery Crops using Polyacrylamide	
Grant Recipient: University of California, Davis	**Grant Agreement No.:** SCB13046	**Date Submitted:** December 2016
Recipient Contact: Steve Tjosvold	**Telephone:** 831 763-8013	**Email:** satjosvold@ucanr.edu

Project Summary

Water quality is impacted by the production of nursery crops when nutrients, pesticides, and sediment run off site. Directly and indirectly these pollutants may impact surface and ground water, fish and wildlife, and the overall quality of the environment. The California nursery industry is a large intensive industry often located in environmentally sensitive areas. The industry is regularly one of the highest users of fertilizer nutrients and pesticides per acre of any other California agricultural crop. Sediment from potting soil and nursery beds commonly enter waterways in water runoff and leads to siltation, which is the leading cause of water quality problems in rivers.

Cost-effective management tools need to be developed to help mitigate water quality issues associated with the nursery industry. Many trials in field crops have shown that linear anionic polyacrylamide (PAM) can significantly reduce sediment, nutrient, and pesticide water pollution. However, PAM has not been tested for this purpose when applied as an amendment in potting soil used in nursery production. This novel method of applying PAM needed to be evaluated and optimal PAM rates for potting soils determined.

Federal and California water quality regulations require that nurseries implement practices to minimize impairments to water quality. Total Maximum Daily Loads (TMDL) of nutrients, pesticides and sediment have been adopted by the Central Coast, Los Angeles, and San Diego California Water Quality Control Boards (RWQCB) where most of the nurseries are located. In the Central Coast RWQCB, a recently updated agricultural order stiffened regulations for discharge of these pollutants into surface water bodies on the Central Coast.

Many nursery operators have limited options to improve mitigation efforts. The use of retention ponds and recycling can control irrigation tail water, but these practices can be expensive and may not be suited for all nurseries since they require a significant amount of land to move and contain runoff. Nursery operators can use drip irrigation for 15 gallon or larger pots to increase irrigation efficiency and reduce runoff. But drip irrigation is not practical for the most commonly produced 1 gallon and 5 gallon potted plants since these plants are moved frequently and would require a complex system of individual irrigation tubes for each pot. Cost-effective management tools need to be developed and PAM as a soil amendment needed to be evaluated.

This project did not build upon a previously funded SCBGP project.

Project Approach

Activities were performed to address the following objectives:

(1) Determine optimal PAM rates in potting soils that reduce turbidity, total dissolved solids, and nutrient loss in pot leachate.

(2) Ensure that the selected range of PAM concentrations are compatible with nursery crops and determine PAM residual effect and release rate into soil leachate.
(3) Ensure that the selected range of PAM concentrations are compatible with nursery crops and determine PAM residual effect and release rate into soil leachate.
(4) Determine PAM impact on water quality in nursery field trials
(5) Transfer information to growers through local and statewide presentations, newsletters, and other publications.

Final Approved Activities and Timeline in Work Plan with Results and Conclusions:

Activities	Timeline	Results and Conclusions
Leachate from PAM-treated and untreated pots will be measured every two weeks for water quality factors.	Oct 2013-Jun 2014	Desirable ranges of PAM were found in the range of 25 to 400 grams per cubic meter of soil based on significant lowering of turbidity, turbidity and total soluble solids (TSS), soluble phosphorus (P) and total P with potting soils containing some sand. This desirable effect was not found with potting soils with mostly organic products. PAM at desirable ranges was found to moderately increase water holding capacity of potting soil. This could be desirable in some potting soils and crops.
Potting soil will be sampled, chemical and physical properties measured twice	Oct 2013-Jun 2014	
Growth and development characteristics will be measured every two weeks in a nursery crop grown from planting to a saleable stage in potting soil treated with the range of the PAM rates. Plant water use will be carefully evaluated during the trials. Soil settling and total porosity will be measured at harvest.	Jul 2014- Jul 2015	Three nursery crops species (*Epilobium*, *Heterotheca* and *Gaura*) were grown from planting to harvest in a commercial nursery with various desirable PAM rates. No adverse effects were observed and no significant differences in fresh and dry weights were found at harvest between untreated and PAM-treated plants. Growth and plant quality measurement were made on an *Osteospermum* crop grown in a research greenhouse. Additional growth measurements were made in the final commercial nursery experiments with lavender (*Lavandula*) crops. Again, no differences were found between untreated and PAM-treated plants at the 100 gram rate.

Activities	Timeline	Results and Conclusions
PAM concentration will be measured periodically in the pot leachate.	Jul 2014- Jul 2015	Data indicated that most of the measurable PAM could be detected leaching in the first ten irrigations. PAM in leachate measured up to 100 ppm at the 400 gram rate. Additional measurements in the final field experiments also confirmed this leaching rate for the 100 gram rate. PAM concentrations were determined in an *Osteospermum* crop at the first irrigation, mid-point of cropping, and at harvest. PAM was only detectable at the first irrigation.
Turbidity measured from leachate collected from 5 soil mixes with various portions of sand. Pots will be treated with various rates of PAM.	July 2015- Sept 2015	PAM decreased turbidity of leachate with increasing portions of sand in a redwood potting soil. The effect was seen in soils containing from 5 to 20% sand with the largest effect at 15% sand. The desirable effect increased with increasing PAM rates.
Leachate from treated pots will be collected and measured for turbidity over successive irrigations in a simulated nursery system.	Oct 2015 – Feb 2016	
Collect runoff water periodically from replicated and randomized PAM-treated and untreated plants/blocks from three nurseries. Turbidity, total suspended solids, nutrients and PAM concentration will be measured every two weeks in leachate from individual pots and collectively as tailwater from plant blocks.	Feb 2016-May 2016	PAM significantly decreased turbidity and TSS of leachate in potting soils containing sand. PAM significantly decreased total and soluble phosphorus in soils with sand and in one soil with mostly organic products. No differences were found between treated and untreated pots for any of the tested nitrogen factors (nitrate, ammonium, and organic nitrogen).
Dissemination of project results at industry meetings and workshops. Grower articles and newsletters published. Meeting and grower attendance, industry newsletters, and associated contacts will be continued. Final project results will be written for scientific publications (late 2016), and expected to be published (early 2017).	Jul 2015-Jun 2016	Four presentations were given: 1. January 22, 2015 – 26 growers in Watsonville, California 2. March 8, 2015 – 22 academic colleagues at the University of California, Davis 3. September 29, 2016 – 30 growers in Watsonville, California 4. October 25, 2016 – 85 attendees in Watsonville, California The scientific publication was started and expected to be published in early 2017.

The overall scope of the project solely benefited specialty crops.

Significant contributions were made by:
The University of California Cooperative Extension (UCCE), Watsonville's Staff Research Associate, involved with implementation, evaluation, and planning.

UCCE, Salinas's Water Quality Farm Advisor was involved with evaluation of data and planning.

The United States Department of Agriculture, Idaho was involved with PAM analysis and quantification of leachate samples.

Suncrest Nursery, Watsonville, California provided commercial nursery beds and potting soil for field evaluations.

Monterey Bay Nursery, Watsonville, California provided commercial nursery beds and potting soil for field evaluations.

Berger (formerly Sunland Garden Products), Watsonville, California provided commercial custom soil mixing facilities to formulate our soil mixes for all experiments.

Goals and Outcomes Achieved

All goals indicated in the Performance Monitoring Plan, with some modifications in protocols, were accomplished. The project team was able to add a few additional activities to the overall Work Plan: Because PAM had unexpected and desirable water holding capacity, plant water use was carefully evaluated in greenhouse plant growth and development studies. The reduction of soil settling was another unexpected and desirable observation made, and this was also measured at harvest. Since observations indicated that soil mixes containing portions of sand were most favorably affected by the addition of PAM, an evaluation of soil mixes with five different portions of sand were evaluated with six PAM rates and leachate turbidity measured at each of ten irrigations.

With respect to the Expected Measurable Outcome, the water quality in field plots was measured with and without PAM, in different soils, at two different nurseries with a total of eight field plots. It was originally expected this evaluation to occur at three nurseries with a total of six field plots.

Performance Monitoring Plan showing a comparison of actual goals and Activities, versus accomplishments:

Goals	Activities	Accomplishments
The project team will expect to determine a useful range of PAM rates.	Periodically leachate from PAM treated and untreated pots will be measured for turbidity, TSS, total N, NO3-N, total P, and soluble P Oct 2013 to Jun 2014	Desirable ranges of PAM were found in the range of 25 to 400 grams per cubic meter of soil based on significant lowering of turbidity, TSS, soluble P and total P with potting soils containing some sand, however, not with potting soils with mostly organic products.
Evaluate properties of potting	Potting soil will be	PAM at desirable ranges was found to

soils evaluate PAM compatibility with conventional crops.	sampled and chemical and physical properties will be measured periodically. Oct 2013 to Jun 2014	moderately increase water holding capacity of potting soil. This could be a very desirable characteristic in some potting soils and crops.
Ensure optimum health and quality plant growth and development with selected PAM rates.	A typical nursery crop will be planted as young plants and grown as a typical commercial crop in potting soil treated with a range of the useful PAM rates (determined in the first objective). Growth and development will be measured. Jul 2014 to Feb 2015	Three nursery crops species (*Epilobium*, *Heterotheca* and *Gaura*) were grown from planting to harvest with various desirable PAM rates. No adverse effects were observed and no significant differences in fresh and dry weights were found at harvest between untreated and PAM-treated plants. *Osteospermum* was grown in a greenhouse in a mostly organic soil and a sand amended soil. No differences were found between untreated and PAM-treated plants. Additional growth measurements were made in the final field experiments with lavender (*Lavandula*) crops. Again, no differences were found between untreated and PAM-treated plants.
Determine how long and at what concentration to expect PAM to be released into areas surrounding the treated pot in a nursery.	PAM concentration will be measured periodically in the pot leachate in the experiment described above. Jul 2014 to Feb 2015	PAM concentrations were measured in non-planted containers with simulated irrigations. Most detectable PAM was leached by the tenth irrigation. PAM concentrations were determined in an *Osteospermum* crop at the first irrigation, mid-point of cropping, and at harvest. PAM was only detectable at the first irrigation.
Determine the impact on water quality within and just outside the experimental field plots.	Runoff water will be collected periodically from treated and non-treated pots/ areas. Turbidity, TSS, nutrients and PAM concentration will be measured in soil leachate and tailwater. Mar 2015 to Mar 2016	Water quality of runoff from treated and untreated plots were monitored at two different commercial nurseries. There were two types of potting soils evaluated at each nursery, one soil was formulated with a significant sand component (15 to 20%) and the other soil was formulated with mostly organic amendments. Each soil either was treated with 100 g/L PAM or left untreated. All pots were planted

		with ornamental lavender. Each of the eight *plots* consisted of 200 plants in 1 gallon pots spaced "pot to pot" on typical gravel nursery beds. Plots were approximately 10 x 10 foot and built to contain most of the runoff at each irrigation. Turbidity was evaluated at every irrigation, and soluble nitrogen (N), total N, soluble P, total P, TSS and PAM were evaluated at every other irrigation. Pot leachate was measured by collecting samples of leachate from the same ten marked pots throughout the evaluation.

Baseline data gathered:
<u>Nursery 1 Pot Leachate</u>
Potting soil A containing sand: PAM reduced leachate turbidity from 70.0 to 19.1 NTU; PAM reduced total soluble solids in leachate from 102.7 to 56.9 mg/L.
Potting soil B containing mostly organic products: PAM had no significant effect on measured factors.

<u>Nursery 2 Pot Leachate</u>
Potting soil C containing sand: PAM reduced leachate turbidity from 38.7 to 23.1 NTU; PAM reduced total soluble solids in leachate from 33.5 to 17.6 mg/L. PAM reduced total P in leachate from 0.25 to 0.14 mg/L.
Potting soil D containing mostly organic products: PAM had no significant effect on measured factors.

<u>Nursery 1 Plot Runoff</u>
Potting soil A containing sand: PAM did not have statistically significant impact on runoff from plots
Potting soil B containing mostly organic products: PAM increased soluble P from 2.5 to 4.0 mg/L and total P from 2.7 to 4.9 mg/L .

<u>Nursery 2 Plot Runoff</u>
Potting soil C containing sand: PAM reduced turbidity and TSS, but not statistically significant. PAM reduced total P in leachate from 2.3 to 1.5 mg/L.
Potting soil D containing mostly organic products: PAM increased turbidity from 4.5 to 7.8 NTU. Although this is statistically significant it is relatively very low overall. These are differences that would be undetectable to the naked eye.

PAM as tested in these experiments can have significant impact on reducing turbidity and TSS concentrations in pot leachate in potting soils containing significant portions of sand mixed with organic products (leachate is defined as the water drained from the bottom of the pot after irrigation). For sandy soils, the mean turbidity reduction in leachate from planting to harvest was 27 to 60% and the mean TSS reduction was 52 to 55%. Potting soils composed of mostly organic products had lower levels of these pollutants and PAM did not reduce these pollutants. In fact, PAM may have actually increased the suspension of some organic portions in runoff. PAM can increase P runoff by a small but significant amount, possibly by suspending organic soil fractions that have adsorbed P.

PAM was detectable in soil leachate in the first ten irrigations. PAM could be detected in runoff in the first ten irrigations at levels as high as 14 ppm. Therefore, PAM was distributed in gravel beds from treated pots. Its effect after deposition in gravel beds and on subsequent crops was not tested.

Gravel beds help reduce turbidity and TSS in runoff, possibly by filtering out the pollutants as the runoff moves laterally through and off the beds. The project team was not able to detect significant reduction of these pollutants with PAM in runoff. PAM reduced turbidity and TSS in tail water for sandy potting soils, but not by a statistically significant amount. Therefore, the project's target to reduce the turbidity of tail water by 25% over six months was not demonstrated. The team however, was able to detect significant reduction of these pollutants in leachate. These leachate pollutants may eventually move from the area under the pot or around the pot. It is suspected that irrigation rates do not move them well but perhaps rainfall and especially heavy rainfall could move them. Rainfall unfortunately did not occur during field testing so this could not be observed or tested.

PAM at all rates tested in these experiments had no deleterious effects on plant growth and quality. The testing occurred in nursery and greenhouse production on a wide range of ornamental plant species.

Beneficiaries

This project benefited the California growers of nursery and floriculture crops who grew in potting soil. Most all California nurseries have mandated water quality mitigation needs and this project provided new knowledge and, in many cases, a method to help.

Nearly all of the California growers of nursery and floriculture crops either use potting soil or receive propagative material in potting soil. Based on the 2012 Census of Agriculture there were 1,306 ornamental crop nurseries in California.

Lessons Learned

Future testing should be done in the field on multiple sequential crops or for a period of a year or longer. This would help to evaluate the long term effect of PAM on water quality and the effect of rainfall events. This project was able to determine the effects of PAM in a snapshot of time, it would also be beneficial to see the potential long term effects of using PAM. Future research work should look at leaching and runoff during winter so rain events could be tested to look at their effect on water quality.

It was fortuitous that preliminary evaluations with PAM happened to be with soil containing sand. With those profound results with turbidity, the team began the formulation of the proposal that led to this project. It was surprising that similar significant results could not be detected in potting soils containing mostly organic products.

Additional Information

Presentations:
"Nuggets of Knowledge" presented at the California Association of Nurseries and Garden Centers (CANGC) Monterey Bay Chapter (January 22, 2015 in Watsonville). This included a description and demonstration of the effect of PAM amendments on leachate turbidity to 26 growers.

"Polyacrylamide as a Soil Amendment to Improve Water Quality in Nursery Runoff" (March 8, 2015 at the UC Davis). This was presented to 22 academic colleagues.

"Polyacrylamide as a Soil Amendment to Improve Water Quality in Nursery Runoff" (September 29, 2016). Technical Program, Berger Soil Products, Watsonville California. This was presented to 30 local growers.

"A Novel Approach for Sediment Control with Polyacrylamide in Container Nursery Production" (October 25, 2016), California Nursery Conference, Watsonville, California. This was presented to 85 attendees.

Figure 1. Effect of PAM at various rates (0, 50, 100, 400 g/m3 on turbidity of soil leachate. Potting soil contained 15 percent sand and 85% organic products. Image here are of leachate collected after third irrigation. Deionized water on the far right for comparison.

USDA Project No.: 47	**Project Title:** Salt-tolerant Lettuce and Spinach Varieties	
Grant Recipient: United States Department of Agriculture, Agricultural Research Service	**Grant Agreement No.:** SCB13047	**Date Submitted:** December 2016
Recipient Contact: Beiquan Mou	**Telephone:** (831) 755-2893	**Email:** beiquan.mou@ars.usda.gov

Project Summary

Salinity is a major constraint to crop production in all major lettuce and spinach districts of California. The seawater intrusion has continued to move farther inland into groundwater aquifers beyond city limits of Castroville and Salinas because of continuing overdraft conditions for municipal and agricultural uses in the coastal regions. In the Central Valley, salts accumulate in farmland due to irrigation water from the Sacramento-San Joaquin Delta contaminated with brackish water from the San Francisco Bay, a shallow saline water table, and a lack of adequate drainage outlet. In the Imperial Valley, salts in irrigation water from Colorado River must be carefully managed to prevent yield losses.

The water quality problem is exacerbated by the climate change. Global warming leads to higher sea levels, which intensify saltwater intrusion in coastal California. Raising temperatures also promote water transpiration from plants and evaporation from soil, leaving more salts behind in soil. Forecasts show that global warming over the next several decades will take place irrespective of any action taken today. Thus the development of crops that can cope with abiotic stresses like salinity may well be the single most important step that can be taken to adapt to a warming planet. However, breeding a new variety takes time, often about 10 years. The ability to breed new varieties is undermined by the rapid loss of the genetic diversity of plants, which is also accelerated by climate changes. Therefore, there was a pressing need to mitigate the increasing salinity stresses through improvement of leafy vegetables for present needs and future conditions. Project staff proposed to screen and identify salt-tolerant lettuce and spinach germplasm and cultivars to adapt to the changing environment. Completion of this project will reduce future crop loss and production costs, conserve water resources, and improve the profitability and sustainability of these important specialty crops.

This project did not built on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Project staff compared and selected the growth mediums suitable and salt concentration for the study of salt tolerance in lettuce and spinach, and found that rock wool cubes were much more efficient than sand culture for this study. Using the improved protocol, project staff first preliminarily screened 3,800 lettuce genotypes and 525 spinach varieties for salt-tolerance.

Based on preliminary screening, 174 lettuce and 60 spinach cultivars and germplasm accessions were selected and re-tested with two trials in sand cultures using pots under greenhouse conditions. Overall, salinity decreased lettuce shoot fresh mass (FM) and dry mass (DM), increased DM/FM ratio and chlorophyll index, and had no effects on photochemical efficiency. Great variation in salt tolerance exits among lettuce genotypes. Generally, genotypes with high growth potential were relatively salt-sensitive based on the percentage of growth reduction, while those with relatively high salt tolerance commonly had low growth potential under control condition.

Goals and Outcomes Achieved

Using the improved protocol, project staff preliminarily screened more than 3800 lettuce genotypes and 525 spinach varieties for salt tolerance in greenhouse based on the percentage of growth reduction under salt stress. Varieties with less salt sensitivity, which was defined as: (fresh weight of plant grown without salt – fresh weight of plant grown with salt) / fresh weight of plant grown without salt, were considered to be salt-tolerant.

Based on preliminary screening, 174 lettuce (50 butter head, 35 crisphead, 30 romaine, 25 leafy, 15 wild genotypes and 19 commonly grown cultivars) and 60 spinach cultivars and germplasm accessions were selected and re-tested in sand cultures using pots under greenhouse conditions. Four week after salt stress, shoot fresh and dry weight, leaf chlorophyll index and fluorescence were measured. Salt tolerance was compared based on the percentage of fresh weight reduction under salt stress.

Based on the greenhouse studies, 56 lettuce varieties with the least salt sensitivity from greenhouse tests and 16 commonly grown cultivars were selected and screened salt tolerance in field with two trials from April 2015 to June 2015 and from July 2015 to September 2015. Similarly, 36 spinach varieties were selected for field trials. Plant fresh and dry weight, size, and core length were measured under salt-stress and control conditions. Soil salinity levels in the field was also monitored.

In order to identify critical physiological traits associated with salt tolerance, 20 genotypes of romaine lettuce with diverse salt tolerance were selected and grown in the greenhouse with sand cultures using pots. Four weeks after salt treatment, physiological traits including shoot fresh and dry weight, leaf area, root dry weight, leaf gas exchange (photosynthesis rate, stomata conductance and transpiration), chlorophyll fluorescence (photochemical efficiency, photochemical yield and electron transport rate), and leaf spectral reflectance, were measured.

The long-term success of the project will be judged by the percentage of lettuce and spinach acreage that is planted with salt-tolerant cultivars in California. This will be measured by mail and telephone surveys of seed companies for the percentage of lettuce and spinach seeds sold with the salt-tolerant trait three years after the completion of the project.

The goal of this project was to screen and identify salt-tolerant lettuce and spinach germplasm and cultivars to adapt to California's changing environment. Out of more than 3800 lettuce and 525 spinach genotypes from the preliminary screening, project staff selected and screened 164 lettuce and 60 spinach genotypes for salt tolerance in greenhouse using sand cultures with two trials. Based on the results of greenhouse study, 56 lettuce varieties with the least salt sensitivity and 16 commonly grown cultivars were further selected and screened for salt tolerance in field with two trials from April 2015 to June 2015 and July 2015 to September 2015. Similarly, 36 spinach varieties were selected and screened in field trials. The salt tolerance of lettuce and spinach germplasm and cultivars was screened and compared in greenhouse and field trials during the project period. Salt-tolerant lettuce and spinach varieties were identified for each lettuce type and spinach.

During preliminary screening, the shoot fresh weight of 3800 lettuce and 525 spinach genotypes under salt stress and control condition was measured and analyzed. During greenhouse study, shoot fresh and dry weight, leaf chlorophyll index and fluorescence of lettuce and spinach genotypes under salt stress and control condition were measured and analyzed. During field trials, plant fresh and dry weight, size, and core length were measured under salt-stress and control conditions. Soil salinity levels in the field was also monitored. During physiological traits study, shoot fresh and dry weight, leaf area, root dry weight, leaf photosynthesis rate, stomata conductance and transpiration, photochemical efficiency, photochemical yield and electron transport rate and leaf spectral reflectance were measured. Baseline data were collected though these activities and salt-tolerant varieties with less than 50% reduction in fresh weight under salinity stress conditions have been identified for each lettuce type and spinach.

Some lettuce varieties showed salt tolerance (less than 15% reduction in fresh weight) such as Morgana, Amerika, PI 358020c, PI 342515 (butterhead), Laura (crisphead), PI 289023, PI 273577, PI 278066, PI 177425 (romaine), PI 171676a, PI 177423, PI 358018b, PI 342477 (leaf). Three poster and one oral presentations were made during professional conferences.

Beneficiaries

Salt-tolerant cultivars will directly benefit lettuce, spinach, and spring mix growers and product companies through improved production with reduced water quality, and seed companies by increasing global seed sales. The completion of this project will benefit all lettuce and spinach growers, product companies and seed companies in California. Data from this project were disseminated in extension publications, professional meetings of American Society for Horticultural Science (ASHS), biannual meetings of California Leafy Greens Research Program regularly attended by more than 250 growers and industry personnel, and professional journals such as HortScience and Journal of ASHS with more than 3,200 subscribers.

Direct beneficiaries include all lettuce and spinach growers, 107 lettuce, 67 spinach, and 25 spring mix product companies and more than 30 seed companies with thousands of personnel involved in growing, processing, and distribution of lettuce and spinach products and seeds in California.

Lessons Learned

It is necessary to find a postdoctoral researcher with sufficient knowledge and skill to carry out the research. The postdoctoral job advertisement, job application, applicant screening, hiring, and relocation process took considerable time. The postdoctoral research associate also had to pass background check before hiring. It took more than six months from October 1, 2013 before postdoctoral researcher could start working on this project.

Even with a late start, project staff designed high-throughput experiments to screen a large number of lettuce and spinach varieties quickly and efficiently using rock wool cubes. Each time 24 rock wool cube sheets, each with 200 cubes, were used for seed germination. Half of the rock wool sheets were used for salt treatment and another half with same genotypes for control. 204 genotypes could be screened in each time. Since rock wool is completely sterile and have optimum air/water ratio, the germination was fast and more uniform and there were more plants for measurement. Rock wool cubes are much more efficient than sand culture for screening a large number of lettuce and spinach varieties quickly and efficiently. The efficiency, accuracy and quality of the experiment were improved. The project staff used fewer replications in preliminary screening experiments, and screened as many varieties as the greenhouse space allowed. The experiment period for lettuce preliminary screen was reduced from seven to four months, and for spinach it was reduced from five to two months. Therefore, this project caught up before March 2015 and did not need to modify the timelines of the work plan since then.

The salt tolerance of seedlings in green house screening is not consistent with that of plants in field trials, because the salt tolerance of lettuce and spinach is affected by not only environmental conditions and severity of salinity but also growth developmental stage. Even for different field trials, it is critical, in the future, to keep salt stress levels similar in order to get consistent results.

The results from two field trials were not consistent, some varieties were tolerant in summer season but were not in fall season. The inconsistency might result from not only different seasons but also different salinity treatments. The solid salts were buried in the beds to induce salt stress quickly and crops were irrigated with saline water in the summer season. During fall season, no solid salts were buried in beds since the same field was used. The different salt stress treatments might lead to different severity of salinity.

Additional Information

Dissemination of results is as follows:

One poster and one oral presentations were made during the annual conference for the American Society of Horticultural Science (ASHS) held in August 2015 in New Orleans. One poster presentation was made during Workshop on Plant Development and Drought Stress in November 2015. And one poster presentation was made for the annual conference of ASHS held in August 2016 in Atlanta.

Chenping Xu, Beiquan Mou, 2016. Fish hydrolysates improve containerized lettuce. American Society for Horticultural Science. Annual meeting. August 8-11. Poster.

Chenping Xu, Beiquan Mou, 2015. Salinity and nutrient deficiency affects spinach growth, physiology and nutritional value. Workshop on Plant Development and Drought Stress. Pacific Grove, CA. November 1-4. Poster.

Chenping Xu, Beiquan Mou, 2015. Evaluation of lettuce genotypes for salinity tolerance. American Society for Horticultural Science. Annual meeting. August 4-7. Poster.

Chenping Xu, Beiquan Mou, 2015. Effects of salinity and nutrient deficiency on spinach growth, physiology and nutrition value. American Society for Horticultural Science. Annual meeting. August 7. Oral.

Three papers were published by, one submitted to, and one is being prepared for, peer-reviewed journals:

Chenping Xu, Beiquan Mou, 2016. Effect of fish-derived protein hydrolysates on lettuce growth and physiology. HortScience Preparing.

Chenping Xu, Beiquan Mou, 2016. Short-time effects of composted cattle manure or cotton burr on containerized spinach and soil fertility. HortScience Submitted.

Chenping Xu, Beiquan Mou, 2016. Vermicompost affects soil properties and spinach growth, physiology, and nutritional value. HortScience 51: 847-855.

Chenping Xu, Beiquan Mou. 2016. Spinach responses to salinity and nutrient deficiency in growth, physiology and nutritional values. J Amer. Soc. Hort. Sci. 141:12-21.

Chenping Xu, Beiquan Mou. 2015. Evaluation of lettuce genotypes for salinity tolerance. HortScience 50:1441-1446.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 48	Project Title: Development of a Nutrient Budget Approach and Optimization of Fertilizer Management in Walnuts	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13048	**Date Submitted:** December 2016
Recipient Contact: Katherine Pope	**Telephone:** (530) 574-3794	**Email:** kspope@ucanr.edu

Project Summary

Fertilizer use in the walnut industry has come under scrutiny in the wake of recent nitrate groundwater contamination findings. Improved nutrient use efficiency (NUE) would decrease the walnut industry's potential contribution to contamination, decrease greenhouse gas (GHG) emission, and save growers money. However, information on nutrient needs of walnuts was outdated, and grower assessment tools were inadequate. This project aimed to provide growers tools to increase NUE, thereby decreasing the contribution to water and air pollution while improving financial sustainability.

California's walnut growers could be better environmental stewards and save significant amounts of money at the same time. Fertilizers made up over 7% of grower operating costs. Fertilization technology has allowed growers to target tree nutrient needs more precisely in time and space. Yet, grower decisions are being made on research developed using old irrigation systems and outdated cultivars when yields were 50% lower. Detailed, walnut-specific nutrient research is necessary to empower growers to be both environmentally and economically sustainable.

This project aimed to develop beneficial management practices (BMPs) and nutrient assessment tools to increase NUE in walnuts. By more precisely targeting nutrient application to tree needs, growers would reduce overall fertilizer use, reducing costs and pollution to the groundwater and atmosphere. This project aimed to create the walnut nutrient budget necessary for this targeted application, quantifying the monthly needs of different orchard components, and estimating seasonal soil nutrient losses and contributions. To increase BMPs adoption, the project aimed to improve grower nutrient assessment techniques to assist growers in monitoring the in-season impacts of new practices, including revisiting leaf critical values, exploring optimum nutrient ratios, and revising leaf sampling protocols.

The need for improved NUE has grown every year. A 2012 study by a University of California, Davis (UC Davis) Groundwater Hydrology Professor and their colleagues, identified many wells in the Tulare Lake Basin that exceeded the Environmental Protection Agency's maximum nitrate concentration limits. These nitrate concentrations endanger the health of tens of thousands of rural Californians. More than 50% of nitrate was estimated to come from synthetic fertilizer use. Similar concentrations could likely be found in other intensely cultivated areas of the Central Valley. Some of the highest nitrate concentrations were found in wells in alluvial fans, the most popular soil for walnuts.

This project built on the 2009 Specialty Crop Block Grant Program Project 16: *Tree Phenology Models for Climate Change Projection and Improved Water and Nutrient Management*. The project quantified minimal and optimal amounts of winter cold walnuts needed for normal spring leaf-out and flowering, including the chill level below which yield declined, and the yield penalty of lower chill, a 15% decrease from maximum yield potential. Thus, growers could decrease the nutrient application depending on the chill accumulation the winter prior to harvest. This relationship will be included in the yield estimation calculations of the proposed nitrogen (N) budget module. This project quantified many other aspects of yield estimation including canopy cover, previous yields, and other variables. Estimating yield will allow a grower to translate the generalized pounds-of-N-needed-by-a-ton-of-nuts to the needs of a specific field in a specific year following a specific winter.

Project Approach

Samples were collected for the walnut nutrient budget, to quantify nutrient demand in different walnut tree parts throughout the year. Various samples were collected and measurements were taken at six walnut orchards in the California Central Valley. These orchards encompassed three geographic areas (northern Sacramento Valley, northern San Joaquin Valley and southern San Joaquin Valley) and included, two different walnut cultivate varieties (‘Chandler’ and ‘Tulare’). Leaf samples were collected from ten trees per site in April through November, 2013-2015 (April-September 2013 funded by the California Walnut Board), fruit (nut) samples and tree yield data were collected from ten trees May through October, 2013-2015 (May-September 2013 funded by the California Walnut Board), and perennial parts (branches, roots, shavings from trunks, etc.) were collected from three trees in January, April, May, July and November, 2014. In May and July each year, twenty additional trees were sampled for the development of nutrient assessment tools. Catkins, the pollen shedding flower structures of walnuts, were measured in April of 2014 and 2015 for nutrient content. The samples were dried, weighed, ground and sent to the UC Davis Analytical Laboratory for nutrient analysis.

Leaf area was measured in October-November 2014 by catching, weighing and scanning fallen leaves from three trees at each of the six monitored sites. This was done as a compliment to light interception measurements by the Lampinen lab, which took place August 2015. These measurements were used both to estimate leaf area to feed calculations of leaf nutrient use, as well as to normalize yield values to account for tree canopy size.

Nitrate movement in the soil was closely monitored at one intensively instrumented site, the ‘Chandler’ northern San Joaquin Valley orchard. Data from soil moisture sensors and tensiometers, as well as soil solution samples, were collected April 2014-March 2015. Samples were collected after each irrigation event during the growing season, and before and after major rain storms in the fall, winter and early spring. Water samples were analyzed for nitrate, ammonia and total dissolved N. These data were analyzed to fit the HYDRUS model, a tool which may have allowed for prediction of behavior of water and nitrate in different orchards, or with different irrigation management. Results of initial HYDRUS model fitting were presented at the European Geophysical Union - General Assembly 2015 in Vienna, Austria in April, 2015 (Geophysical Research Abstracts, Vol. 17, EGU2015-14633, 2015, EGU General Assembly 2015. Abstract: http://meetingorganizer.copernicus.org/EGU2015/EGU2015-14633.pdf). Unfortunately, upon final analysis, there was insufficient data to adequately fit the HYDRUS model. However, the data were analyzed to estimate the nitrate leaching of the orchard that was monitored under its current management practices and the data gathered will inform future nitrate leaching research.

Nutrient content data was analyzed and charted for annual and monthly demand (nutrient budget) for the three years of data. A draft manuscript of N, phosphorus and potassium content in the walnut fruit over the course of the growing season, "Seasonal nutrient demand in mature deciduous tree species: Studies in walnut," was produced and edited for journal submission. The complete nutrient budget analysis, including all parts of the tree to which N, phosphorus and potassium were allocated, required excavation on at least one entire tree, to scale up the data gathered from perennial parts in 2014. No growers could be found who was willing to excavate a whole healthy tree in the course of the project. Redoubled effort was put into finding trees to excavate in the winter of 2016-2017, with funding from the California Walnut Board. Pending the information gathered from the excavated tree, a complete nutrient budget will be published in scientific journals, industry magazines and through a web-based tool.

Analysis of May and July leaf sample values to build an early sampling prediction model was completed. A project to gather additional data to build a better early season sampling prediction model has been funded by the California Department of Food and Agriculture (CDFA) Fertilizer Research and Education Program (FREP). The data from this project will be integrated in with the analysis of those data and published together, likely in the next 12 to 24 months. The predictive model will then be shared with a private leaf analysis lab. May and July leaf sample values were also analyzed to quantify necessary tree number and spacing for an accurate orchard leaf sample measurement by growers. A manuscript was drafted for a horticultural and grower-oriented publication to disseminate this information.

Numerous 20 to 30 minute presentations on walnut N management were given to walnut growers and others involved in walnut orchard management using research findings regarding total season N needs and the timing of demand. Over the course of 2015 and 2016, presentations were given at meetings targeting growers in every walnut production county in California (see Figure 1).

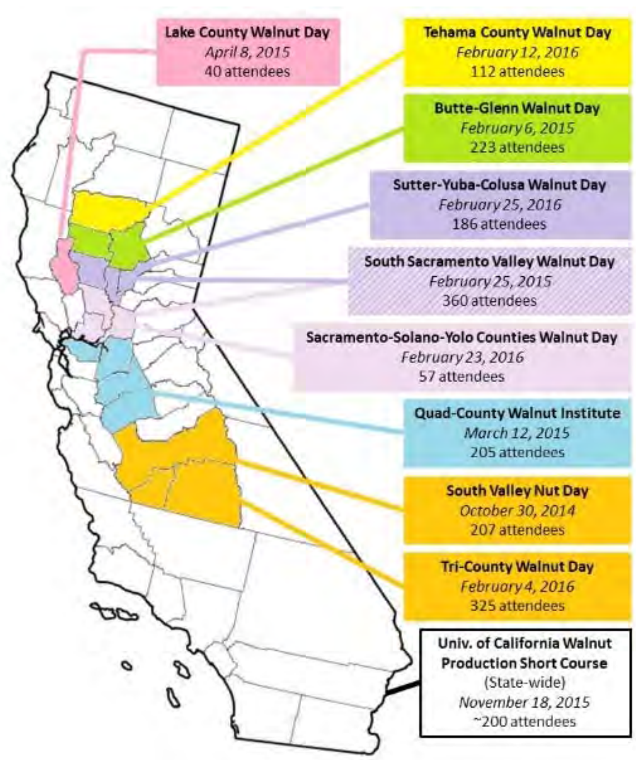

Figure 1. Walnut industry meetings at which presentations were made on nutrient management.

The general principles of nutrient management and budgeting for perennial crops were also taught to a number of Certified Crop Advisors (CCAs) at the University of California Agriculture and Natural Resources -CDFA Nitrogen Management Workshops. The timing of N demand by growing walnut fruit was included in the 2015 version of those presentations. A total of 245 CCAs that worked with tree crops, a large proportion of whom worked with walnuts, went through this training at three different locations in 2015.

Research findings were presented at a number of smaller meetings of researchers, including at the annual Walnut Research Conference, January 29, 2015 and January 28, 2016, attended by all of the UC Davis, the UC Cooperative Extension and the United States Department of Agriculture walnut researchers in California. There were also representatives from the California Walnut Board and California Walnut Commission, including growers and processors who served on the Board. Findings were also presented at the UC Pomology Education Continuing Conference (PECC) on March 23, 2015, attended by all UC tree crop researchers. PECC was a particularly important small venue through which to communicate and discuss research with farm advisors in the UC Cooperative Extension system.

In addition, the findings of this project were presented to the Nitrogen Technical Advisory Workgroup, which was charged with developing the Nitrogen Management Plan Worksheet and its implementation for the Central Valley Regional Water Quality Control Board under the Irrigated Lands Regulatory Program. The most up-to-date state of knowledge on walnut N management based on research findings was presented on April 24, 2015, at the “Nitrogen Removed Workshop” meeting of the Central Valley Water Coalitions charged with estimating the N removal of crops for future nitrate regulations and accounting. The Grant Manager, was also present at subsequent meetings by the same group on July 20, 2015 and September 4, 2015, to answer questions about N management in walnut production.

Written materials were published and disseminated based on research findings to date, to assist walnut growers in budgeting their N applications over the 2015 and 2016 growing season. “N Budgeting Following the 4 R’s,” a step-by-step guide to N budgeting for walnuts was produced and sent to recipients of the Yolo, Solano, Sacramento Orchard Newsletter (approximately 450 recipients) in April, 2015. This guide was sent to all of the walnut farm advisors in the UC Cooperative Extension system to enable sharing project-derived information with their growers. Its contents were also transformed into an article in the July 2015 edition of Western Fruit Grower magazine and the California Walnut Board (4,500 recipients). An additional article on this subject, “Following the ‘4 R’s’ Can Improve Nitrogen Delivery to Tree Nuts” was published online and in print by Western Farm Press on April 20, 2016 (see attachment 1).

The accounting department helped to track all project expenditures and ensure that grant funds were used to solely enhance the competitiveness of specialty crops.

Funding from the California Walnut Board paid for soil hydrology equipment, and the equipment and vehicles needed for sample collection to initiate the project before funding was available through the grant. The California Walnut Board then paid for approximately one-third of the salaries for the Grant Manager/post-doctoral researcher and the project junior specialists. In-kind support was provided by individuals from the UC Cooperative Extension (UCCE), Tehama County and San Joaquin County through assistance at leaf, fruit, perennial part and harvest sample collection in 2013, 2014 and 2015. In-kind support was also provided by the Department of Plant Sciences and the Department of Land, Air and Water Resources at UC Davis through the time provided to plan logistics and execution of field work, specifically harvest planning, sample processing and educational presentations, general oversight and soil hydrology instrumentation planning. The Lampinen lab at UC Davis conducted light interception measurements at orchards as discussed above. Laboratory space was also provided for sample processing by other UC Davis laboratories. Five commercial walnut growers allowed the project team to conduct research on their property. The Project Manager managed data analysis, wrote outreach materials and gave presentations throughout the Central Valley (Figure 1).

Goals and Outcomes Achieved

The Goal of this project was to improve the N use efficiency of California walnut orchards, through the outcomes of :

1) Increased number of walnut growers fertilizing according to the needs of the trees in each particular month or developmental stage, and
2) Increased number of growers sampling leaflets to measure the nutrient status of their trees to integrate tree nutrient status into fertilizer management decisions based on their nutrient needs.

The project activities conducted in order to build the nutrient budget were the first necessary steps towards achieving outcome 1. In order to educate growers, researchers needed to first know the amount of fertilizer required by the trees. Since the first year of monthly data was analyzed and available for growers, researchers involved in this project, mostly the Project Director, shared the timing of fertilizer needs of trees by month with growers at the meetings shown in Figure 1 and with other farm advisors and key decision-makers, who could then reinforce this information with the growers and managers. This information was also distributed in numerous publications as previously described.

Towards achieving outcome 2, the importance of leaf sampling to help inform fertilizer management decisions was also discussed at presentations listed in Figure 1. Additional funding was secured to gather additional data to improve the predictive nutrient status model, therefore that model is not yet available to growers or leaf analysis labs and has not yet been adopted.

The research necessary to make recommendations to growers regarding nutrient budgeting and leaf sampling is mostly completed, with the exception of the whole tree excavation for the nutrient budget and some remaining statistical analysis and publication of results. Growers and others involved in fertilizer management in the walnut industry were made aware of the concepts of nutrient budgeting and leaf sampling, and have begun to make changes such as splitting fertilizer among more applications in the growing season to improve N use efficiency.

Given the increased scrutiny regarding N application in agriculture in California under the Irrigated Lands Regulatory Program, and the aggressive outreach and education work of participants in this project, it is likely that many growers have improved their N use efficiency over the duration of this project. Increasing regulation will result in their continuing to do so. The results of this project, will enable growers to not just be compliant with the Irrigated Lands Regulatory Program, but to also enable them to simultaneously achieve sustainable economic yields.

Target	Achievement
Nutrient budget tool and leaf sampling protocol will be presented to 90% of farm advisors representing counties with 5% of the state's walnut acreage or more.	Nutrient budget information was presented to 100% of UCCE farm advisors representing 5% or more of the state's walnut acreage at the 2015 and 2016 Walnut Research Conference and the 2015 UC Pomology Education Continuing Conference. The revised leaf sampling protocol was completed and will be presented at the next Walnut Research Conference in January, 2017.
Nutrient budget tool and leaf sampling protocol will be presented to 25% of the state's commercial walnut growers by project researchers or collaborators.	The concept of nutrient budgeting and initial data from the project was presented at meetings in every California county with significant walnut production (Figure 1). Attendance at these meetings totaled 1,915 people – growers, crop advisors who made nutrient management decisions, orchard managers and others industry members. An additional 245 Certified Crop Advisors were trained on the principles of nutrient budgeting in tree crops, including information on walnut budgeting. Even taking into account some double-attendance, this meeting attendance far surpassed the goal of 25% of walnut growers or those responsible for fertilizer management decisions. The importance of leaf sampling was discussed at these same meetings, though the revised sampling protocol had not yet been developed. The nutrient budget tool and new leaf sampling protocol were discussed at annual meetings held by UCCE farm advisors winter 2016 and in the winter of 2017. This information will be in demand taking into consideration the fact that growers are now required to complete a N plan every year for every walnut orchard.
Webpages will be visited 500 times in first six months of being available.	Webpages with the nutrient budget tool are pending the necessary tree excavation in order to finalize the nutrient budget. This excavation is planned for the winter of 2016-2017.
Decision support application will be downloaded (or updated for those with the almond version) 50 times in the first six months of being available.	Decision support applications with the nutrient budget tool are also pending the tree excavation in order to finalize the nutrient budget.

Target	Achievement
Grower-oriented publications containing articles on nutrient budget tools will be read by 5,000 people.	As outlined in the Project Approach narrative, the principles of using a nutrient budget was discussed in numerous newsletter articles and industry publications, along with best estimates of that budget with the information available from the project when each article was written. The California Walnut Board's newsletter alone reached 4,500 recipients. Readership of Western Farm Press and Western Fruit Grower Magazine were each in the thousands. Additional articles will be written as the nutrient budget is finalized and tools are made available.
One hundred walnut growers will submit May leaf samples in the first three years following the project.	Additional data is currently being collected through a CDFA FREP grant to improve the accuracy of the model built during this grant. The prediction model necessary to use May leaf samples has thus not yet been finalized or made available to analysis labs.

- Samples collected, analyzed and statistically reviewed from six sites over three years towards building a nutrient budget for two of California's most important walnut cultivars.
- Principles of using a nutrient budget and preliminary results presented to all UCCE farm advisors, 2,100+ meeting attendees, 4,500+ California Walnut Board newsletter readers and thousands of industry publication readers.
- Nutrient budget is pending tree excavation and was near completion at the conclusion of this grant.
- Leaf sampling protocol revise and in preparation for publication and dissemination.
- Early leaf sampling model under development as nutrient management tool for growers.
- Multiple journal articles in draft or in preparation.

Beneficiaries

California's walnuts growers were the most direct beneficiaries of this project. Better information regarding the timing and amount of fertilizer needed by their trees will enable them to apply adequate fertilizer to sustain yields without spending money on unnecessary fertilizer or being out of compliance with state regulations. More broadly speaking, the groundwater-drinking residents of the state of California benefited from this project's accomplishments, because less unnecessary fertilizer application, and applications at the appropriate time, will mean less nitrate leaching into the groundwater.

This project will enable California's 4,000 plus walnut growers to decrease fertilizer use, and reduce costs, groundwater pollutants, and GHG emissions. Best estimates prior to the start of this project suggested walnut cultivation provided 70-115 more pounds of N per acre than was harvested in nuts and shells. If 20% of the remaining N were used for leaves, roots, and perennial parts, potentially 54-98 pounds of applied N were not used by the crop per acre every year. Multiplied over California's 280,000 bearing walnut acres, every year as much as 15-27 million pounds of N were available for potential leaching or volatilization. This wasted N could cost walnut growers as much as $12-23 million a year.

By assisting growers in reducing fertilizer use, this project also aimed to enable cost savings to the public by avoiding groundwater remediation and or health costs associated with contamination. Though there were no simple figures of the costs associated with remediating nitrate groundwater contamination, short-term solutions for providing clean water to the estimated vulnerable population of 220,000 in the Salinas Valley and Tulare Lake Basin would cost, at minimum, $12-33 million. Given 90% of residents of the Central Valley relied on groundwater for at least some drinking water, mitigating continued contamination of these wells could result in significant avoided costs to well users and taxpayers.

Lessons Learned

This project was very effective at engaging with growers to disseminate information about nutrient budgeting. Working closely with farm advisors in the UCCE system was critical. Starting the project with three farm advisors as collaborators, rather than just colleagues, was important both for ensuring they would find outlets for reaching growers and other industry participants and for ensuring the information was conveyed in a way that was clear and actionable to growers. Having the support of the California Walnut Board was also critical to success, in getting buy-in from grower collaborators who let the project team use their orchards, in having an annual venue to share results with other researchers, and in having an avenue through their newsletter to spread information learned.

The two biggest challenges of this project were difficult lesson to learn from. Firstly, it was very difficult to find growers willing to allow excavation of trees to analyze the entire tree for nutrient content, to scale up data from five sampling events of perennial tissue. Walnut prices were fairly high over the course of the project and none of the participating growers were willing to allow the removal of these very profitable trees. This was the difficulty of working with walnuts as opposed to almonds or pistachios, both of which are grown by among others, a few high-profile, large-scale growers who are less concerned with the loss of a few trees. There were no walnut growers who grow on a comparable scale of acreage.

Another significant challenge was personnel turn-over which led to numerous inefficiencies. This included the need to continually train new employees, search for data and samples when employees left, and restart statistical analyses left unfinished. In order to avoid this, systems for data storage and analysis dictated by the Project Manager need to be in place before the start of sample collection.

A positive unexpected outcome of this project was a related emphasis on water management, which could lead to overall better water stewardship. One of the keys to increased N use efficiency was to ensure the N applied stayed in the rootzone so that it could be taken up by the roots. Excessive irrigation can push water past the rootzone, carrying N with it. Good N management could also result in a modest reduction in water use by walnut growers.

As discussed above, not all targets of this project were met in the desired timeframe. Funding was secured from other sources to address the pending data collection and outreach and education. Outcome 1, increasing the number of walnut growers fertilizing according to the needs of the trees, was achieved, and more growers will continue to shift in their practices. If the project team had been able to excavate trees to complete the N budget before the end of the grant, the team would have been able to create tools that may have allowed for an even more rapid shift in practices. Outcome 2, increasing the number of growers sampling leaflets, was also not fully achieved due to additional sampling that will be done this year to improve the model that will be used to interpret leaf sampling results. Thus, the major lesson from the outcomes not entirely achieved in this project would either be a) set less aggressive goals or b) assess progress mid-project to know if additional time and funding is required to complete the goals of the project, even if it cannot be done in the timeframe of the first grant.

Additional Information

See attachment.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 49	**Project Title:** Developing Soil Fumigation with Reduced Application Rate in Low Permeability Tarp Mulched Raised-Bed System	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13049	**Date Submitted:** December 2016
Recipient Contact: Ruijun Qin	**Telephone:** (559) 596-2904	**Email:** Ruijun.qin@ars.usda.gov

Project Summary

California strawberry production depends highly on pre-plant soil fumigation to control soilborne diseases and weeds. Most California strawberries are grown in raised-bed systems covered by standard polyethylene (PE) film and are drip fumigated (i.e., fumigant is applied via drip lines buried in beds). Since methyl bromide (MeBr) was phased out, Telone (1,3-dichloropropene or 1,3-D) and chloropicrin (CP) have been used as the major alternatives. However, high fumigant emissions have led to increasingly stringent federal and state regulations on the use or the availability of the existing fumigants, so California strawberry growers are facing challenges in pest control. Without fumigants, the industry will suffer a serious economic loss. Good pest management tools are needed urgently to achieve optimal pest control target with reduced environmental impact.

Low permeability film (LPF), such as totally impermeable film (TIF) and virtually impermeable film (VIF), can effectively reduce fumigant emissions, improve pest control efficacy, and have the potential to allow reduced application rates in broadcast-fumigated field. However TIF performance in drip-fumigated, raised bed system has not been evaluated sufficiently for the pest control efficacy and the emission potential. The objective of this project was to demonstrate the most efficient pest control tool in raised-bed fields through measurements of soil fumigant distribution, pest control efficacy, fumigant emission, and strawberry production under LPF. The overall goal was to help California strawberry growers increase fumigant use efficiency by using less fumigant for good pest control and reduced environmental impact to comply with environmental regulations.

USA is the top nation producing nearly 30% of the world's strawberries. California is the leading state producing 82% of USA's strawberries. More than 2.1 billion pounds of California strawberries were harvested in 2011 with a value of $2.0 billion. The productivity and the economic sustainability of the strawberry industry in California are highly dependent on preplant soil fumigation to reduce pest infestation. In 2009, approximately 0.53 million ton of 1,3-D and 1.76 million ton of CP were used in California strawberry industry. Most fumigants used for strawberries are applied through drip fumigation in raised-bed system. With the loss of MeBr and the increasingly stringent regulation on the use of fumigants, critical pathogens and weed problems have increasingly impacted California strawberry production. This project seeks solutions to multiple challenges by using low fumigant rates with LPF in raised-bed systems to improve fumigation efficacy, reduce emission, and increase production. The field data will provide information for the strawberry growers on how to effectively use fumigants and LPF and will help strawberry growers comply with fumigant emissions regulations. The project will impact directly more than 21,100 acres of California strawberry fields that are using raised-bed production systems with drip fumigation and will benefit the economic and environmental sustainability of the California strawberry industry to maintain the leading position in domestic and international strawberry market. This project will also benefit other annual high-value specialty crop growers who grow crops in raised-bed production system with drip fumigation. In the long run, this project will benefit the state by reducing the air pollution from soil fumigant use.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

During the entire grant period, the research team held regularly scheduled project meetings and had many informal meetings to facilitate project management, solve emerging problems, and maintain effective communications. The research team communicated frequently with other project participants, e.g., growers and fumigation industries to ensure the success of the field trials.

There were two large scale field trials conducted in growers' fields. The first one was conducted from September 2014 to July 2015 at a farm located at Camarillo, California. The second one was conducted from September 2015 to June 2016 at a farm located at Oxnard, California. Since quite a large portion of the fields were neighboring a residential area, the air quality is being strictly regulated, especially regarding fumigant emission because large quantities of fumigants are used in the area every year for strawberry production. Therefore, the grower needed to use LPF in the fields to minimize the fumigant emission in their raised-bed production systems. Meanwhile, the fields suffered from pathogen problem, such as Fusarium. The weed problem was also a critical issue. The selected field status could well represent a typical coastal strawberry production region, where growers are facing big challenges in the air pollution and pest pressure.

In the trials, the farm crew helped the research team prepare soils, set-up raised beds with drip tapes installed under soil surface, and cover the beds with either LPF or regular PE film for experimental purposes. The fumigant was applied in September 2014 for the first trial and in September 2015 for the second trial. In the trials, different films (LPF and PE), different fumigant rates (non-fumigation control, full rate, and half rate fumigant), and different application methods (traditional two drip lines, new four parallel drip lines) were tested. (In the second trial, new two shallow plus two deep drip lines were added).

During the soil fumigation period in each trial, the research personnel of the University of California, Davis (UCD) and the United States Department of Agriculture – Agricultural Research Service carried out field sampling intensively. The measured parameters include fumigant emission, fumigant distribution in soil profile, fumigant under film above soil surface, residual fumigants, and pathogens in soils. The research personnel from the University of California, Agriculture and Natural Resources and UCD prepared pathogen and nutsedge bags and buried the bags in the field in order to determine the fumigation efficacy on pest control.

One month after fumigation, the farm crew of the cooperating growers transplanted strawberry plants. Then, throughout the strawberry growing season, research team evaluated regularly pest control results, crop growth, and crop production in response of different treatments.

The lab analysis and data processing on proposed parameters were conducted intensively in each lab of the research team.

The project did not enhance the competitiveness of non-specialty crops. The project was designed primarily for benefiting the California strawberry industry which produces >80% of the USA strawberry fruit. Most California strawberries are produced in plastic tarp mulched raised-bed production systems with drip-fumigation for pest control. However, fumigant emission concerns are driving many regulatory decisions that may impact productivity and economic viability of California strawberry. This research evaluated and demonstrated the impacts of alternative fumigation strategies on fumigant behaviors in soil profile, pest control, strawberry production, and fumigant emissions in LPF covered raised bed systems. The information developed and the technology transfer efforts from this project can help the California strawberry industry maintain soil fumigant availability and ensure the leading position in both domestic and international markets.

The team members have successfully conducted soil fumigation research in specialty crops for ten years and have excellent records in conducting collaborative projects.

Throughout the project period, the project director has been in charge of the overall project management and ensured that all project tasks were conducted in a timely manner. The research team has regularly scheduled project meetings and more informal communications to monitor project progress.

The research team has successfully carried out two large scale field trials in growers' fields; processing all field samples and analyzing data on fumigant emissions, fumigant movement in soil, and soil residue fumigant.

The cooperating growers and their farm crew have provided strong support on preparing fields, monitoring the field trials, maintaining strawberry growth, and harvesting the crop. Two companies have provided fumigation services including materials and application services.

Goals and Outcomes Achieved

Two large scale field trials have been carried out successfully and all the samples have been processed and the data have been analyzed within the grant period. Based on the data of two field trials, the following outcomes have been achieved:

1) Low permeability film significantly reduced fumigant emissions from film covered raised-beds as compared to PE film. The peak emission flux was ≤ 5 μg m^{-2} s^{-1} from VIF covered beds (10 times less than that from PE covered beds) in the first trial and ≤ 0.5 μg m^{-2} s^{-1} from TIF covered beds (100 times less than that from PE covered beds) in the second trial. Drip tape layout did not impact fumigant emissions in general. The fumigant emissions from uncovered furrow were extremely low regardless of film type, drip tape number, and application rate, suggesting that emission from furrows should not be a concern.
2) Low permeability film retained much higher fumigant concentration than the PE film. When reducing the application rate to 50%, the fumigant concentrations under LPF is still superior to (or comparable to) the fumigant concentration under PE, indicating that the LPF covering may help growers reduce fumigant application rate and correspondingly further reduce environmental pollution. In general, the PE beds with conventional full rate fumigant did not provide satisfactory pest control results in both trials because of the high emission loss resulting in insufficient fumigant dosage for pest control. In some cases, the VIF or TIF covered beds with half rate also did not show complete pest control results, because of insufficient fumigant dosage or non-uniform fumigant distribution for pest control.
3) Both trials showed that fumigant distribution was not uniform with the conventional 2-drip tape layout even under LPF. The new 4-drip tape layout showed promising results in improving fumigant distribution

in comparison with the 2-drip tape layout. Therefore, using LPF and increasing drip tape number can be the optimized fumigation technology for achieving optimal pest control result and fumigant emission control targets.

4) The residual fumigant level was very low at the end of field monitoring [i.e., one week or ten days after the Tri-Clor fumigant (200 lb ac^{-1}) was applied]. As their normal procedure, after the soil fumigation period, growers will wait for a few weeks and then transplant strawberry in the fields. Therefore, the risk of the phytotoxicity should not be a concern.
5) Corresponding to the fumigant distribution results, the LPF treatments provided better weed control and pathogen control results than PE treatment or non-fumigated control. The four drip tape layout further improved pest control results than the two drip tape layout.
6) Field measurements showed that the canopy size was generally lower in the non-fumigation control. The berry production was higher in the treatments with full rate fumigant under LPF than other treatments. The 4-drip tape layout further improved berry production than the 2-drip tape layout. However, leaf greenness index and leaf conductance in general was not different among fumigation treatments.

Besides the research activities, intensive outreach activities have been conducted as follows:

1) The research findings have been presented intensively at various extension meetings and field days (e.g., Southern California Association of Pest Control Advisers meetings, Central coast strawberry meetings, the 1st Soil Management Meeting in California, the 2015 North American Berry Conference/ 8th North American Strawberry Symposium), with over 1,000 people in attendance including growers, scientists, California Strawberry Commission members, industry representatives, and governmental agencies.
2) The research findings have also been presented at Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions with over 500 people in attendance including growers, international scientists, students, California Strawberry Commission members, company representatives, and governmental agencies.
3) The research findings have been presented at American Society of Agronomy, Crop Science Society of America, Soil Science Society of America International Annual Meetings, and the American Society for Horticultural Science Conferences. There were over 10,000 people in attendance including international scientists, students, and company representatives.

As a result, the techniques have been presented to the many growers in the California strawberry industry during the entire grant period. The extension results will be further improved beyond the grant performance period, based on new extension presentations and publications.

Beyond the grant period, the research team will develop more presentations and publications based on the research findings from this project. Therefore, it can be expected that the research findings will be adopted by the California strawberry industry quickly. In the long-term, this project will be a benefit for improving air quality because of dramatic reduction of fumigant emission loss, reducing the growers' costs due to improved fumigant use efficiency, helping growers maintaining the availability of fumigant use for pest control, and promoting the understanding of soil fumigant for growers and publics.

The goals established for the reporting periods included 1) carrying out two large-scale field trials to determine a) the effective fumigant rates in TIF beds with improved efficacy on the critical pest control and good strawberry production, b) lethal fumigant dosage values on inoculum of several main pathogens, citrus nematode, and weeds being buried in raised-beds, c) fumigant emissions from tarped beds and from uncovered furrows, d) fumigant concentration change during fumigation period and soil residual fumigant at the end of fumigation, e) the field performance of recycled plastic film; 2) carrying out extension activities to the strawberry industry in a timely manner, i.e., initially to the collaborating growers and their neighbors and expanding to more than 200 growers and interested stakeholders by the end of the grant period, as well as presenting data to scientists and regulators at international conference and publishing papers; 3) extending the research findings to the whole California strawberry industry within a few years after the grant performance period.

The actual accomplishments from the project are 1) two large-scale field trials have been conducted in southern coastal area, which can represent the coastal region of California, as the strawberry industry is faced with similar challenges. The actual accomplishments are a) the full rate (~200 lb/ac Tri-Clor) fumigant under LPF provided optimal pest control result and strawberry production, while the half rate fumigant under LPF showed comparable results as the full rate fumigant under PE; b) the LPF treatments, especially with the full rate, provided effective control of the most critical pathogen, fusarium, and the most difficult weed, nutsedge; c) LPF dramatically reduced the fumigant emissions from tarped beds while the emissions from uncovered furrow were not a concern; d) fumigant concentrations in soil profile were well determined and the LPF covering showed much higher fumigant concentration than the PE covering; e) trace level of residual fumigant level was detected at the end of fumigation monitoring period (7-10 days). Since growers normally wait for several weeks after fumigation before transplanting, the crop phytotoxicity from residual fumigant will not be a concern; f) the recycled plastic film was not included in the trials because the film was not available from the manufacturer. However, since this film was made mainly of used PE film, it is not recommended to be used for soil fumigation purpose due to the similar issues (high emission loss and unsatisfactory pest control) as PE film; g) based on field observations of extension specialists, the conventional 2-drip tape layout showed unsatisfactory pest control at the bed shoulder or bed center. To solve this emerging problem, the project team proposed and tested a 4-drip tape layout in the field trials, which further improved pest control result than the 2-drip tape layout because improved fumigant distribution was achieved. 2) Intensive extension activities have been carried out. The research findings have been delivered to the collaborating growers initially and expanded to over 1,000 growers and interested stakeholders throughout the coastal areas by the end of the grant period. 3) The research findings have been delivered to scientists and regulators, several international conferences such as Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America International Annual Meetings, and the American Society for Horticultural Science Conferences. 4) The research findings have been distributed widely to the California strawberry industry by the end of grant period. For example, most growers have adopted LPF since the growing season of 2015. Starting from the collaborating growers, an increasing number of growers are adopting the multiple drip fumigant technology. 5) Based on research findings, two or more publications will be achieved beyond the grant period.

1) Before the project, there was no comprehensive data available for evaluating the LPF performance in soil fumigant behavior (especially regarding fumigant distribution in soil profile), pest control results, and strawberry production. The outcome of this project filled the knowledge gap very well.
2) Before the project, growers rarely use LPF because of the knowledge gap and higher price. Based on the research findings of this project, almost all growers have used LPF in their fields because of the excellent fumigant emission control and improved pest control results since the growing season of 2015.

3) The LPF covering improved fumigant distribution, pest control, and berry production than the PE covering or non-fumigant control.
4) With the broad adoption of LPF, the fumigant emission can be reduced >90% of that from PE covered beds.
5) The LPF covering allow growers to reduce fumigant rate 50%, which may still show similar pest control results as a full rate fumigation under PE film.
6) This project provided a novel soil fumigation strategy by increasing drip tape numbers to improve soil fumigant distribution.
7) An increasing number of growers are adopting the multiple drip fumigation technology based on the research findings of the project.

The major successful outcomes of the projects include: 1) this project provided timely information in soil fumigation under LPF, 2) the project encouraged most growers to use LPF in their fields, 3) >90% fumigation emission has been controlled by LPF in comparison with PE, which will further improve environmental quality, 4) the adoption of LPF will allow growers to reduce fumigant application by 50%, if the current application under PE can achieve the desired pest control results in their fields, 5) this project showed a novel and improved fumigation strategy by increasing drip tape numbers under LPF.

Beneficiaries

The project is mainly for the benefit of the California strawberry industry. Most California strawberries are produced in PE film covered raised-bed production systems with drip-fumigation for pest control. However, fumigant emission concerns are driving many regulatory decisions that may impact productivity and economic viability of California strawberry. Meanwhile, growers are facing challenges in controlling critical pests such as fusarium and nutsedge.

This project evaluated and demonstrated the optimized fumigation strategy with LPF covering and/or 4-drip tape layout on pest control, strawberry production, fumigant distribution, and fumigant emissions in raised bed systems. The information developed and the technology transfer efforts from this project may help the California strawberry industry maintain soil fumigant availability and ensure the leading position in both domestic and international markets.

The comprehensive field data was collected in the typical strawberry soils in coastal region of California, which represents the most important strawberry production areas in California. The research findings have been delivered to the strawberry industry in a timely manner, i.e., initially to the collaborating growers and their neighbors and expanding to over 1,000 growers and interested stakeholders by the end of the grant period through various extension efforts. The data has been presented to scientists and regulators at the international conferences. By the end of grant period, most growers have utilized LPF in their fields and an increasing number of growers are adopting the 4-drip tape layout in their fumigation practices. The optimized fumigation technology from this project will help growers maintain the availability of soil fumigant, meet the regulatory requirements in fumigant emission control, avoid crop loss/failure from critical pest pressure, and reduce fumigant material costs. As a consequence, the California strawberry industry will still maintain the leading position in both domestic and international market. In the long run, this project will be a benefit to the air quality of California because of significantly reduced fumigant emission.

Lessons Learned

Several important factors contributed to the success of the project: 1) Good research team ensured the success of the project. This project is based on comprehensive research/extension activities including multiple subjects such as soil fumigant behavior, pest control, and crop productions. Meanwhile, both research and extension specialists are very important in this project. 2) Good communication among the research team and with collaborators allows the research team to achieve the optimal results. 3) Good soil preparation is the key factor in securing the success of the soil fumigation. In this project, both growers' farm crew prepared the soil very well. As a result, the good performances of LPF were well showed in the experiments. However, in case that the soil is not well prepared (e.g., the soil is too dry with many large clods), the LPF properties might be damaged and the performance of LPF might be compromised. 4) Good and sustainable performance of film is critical in retaining fumigants in soil, reducing fumigant emission, and improving pest control results and berry production. Ideally, it is necessary to have the film permeability information (before use and after 7-10 days field use) for all the available films in the market, which will help growers and regulatory agencies in selecting the right type of films and achieve the optimal fumigant emission control target. 5) Flexibility is important for conducting a successful project. For example, in this project, the recycled plastic film was dropped because it was not available. Meanwhile, based on the actual field status, the research team proposed and tested 4-drip tape layout which further improved soil fumigation results in comparison with the conventional 2-drip tape layout. 6) More field data should be collected for optimizing the 4-drip tape fumigation technology and for facilitating the adoption of this new technology. 7) As the currently available fumigants, e.g., CP and/or 1,3-D are not well distributed in the soil profile. New fumigants or fumigant application method should be studied to assure the ideal pest control targets.

Almost all the expected outcomes or results have been achieved in the project. Two major changes were made to the project due to logistical issues or updated research results. 1) The recycled plastic film is not available from the manufacturer and was dropped. Currently the production of this recycled film is stopped because the company needs to go through the environmental assessment process. Since this film is mainly made from recycled PE collected from field, its performance in soil fumigation is expected to be similar to PE. Thus, lack of this film does not have significant impact on the emissions and pest control aspects of the project. 2) 4-drip tape layout were added in the project, such as 4 parallel drip tapes or 2 shallow plus 2 deep drip tapes, with the target of improving fumigant distribution and pest control results. The new drip tape layout shows superior results compared to the conventional 2-drip tape layout. This modification further improves the soil fumigation technology, which is one of the major outcomes of the projects.

The goals and outcome measures were achieved successfully in the project.

Additional Information

A few represenative presentations are included here. Being the farm advisor of strawberry and vegetable crops, the co-PI has played a very important role in delivering the extension results by using various methods (e.g., field visits, informal meetings and communications with growers, orgainzing extension meetings and field days, and delivering information at various meetings.) The publications are being developed by the research team and they are expected to be available beyond the grant period.

Qin, R., O. Daugovish, S. Gao, J. Gerik, T. Gordon, H. Ajwa, and B. Hanson. 2016. Improving drip fumigation for strawberry production in California. *University of California Cooperative Extension*

Ventura County Workshop: Fumigants and non-fumigant alternatives: regulatory and research updates. Ventura, CA, April 2016.
Qin, R., O. Daugovish, S. Gao, J. Gerik, T. Gordon, H. Ajwa, and B. Hanson. 2016. Soil fumigation with multiple drip tapes in low permeability film covered raised-bed systems. *1st Soil Management Meeting*. Salinas, CA, February 2016.
Qin, R., O. Daugovish, S. Gao, B. Hanson, and J. Gerik. 2015. Optimizing fumigation efficiency by doubling drip line number and using low permeability film in raised-bed production systems. ASA, CSSA & SSSA 2015 International Annual Meetings. Minneapolis, MN.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation efficiency by increasing drip-tape number and using low permeability film in raised-bed production systems. American Society for Horticultural Science Annual Conference. New Orleans, LA.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation technology by doubling the number of drip tapes in raised-bed production systems. *University of California Cooperative Extension Ventura County Workshop: Fumigants and non-fumigant alternatives: regulatory and research updates.* Ventura, CA.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation technology in raised bed strawberry production systems. *2015 North American Berry Conference/ 8th North American Strawberry Symposium.* Ventura, CA.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.:	Project Title:	
50	Towards Sustainability of Lettuce Production through Breeding Approaches to Increase Water and Nitrogen Use Efficiency.	
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Recipient Contact: David Still	**Telephone:** (909) 869-2138	**Email:** dwstill@cpp.edu

Project Summary

Lettuce crops are the sixth, most valuable commodity and are harvested from more than 206,000 acres of land in California, but lettuce requires a dependable supply of high quality water and relatively high amounts of nitrogen fertilizers to produce a marketable crop. Water is becoming a less predictable and scarce commodity in California due to global warming. Allocations from a limited water supply are made to urban areas and the environment, resulting in less water available to support agriculture. Ironically, the nitrogen fertilizers used to produce crops volatilizes to nitrous oxide, a potent greenhouse gas, which further drives global warming. Nitrogen has other environmental impacts, including nitrate leaching, which has the potential to contaminate groundwater and drinking supplies. Developing lettuce cultivars that use less water and nitrogen will ensure the sustainability of this crop in California while mitigating environmental impacts.

California supplies the United States with approximately 76% of the commercially produced lettuce. It is a valuable commodity for this state with a farm-gate value of $1.5 to 2 billion annually. It is planted or harvested on 753 farms every day of the year. In addition to the farms that produce the crop, many allied commercial enterprises specialize in pre-harvest and post-harvest activities and processing that are needed to bring the crop to consumers. Thus, the economic impact of this crop is greater than the $2 billion farm gate value. Climate models predict more severe and prolonged droughts for California. The amount of nitrous oxides from fertilizers is underestimated by several-fold. To ensure lettuce production remains a viable industry in the state, the crop must be adapted to use less water and nitrogen fertilizers.

This project was the beginning steps to develop lettuce cultivars that are adapted to lower water and nitrogen inputs. Because the beginning and end of droughts cannot be predicted, coupled with a typical sever to eight year lettuce breeding cycle, developing lettuce cultivars with better water and nitrogen use efficiencies could not have been delayed.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The overall goal of this project was to determine the variation in water and nitrogen use efficiency in lettuce germplasm grown under limited water and nitrogen and to identify quantitative trait loci (QTL) associated with these traits.

Detailed field studies were conducted followed by genetic analyses to establish the association between QTL and water use efficiency (WUE), nitrogen use efficiency (NUE) and components of these traits (yield, carbon (C) and nitrogen (N) concentration, C and N isotope discrimination). This study established QTL markers based on single nucleotide polymorphisms and can be utilized by other researchers and breeders to develop cultivars with improved WUE and NUE using their own proprietary materials. Conducting a multi-year study at two locations provided knowledge of trait stability across environments and indicated the complexity of both WUE and NUE.

In each of the three years, a recombinant inbred line (RIL) population was grown that consisted of 152 F10 families that was developed from single seed descent from a cross between cv. Diplomat and cv. Margarita, an iceberg and butter head type, respectively. A total of 30 cultivars were grown as commercial checks in each production year and location. The RIL population was evaluated under two different water/N treatments, a non-limiting high water/high N and a limited water/limited N treatment (130% ETo/100%N and 65%ETo/50%N, respectively).

Horticultural quality, yield and physiological status were evaluated on plants grown under both water/N treatments. This included assessment of 152 RIL families and 30 commercial cultivars. No difference in quality was observed between the high water/high N and limited water/limited N treatments. Specifically leaf color, tipburn and premature bolting did not differ between treatments.

Yield at market maturity was measured in each of the three years for both treatments. In year 1, there were no differences in yield between the genotypes produced under high water/high N and those produced in limited water/limited N. In year two, the yield was greater in those produced under limited water/limited N, whereas in year three, yield was higher in the high water/high N treatment.

Water stress was assessed using isotope analyses of 13C. C isotope discrimination (Δ13C values) is a measure of the amount of stress experienced by the plants due to limited water availability and is integrated over the entire crop cycle. In each year of the study, there were no differences in Δ13C values between the high water/high N and limited water/limited N treatments. This indicates that despite receiving half the water, plants grown under the limited water/limited N (65% ETo/50% N) treatment did not experience stress due to water deficit. This was a surprising finding since measurements of soil water potential were substantially lower in the low water treatment plots, indicating less water available.

Water use efficiency was defined on a whole plant basis, with the amount of biomass produced per unit of water applied (grams of fresh weight at market maturity per cubic meter of water applied). From that perspective, plants grown on the limited water/limited N treatment had 64, 51 and 55% greater WUE for Years 1, 2 and 3, respectively, than those grown in the high water/high N treatment.

N use efficiency can be expressed as the amount of yield per N applied (grams of fresh weight at market maturity per Kg N applied). By this measure, plants grown under the limited water/limited N treatment had 47, 51, and 55% greater NUE for Years 1, 2 and 3, respectively, than those grown under the high water/high N treatment. N use efficiency can be observed at a cellular/tissue level by obtaining the C and N content of oven-dried plants and obtaining the ratio of C concentration to the N concentration. Using this measure, the plants grown under limited water/limited N had higher C:N ratios in all years, but were statistically significant in year 2 and year 3, but not year 1.

N use efficiency is affected by two mechanisms, 1) root uptake and transport to leaves and 2) assimilation into organic N in leaves. The leaf N concentration reflects this efficiency. The N concentration in leaves was

higher in plants grown under the high water/high N treatment than the limited water/limited N treatment in all years, but was statistically different in year 2 and year 3, but not year 1.
The mechanisms plants use to uptake and assimilate N depends on the concentration and form (ammonium versus nitrate) in the soil. Based on these results and other experiments performed in the lab, project staff postulate that the 15N isotope discrimination reflects different N forms and concentrations in the soil and metabolism used by lettuce under different N field conditions. The leaf 15N values from plants harvested at market maturity were 1.8, 1.9 and 2.2 times higher in the plants grown under limited water/limited N treatments compared to the high water/high N treatment plants.

The experiments utilized a recombinant inbred line of lettuce for the purpose of identifying and mapping QTL associated with water and N use efficiency. In each of the three years, QTL were identified and mapped for C and N isotope discrimination (Δ13C, 15N), C and N concentration, WUE and NUE. Significantly, a portion of the QTL were identified under the limited water/limited N treatment but were not present in the high water/high N treatment. This supports the previous observation that lettuce uses different mechanisms to grow under limited water/limited N than it uses to grow when water and N are abundant. Importantly, project staff observed in three genotypes, 86% of the leaf N under limited water/limited N than the best performing genotypes that were grown in high water/high N conditions.

The research conducted, specifically and directly, benefited the economic competitiveness of lettuce and no other commodities.

Two of the three lettuce crops were produced at the Yuma Agriculture Center, which is located in the center of the low desert lettuce production area. Their farming methods, climate and soil are similar to those that affect the commercial growers that operate in the low desert production area, ensuring the results obtained by this project are widely applicable to the industry.

Goals and Outcomes Achieved

The Diplomat x Margarita RIL was grown in three production years and the water use and N use efficiency assessed at market maturity. Field performance was evaluated on the RIL population grown under high water/high N and limited water/limited N conditions.

Water and NUE were assessed using C and isotope discrimination. WUE and NUE were assessed at a whole-plant level using yield per unit of water or N applied. Isotope discrimination revealed physiological mechanisms used by the plants when grown under the high water/high N and limited water/limited N treatments.

Growing the RIL population over three years and two different areas provided assessment of the environmental stability of QTL associated with WUE and NUE and the components of WUE and NUE.

Matching funds allowed the project to develop and utilize a new genetic map and provided the basis for developing genetic markers that are anchored to the lettuce physical map and genetic maps published by other labs. Through the activities described above, each of the expected measurable outcomes were achieved. Specifically, QTL associated with WUE and NUE using two different metrics were identified. One major QTL associated with WUE explained 24% of the variation, and two QTL associated with NUE and leaf N concentration was identified. There are no published reports of QTL associated with WUE, NUE or N concentration.

The data from this project support the conclusion that N metabolism varies quite significantly from one environment to another (field or year). The N isotope discrimination differences between the high and limited N treatments clearly indicate lettuce plants use different metabolic and mechanistic pathways to translocate and assimilate N. This work establishes the markers that are associated with WUE, NUE and the components that contribute to these traits. This work establishes methodologies for conducting WUE and NUE studies in lettuce and WUE and NUE germplasm benchmarks for lettuce researchers and breeders.

Each year, three to five undergraduate students were trained. For harvests and sample preparation, the number of students involved was as high as nine. The students learned how to organize a large project for planting, harvesting, and sample preparation. Others learned to calculate and implement irrigation based on ET, how to calculate and apply the correct amount of water and fertilizers, how to harvest and prepare samples, collect, organize, analyze and display data.

Each year of the project, a postdoc was involved in overseeing and organizing the project. The postdoc was likewise trained in the field components of the project and devised and implemented the postharvest data collection and isotope analyses. The postdoc constructed the genetic map, identified and mapped QTL, assisted and presented data for meetings and is currently involved with preparing a manuscript.

The results of this project were presented through outreach activities including oral presentations and posters presented at grower/industry conferences. Presentations to the Annual Research Conference of the California Leafy Green Research Board (CLGRB) on: 18 March 2014; 17 March 2015; 15 March 2016. Each year the conference was held in Coalinga, California and each conference included 150-200 growers and industry personnel from the lettuce industry.

Each year oral presentations were made at the field day held at the United States Department of Agriculture, Agricultural Research Service station in Salinas, California on 8 October 2013, 7 October 2014 and 6 October 2015. At each meeting, approximately 20-30 industry and CLGRB members attended.

Poster presentations were made at academic conferences:
Breeding lettuce to increase nutritional content across multiple environments. Plant and Animal Genome Conference, XXIII, San Diego, California. January 13, 2015.

Breeding lettuce for improved water and N use efficiency. Plant and Animal Genome XXIV Conference, San Diego, California, January 9-13, 2016.

Toward improved water use and N use efficiency in lettuce: mapping QTL associated with N and water use efficiency. Poster presented at the American Society of Plant Biologists Annual Meeting, Minneapolis, Minnesota, 26–30 July 2015.

The outcomes achieved in this project represent the first steps to develop the tools and knowledge needed to improve WUE and NUE in lettuce. The release of lettuce germplasm with these improved traits by public and industry breeders is several years into the future but will be based on this and similar research.

The long-term goals of this project are to improve WUE and NUE in lettuce through genetic improvement. To achieve this, the tools in form of DNA-based markers and knowledge of the physiology, morphology, biochemical pathways must be understood. Ultimately, genes must be identified that can be targeted that can materially improve WUE and NUE.

To that end, a series of short-term goals were set forth and achieved. The goals of this project were to: Identify quantitative trait loci associated with WUE and NUE. Project staff discovered multiple loci that are associated with WUE and NUE.

Assess the environmental stability of these QTL. The experiments were performed across three different years and two production locations. The data clearly indicated environmental effects on the QTL with some loci being present every year while other loci were not. Further, QTL were present in one treatment or the other, indicating different mechanisms used by lettuce to adapt to limited water/limited N. Thus, project staff fully accomplished the goals set forth for the project.

This project establishes the baseline data by identifying loci associated with NUE and WUE using both isotope discrimination and whole-plant methods. It establishes DNA-based markers that can be used by public and industry breeders in their WUE/NUE breeding program. It establishes baseline data for both WUE and NUE under high water/high N conditions that the industry uses, as well as baseline data for lettuce produced under limited WUE and NUE.

Highlighted accomplishments are: Multiple quantitative trait loci associated with WUE and NUE were identified. One QTL associated with WUE accounted for 24% of the variation. A second QTL associated with NUE was identified that accounted for 17% of the variation. A third QTL was identified with N concentration that accounted for 17% of the variation in the population. DNA-based markers were established that will facilitate breeding for improved NUE and WUE. Baseline data was established for WUE and NUE based on industry practices and under limited water/limited N inputs. Biological and genetic insight was gained from the isotope experimental approach that will establish the basis to more fully understand how to improve lettuce and directly identify the genes underlying the QTL identified in this project.

Beneficiaries

Public and industry researchers will benefit from this project since it provides methodology for studying WUE and NUE and establishes baseline data based on whole-plant and isotope analyses. Public and industry plant breeders will benefit from this project since it identified loci and developed molecular markers that can be used to develop germplasm. The long term beneficiaries will be the lettuce industry and growers across 750 farms in California that are commercial producers of lettuce. This research will lead to producing lettuce using less water and N over 206,000 acres, and lower the environmental footprint of lettuce production.

Lessons Learned

Irrigation management was a key component to this research project that project staff accumulated expertise in over time. Remote sensing of soil and plants would have added an additional layer to interpreting the results. Augmented experimental designs were important to keep the project costs down while screening the large number of entries needed to develop genetic maps and identify QTL.

The complexity and environmental variation of the N cycle in the field and N metabolism in the plants was unexpected but all project goals were accomplished.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 51	**Project Title:** Biobased Matrix with Encapsulated Microbes as Substitute for Synthetic Fertilizers and Pesticides	
Grant Recipient: United States Department of Agriculture, Agricultural Research Service	**Grant Agreement No.:** SCB13051	**Date Submitted:** December 2016
Recipient Contact: Charles Myers	**Telephone:** (510) 559-5769	**Email:** Chuck.myers@ars.usda.gov

Project Summary

To obtain higher specialty crop yields, U.S. farmers have increasingly become dependent on synthetic fertilizers and pesticides. Use of these chemicals over the past decades has severely diminished the quality and quantity of beneficial microbes in soil as well as their capacity to carry out useful biological activities. These microbes secrete enzymes and other useful compounds that help plants fix nitrogen, produce humic acids, and solubilize sulfates, phosphates, and potassium. However, these microbes exist in low concentrations in soil due to increased chemical use. Also, only 30-40% of applied fertilizer is used by plants. The rest is lost and contaminates the environment. A novel matrix (U.S. Patent #8865214 B1) has been developed by U.S. Department of Agriculture scientists in Albany, California to encapsulate these microbes. This product contains selected naturally-occurring soil microbes encapsulated in a bio-based porous matrix made from gypsum and starch. Preliminary green house and small-scale field trials (one acre) have shown improved plant growth and yields. These matrix formulations can be used to stop and reverse the deterioration of agricultural soils caused by continuous use of fertilizers and pesticides and offer an environmentally-friendly alternative to the synthetic chemicals. The objectives of this project were to (1) further develop matrix formulations with encapsulated microbes for use on onion, strawberry, and tomato crops, (2) develop pilot scale production capabilities to produce the matrix formulations, and (3) conduct field trials with onion, tomato, and strawberry growers.

The use of bio-based matrix formulations directly aligns with the goal to implement beneficial management practices that improve farm viability and the agricultural economy as well as the environment. The use of matrix formulations is a beneficial management practice because if successful, it could result in overall higher specialty crop yields, better soil health, more sustainable agriculture, and it would help reduce the impact of agriculture on the environment. Since the encapsulated microbes may survive for more than one growing season, only a few applications may be necessary to be effective. This is an advantage over fertilizers which are typically applied multiple times during a crop growing season. The exploitation of beneficial soil microbes should improve farm viability and the agricultural economy. In addition, the replacement of fertilizer by the matrix formulation reduces environmental contamination from farming. The heavy use of fertilizers in agricultural regions of California is thought to be an important contributor to elevated nitrates in ground water. Using less fertilizers will reduce the overall amounts of nitrate fertilizers that percolate through the soil profile and into the ground water reserves.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

There were three objectives to the project. Objective 1 was to further develop matrix formulations with encapsulated microbes for use on onion, strawberry, and tomato crops. Objective 2 was to develop pilot-scale production capabilities to produce the matrix formulations. Objective 3 was to conduct field trials with onion, tomato, and strawberry growers. Initially, this work was to have been done in close association with a specific supplier of beneficial soil microbes. When it became apparent the initial company was unable to cooperate on the project, other suppliers (Flozyme Corp., Biogro, and Sentinel) were contacted to participate as suppliers for the project and efforts began to isolate phosphorous solubilizing bacteria that could be used to reduce the fertilizer requirement for phosphorous in crop growth.

A key milestone was to scale-up the manufacture of the starch/gypsum matrix material. The matrix material was originally made using an extrusion process. However, an agglomeration process was tested and found to be very effective for making the encapsulated granules. Agglomeration is inexpensive and very easy to scale-up with minimal capital costs. The milling equipment requested in the original proposal was not needed for the agglomeration process used for this project so the equipment was not purchased. The research trials were conducted on research farms instead of grower fields as originally planned for two reasons; the farmers that project staff spoke with were not equipped to run multiple treatments with replicates and the new suppliers' products were still not certified for commercial use in California. Two tomato trials and one onion trial were conducted at a farm in Escalon, California. Mineral analyses were performed. A second onion trial and two strawberry trials were performed at a research farm located near San Luis Obispo, California. Soil analyses were performed before and after the growing season.

There were several considerations that determined the approach to field trials. As mentioned earlier, the supplier of beneficial microbes that had originally agreed to collaborate on the project and had done extensive field trials in California stopped operation for two years just as the project got underway. Other suppliers were found to supply the microbes for the project. A second supplier stopped operations soon after supplying microbes for the first trial. In short, this industry sector is quickly developing and changing. A program was initiated in the laboratory to isolate beneficial soil microbes and test them in the greenhouse as a hedge against other suppliers halting production.

Fertilizer-treated controls were run in all of the trials. This was done to know whether the microbial treatments boosted the production compared to the controls without microbes. Various treatments were also run of the liquid mixtures of microbes that were encapsulated in the starch/gypsum matrix material. This was done to establish that the liquid microbial product was indeed effective and to determine whether the matrix material would be as effective as the liquid.

In the initial tomato trial, microbial products from Inogro and Sentinel Biologix were tested. The microbial products were encapsulated in the starch/gypsum matrix using the agglomeration process described earlier. The tomato trial included both the liquid product that was encapsulated in the matrix material and the matrix material itself. This trial was designed to show how effective the liquid product was in reducing fertilizer requirements compared to the matrix encapsulated product. Humic acid that did not contain any microbial additives was also tested as a control since the Inogro product had humic acid as a carrier. The humic acid control was included to determine the effect of humic acid itself on the crop production. This trial also contained an autoclaved liquid product in which all of the microbes were killed. Since the primary goal was to determine whether the treatments could reduce the fertilizer requirement, fertilizer levels of 0%, 50%, and

100% were tested. Liquid treatments were actually applied first to the greenhouse seedlings. Since the seedlings were being transplanted into the field, it seemed reasonable that by inoculating the soil in the greenhouse would lead to a better result in the field when the transplant and its soil ball were planted in the field.

The results of the first tomato trial were surprising. There were no significant treatment effects detected, even among the controls receiving a range of fertilizer from 0% to 100%. Overall, the amount of variation in the data precluded any hope of seeing any treatment effects. The most telling data was for the control samples that received no treatment other than the fertilizer treatment. The mean yield for plots receiving no fertilizer was actually higher than for the plots receiving 100% fertilization. The result could be indicative of a very high nutrient content in the field to start the experiment such that there was very little additional response on plots that received additional fertilizer. The soil analysis taken before the tomatoes were transplanted into the field showed a high level of phosphorous and potassium and moderate levels of nitrogen. The farm manager indicated that a preplant fertilizer had been applied to the field in early spring. This could have been responsible for the poor fertilizer response observed. The excessive variation in the data also made it difficult to detect treatment differences. The decision was made to run a second tomato trial on plots that had received no preplant fertilization.

A second trial for tomatoes was started March 2015. The trial was conducted at an agricultural research farm near Escalon, California, on Sunseed 6366 variety of processing tomato. The experimental design was simplified by using only nine treatments. The treatments included controls receiving 0%, 40%, 70%, and 100% fertilization. The microbial treatment was a product called Bontera. This product was tested since the Inogro and Sentinel products were no longer available. The Bontera liquid microbial product was encapsulated into the starch/gypsum matrix. The matrix was tested at three levels of fertilization (0%, 40%, and 70%) while the liquid material was tested at two levels of fertilization (40% and 70%). The tomato seedlings were first treated in the greenhouse to inoculate the soil that would be placed into the field along with the tomato transplants. The seedlings were transplanted into the field on April 10, 2015. At the time of transplanting the seedlings, the matrix treatment was first applied into each transplant hole of the appropriate treatment and mixed well before adding the seedling. Liquid Bontera was added to the transplant hole at the time of transplanting only for the liquid treated plots. Additional Bontera liquid applications were made to just the plots with the liquid treatment. The liquid treatment was applied through the drip system at three and six weeks after transplanting the tomato seedlings. The application rate was according to the supplier's recommendation. No phytotoxicity was observed in any of the plots at any time during the trial. Irrigation was by drip irrigation and the different fertilizer regimes were applied through the drip system. Individual drip lines were provided for each of the fertilizer levels for the respective replicates in each fertilizer regime. Also, separate drip lines were established to administer the Bontera Liquid at the three and six weeks post plant applications. All drip applications were conducted using a Dosatron drip injector.

There were various parameters measured for the plants but the parameter of most interest in all of the trials was the total yield. The data for total yield were analyzed for the second tomato trial. The variability was very high again but there were two treatments (Matrix with 70% fertilization and the Control with 100% fertilization) that were significantly greater than the unfertilized control. Some may interpret this result and erroneously conclude that the matrix treatment with 70% fertilization is able to reduce the fertilizer requirement by 30% based on the fact that there was no significant difference between the yield of the control with 100% fertilization and the yield of the matrix material with 70% fertilization. The only valid statistical conclusion from the second tomato trial was that the matrix treatment with 70% fertilization and the control with 100% fertilization had significantly higher yield than the unfertilized control. This is probably indicative of a fertilizer effect. The plots that had the matrix treatments were generally higher than the controls with similar amounts of fertilization. The one exception was that the control with 40% fertilization was higher than the matrix treatment with 40% fertilization.

For the first onion trial, a yellow onion variety was planted by seed March 2015. The soil analysis was performed before the onion seed was sowed. The field plots received no pre-plant fertilizer in 2015. This was done to try to deplete the soil nutrient levels somewhat and help accentuate the treatment effects. The matrix was broadcast on the soil surface at the time the onion seed was sown. This experiment was designed such that the effects of fertilization on crop yield could be observed. The same treatments used in the second tomato trial were used for the onions. The controls had 0%, 40%, 70%, and 100% of the normal fertilization applied during the growing season. The matrix treatments were applied along with different amounts of fertilization (0%, 40%, and 70%). Two liquid treatments of liquid microbial product were included in the study at 40% and 70% fertilization. The liquid Bontera product was sprayed on the soil surface followed by sprinkler irrigation to ensure the liquid product percolated down through the soil profile.

Soil analyses was performed before, during, and after crop growing season. The project team found in field trials in 2014 that the matrix treatment and liquid treatments had no discernible effect on soil nutrient levels. Tissue analysis was also performed in 2014 to determine whether the treatments increased the level of Nitrogen (N), Phosphorous (P), and Potassium (K) in the plant tissues. However, the data was variable and no significant effect was observed. Consequently, the extensive amount of soil testing was curtailed from what was originally planned. Soil analyses were taken only before planting to determine the initial soil nutrient levels. The pre-plant soil nutrient levels were important to know since it had direct bearing on whether the crop would respond to additional fertilizer applied during the growing season. The main focus was to determine whether the treatments affected the crop yields which, was of most interest to growers.

Since the onions were a later variety and were planted later in the year, the onions were harvested near the end of September 2015. The onions received no pesticide treatment during the growing season. The onion yield was recorded for each treatment. The onion root structure and condition was observed. There were no infections observed in any of the treatments or controls. The yield data for each treatment was analyzed. The results showed that there were no treatment differences. The variability in the data appeared to be excessive. The coefficient of variation (CV) should be less than 15% for field trials. When the CV is much higher than that, there is a risk that real differences will not be detected. The CV for the onion yield data ranged from 9.8% to 66.3%. The data of only two of the treatments had a CV of 15% or below. The results indicate that neither fertilizer nor the matrix treatments significantly affected onion yields.

Conclusions for this trial were that the effect of the matrix treatment on disease and bulb rot was not apparent from the data because there was no disease or rot in any of the treatments including the controls that did not receive the matrix treatment. The data variability for the onion was higher than that of the tomato trials. This is probably due to the fact that the tomato trials were planted with seedling transplants from the greenhouse. The onion trials were seeded in the field which inherently introduces more variability. The onion data indicated that neither fertilizer nor the matrix treatment affect yield. The poor yield response to fertilization could be due to the high level of soil nutrition when the study began. The pre-plant soil analysis indicated very high levels of P, medium to high levels of K, and medium levels of N. A greater fertilizer and matrix response could be expected in trials performed on nutrient-poor soils. The matrix or any other microbial product will not be as effective on nutrient rich soils.

A second onion (Walla Walla) trial was conducted to try to reduce the variability of the data and better detect treatment differences. The onion trial included six replicates instead of four and onion transplants were used instead of sowing seed in the field. These two changes in approach were designed to improve the ability to detect treatment effects. The trial started March 2016 on a research farm in Guadalupe, California. The products tested were the Bontera product and a new product from L.H. Organics. Both products were encapsulated in the starch/gypsum matrix. Also, a control that consisted of the starch/gypsum matrix alone (no microbes) was tested. In addition, the Bontera liquid was tested. The matrix granules were broadcast onto the plots and worked into the soil as would be expected for commercial applications of this product. The liquid product was initially applied by a sprayer and soaked into the soil with sprinkler irrigation. The sprinkler irrigation was used for the first ten days after transplanting onion seedlings to ensure the seedlings were established. Subsequently, the onions were irrigated by drip irrigation. Liquid treatments of Bontera liquid were made through the drip irrigation at four and eight weeks after transplanting the onions. Fertilizer treatments were made through the drip system. There was no phytotoxicity observed in any of the treatments. The trial lasted 17 weeks and the onions were harvested July 2016. The onions were sized and weighed and the data were recorded. The effect of the fertilizer was very apparent. The trials with no fertilizer had higher amounts of small and medium-sized onions. The fertilized plots had higher amounts of L, XL, XXL onions. Based on the clear fertilizer response, it is readily apparent that adding fertilizer beyond 70% of the recommended rate will give only a small yield response if any. In this trial, only the BL treatment was consistent in giving an increase in onion yield. However, the effect was minor and not statistically different from the control. There was no increase in yield for plots receiving the matrix treatment compared to the controls.

There were two strawberry trials conducted at a research farm in Guadalupe, California. The first trial was conducted on soil with no chemical sterilant treatment. Strawberries are typically cultivated on soil that has been chemically sterilized with methyl bromide or another comparable product. This trial was conducted without the use of a sterilant to determine whether the microbial treatment would be able to protect the plants from soil-borne diseases and stimulate production on a non-sterile soil. The trial had treatments that included controls receiving 0%, 40%, 70%, and 100% fertilization. The microbial product was Bontera. The Bontera liquid microbial product was encapsulated into the starch/gypsum matrix. The matrix was tested at three levels of fertilization (0%, 40%, and 70%) while the liquid material was tested at two levels of fertilization (40% and 70%). The matrix was added in measured quantities into the transplant hole of the strawberries at the time of planting. The study was initiated on July 8, 2015 and completed on December 10, 2015. The strawberry trial coincidentally was conducted next to a trial from another research that had prepared the site by sterilizing the soil. The difference between the trials on non-sterile versus sterile soil was dramatic. Four weeks before terminating the strawberry trial, photographs were taken. There were many plants that had died in this first trial due to choosing not to sterilize the soil ahead of time.

The conclusion of this study indicated that the microbial treatments were virtually ineffective in controlling soil-borne diseases in strawberries grown on unsterilized soil. Due to the lack of plant vigor and growth, the data was variable and no significant treatment effects could be detected. Mean values for marketable yields were higher on the plots treated with either the liquid or matrix products and 40% of the normal level of fertilizer. However, these differences were not significant. Farmers would not be recommended to use the microbial treatment without pre-plant soil sterilization treatments.

A second strawberry trial was contracted with a company conducted in Guadalupe, CA and services were contracted with Pacific Ag Research. The trial consisted of ten treatments with four replicates using plots that were 3.3 feet by 50 feet. A randomized complete block experimental design was used. The trial was initiated in November 2015 and terminated June 2016. The plot soil was 79% sand, 10% silt, and 11% clay, the pH was 7.3, cation exchange capacity was 6.9 meq/100g, and organic matter content was 0.6%. The soil was fumigated with PicChlor 60 EC at 30gal/acre three weeks before transplantation. The trial was planted with strawberry transplants (cv. Monterey) on November 30, 2015 on raised beds covered with polyethylene film as is typical for the industry. Plant spacing within rows was 14 inches and planting density was 22,500 plants per acre. The treatments consisted of fertilizer at rates of 0%, 40%, 70%, and 100%. Bontera and L.H. Organics microbial products were encapsulated in the starch/gypsum matrix. Both matrix products were tested at 0%, 40%, and 70% fertilization. No liquid products were tested in this trial. The granular matrix product was added (3 grams) to the transplant hole at the time of planting just before adding the transplant. The fertilizer treatments were added through the drip irrigation system at regular intervals throughout the growing season.

The experimental trial was well managed and the data are much better compared to trial #1. The results showed that fertilizer is a major factor in improving the crop yields. However, the matrix treatment had no significant effect on yields except for the L.H. Organics material at 70% fertilization that was significantly lower than the control with 70% fertilization.

Soil analyses were performed before various trials and then again at the end of the trials. Generally speaking, there was no correlation between the various treatments and the nutrient levels.

This project does not enhance the competitiveness of non-specialty crops. The bio-based matrix formulations was only applied to fields growing onion, strawberry, and tomato, which are specialty crops.

Beneficial soil microbe formulations were generously provided by Inogro, Flozyme Inc., Biogro, Sentinel Biologix, and L.H. Organics. All of the microbial products were encapsulated in the starch/gypsum matrix. These products comprised the granular material used in various onion, tomato, and strawberry trials.

Goals and Outcomes Achieved

One of the proposed goals and outcomes was to reduce the amount of fertilizers and pesticides used by onion, strawberry, and tomato growers after their replacement with the novel bio-based matrix formulations. The first measurable outcome involved measuring how much the encapsulated beneficial soil microbes reduced the fertilizer and pesticide requirements. The best measurement to demonstrate this outcome was yield. Yield is ultimately the parameter that is important to farmers. Four different microbial products were tested during the course of the project. Trials were conducted on specialty crops including tomatoes, onions, and strawberries. There was no consistent positive effect of the microbial treatments on yield for tomatoes, onions, and strawberries. For onions, there was no significant loss due to disease in either the treatments or the controls.

Another one of the proposed goals and outcomes was to perform large-scale field trials using the matrix formulations. This work was to be performed in partnership with a company who had the microbial product to be evaluated and the relationship with farmers for conducting field trials. The project plan had to be modified due to the company's suspension of operations and production. Four different sources of microbes were tested on research field plots to determine their efficacy. No large-scale field trials were conducted in part due to the suspension of the company but also because farmers approached were unwilling to run replicates or evaluate more than one treatment. For these reasons, all new microbial products were tested only on research plots. Another of the proposed outcomes was to calculate from these trials, the total reduction in fertilizer and pesticide use. The results of the trials indicated that there was not enough difference in the yield among the different treatments to rule out that the differences were due to random variation. Therefore, based on the results of the study, the project team cannot recommend the use of microbial products that were tested as a viable means for reducing fertilizer or pesticide use. The second measurable outcome was to number the growers who were implementing the use of the matrix material on their crops. This measurable outcome is premature because none of the suppliers have product that is certified for use in the state of California. Flozyme Corporation is in the process of certifying their product but it may still take several months. However, due to the limited effectiveness of the microbes on the specialty crops tested, it is not recommended that growers use the products tested until more effective materials can be developed.

In addition to reducing fertilizer usage, the goal was to reduce pesticide use. The first strawberry trial was grown on soil without the use of a chemical soil sterilant. This trial was performed to see how effective the treatments were in control soil-borne diseases in strawberry.

The objectives of the project were to (1) further develop matrix formulations with encapsulated microbes for onion, tomato, and strawberry crops, (2) develop pilot scale capabilities to produce the matrix formulations, and (3) conduct field trials with onion, tomato, and strawberry growers. The matrix material was further improved by developing a granulation process for encapsulating microbes supplied by companies for specialty crops. The granulation process was scaled-up to produce sufficient matrix material of the appropriate granule diameter to conduct field trials. Field trials were conducted on tomato, onion, and strawberry using research farms. The trials were all repeated twice in an attempt to improve upon the first trial for each crop.

The outcome measures were not long term. The outcome measures were completed for six trials of tomato, onion and strawberry.

The accomplishments were that the matrix material was further improved by developing a granulation process for encapsulating microbes supplied by companies for specialty crops. The granulation process was scaled-up to produce sufficient matrix material of the appropriate granule diameter to conduct field trials. Field trials were conducted on tomato, onion, and strawberry using research farms. The trials were all repeated twice in an attempt to improve upon the first trial for each crop.

At the onset of this project, a grower meeting was held where frustration was expressed about whether microbial products were effective or not. Some growers were running their own trials with inconsistent results. During the course of this project, it was striking how many new companies are springing up with products they claim are effective for specialty crops. Unfortunately, the microbial products tested in this project were not effective in significantly increasing the production of tomatoes, onions, or strawberries at the application rates and field conditions tested. More research is necessary to develop more effective microbial products or to better hone the application rates.

Regarding the starch/gypsum matrix, an agglomeration process was developed for mass production of the encapsulated product. The matrix was effective in encapsulation based on laboratory tests that showed microbial activity when the matrix was placed in contact with water. No conclusion can be made regarding the effectiveness of the starch/gypsum matrix material in the field because the encapsulated microbes were shown in the liquid treatments to be ineffective in significantly increasing crop production. A positive effect would only be expected if the microbes were shown to work. The matrix material may work fine with other microbes that are more effective.

Beneficiaries

Growers of specialty crops, specifically onion, tomato, and strawberry farms in California were benefited by the project. Data was presented from the study to a group of university staff, and other stakeholders at an invited talk given at UC Davis. In addition, the results of the research were communicated to other stakeholders including suppliers of beneficial soil microbes.

The number of beneficiaries of the project include 380 onion, 1782 tomato, and 729 strawberry farms in California.

Lessons Learned

The use of beneficial soil microbes in agriculture has tremendous potential and is already being exploited commercially for specific applications such as in disease control and for nitrogen fixation in legumes. Expanding the use of beneficial soil microbes to improve the production of California specialty crops is a relatively new area of interest and could benefit farmers by reducing the amount of chemical inputs. Concerns about chemicals in ground water and in irrigation runoff are among the issues driving research to reduce chemical usage in fields. The results of this study may appear underwhelming but there were lessons learned that could help future research. The original plan was to work with a California producer of beneficial soil microbes and scale-up production of the starch/gypsum encapsulation matrix so that treatments could be made on plots of tomato, onion, and strawberry in farmer's fields. The problem encountered with working closely with a single, small producer of microbes was that the company originally chosen halted their production even before the project got underway. In future research, the investigators are advised to source their microbes from a larger, established company, if possible, with data to support their recommendations for application rates and methods. Investigators may also choose to use their own blend of microbes provided they have isolated and characterized the benefit of said microbes to plant growth in greenhouse or field trials.

Another lesson learned was that experimental field trials are best conducted on research farms. One large grower offered to run a single treatment of the material. However, they were not able to run replicates or multiple treatments. The data from this study showed that field variability can be quite high making it very difficult to determine whether differences are real or simply due to random variability. The grower meeting held at the Western Regional Research Center at the beginning of this study was attended by farmers that reported the microbial products they tested in their fields worked some years and not others. Due to the natural variation in field data, it is imperative that trials be designed with replicates and controls to determine whether the differences are real or random. It was determined early on that field trials are best done on a research farm that has the resources and support to properly conduct field trials. It was also observed that the amount of variability can be minimized by using transplants rather than sowing a crop directly to the plots.

Another lesson learned is the importance of narrowing the scope of the project. The proposal for this project was written to address a reduction in fertilizers as well as pesticides. These factors really need to be addressed separately. As project staff saw with the strawberry trial run on unsterilized soil, pest and disease intrusion can easily increase the data variability to the point that any treatment effect is masked.

Another lesson learned is that the study should focus on the most important parameter, yield. If there is a difference in yield, then there is a reason to measure other parameters such as shoot and root weight, plant vigor, plant height, etc. Once it becomes apparent that differences in yield will be difficult to detect, there should be an adjustment so that other valuable time and resources are not spent needlessly on measurements that would are no longer pertinent.

One of the unexpected results of the project was the fertilizer response of the crops. In some trials, the variability of the individual plots was such that there was no significant yield response to fertilizer. However, when the plots were well prepared and when seedling transplants were used rather than seed, the uniformity was better and variability was minimized. When a proper fertilizer response was observed, the response curve was not linear. There was a much higher response when increasing the fertilizer treatment from 0% to 40% compared to the lower response when increasing the rate from 70% to 100%. In virtually all cases, there was little or no significant difference in yield when increasing the fertilization rate from 70% to 100%. This finding brings into question whether farmers should be adding the recommended fertilizer rate. From a business standpoint, it may be profitable to add an excess of fertilizer to reach a maximum yield response. However, this practice can be especially hard on the environment since there is more of a chance that more of the excess fertilizer is lost in the environment. The question arises about whether the fertilizer recommendations should be lowered. The fertilizer yield response issue can also influence product claims in a negative way. For instance, a study that has a treatment with 70% of normal fertilization may likely get a statistically similar yield to a control with 100% fertilization. The company representatives may erroneously claim that the treatment has replaced the need for 30% of the fertilizer requirement. Rather than base claims on the fact there is no significant difference between a treatment at one fertilizer rate and a control at a higher fertilizer rate, the claims should be restricted to whether there is a significant difference between a treatment and a control at the same level of fertilization.

The second expected measurable outcome listed in this project had very little chance of being met in retrospect. The commercial microbe suppliers are still developing their products in many cases. Secondly, none of the products tested are actually certified in the state of California for commercial field use. This information came to attention after the project was underway. Future investigators need to be aware of this issue before expecting farmers to begin using these products.

Additional Information

Sharon, J., Glenn, G.M., Lee, C., Isolation of highly efficient phosphate solubilizing bacteria capable of enhancing plant growth. Journal of Soil Science and Plant Nutrition . Log#321229 (accepted 6/23/2016)
Attachment 1 – Tomato Trial
Attachment 2 – Onion Trial
Attachment 3 – Strawberry Trial

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 52	Project Title: Microcalorimetry for the Rapid Assessment of Specialty Crop Salinity Tolerance	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13052	**Date Submitted:** December 2016
Recipient Contact: Lorence R. Oki	**Telephone:** (530) 754-4135	**Email:** lroki@ucdavis.edu

Project Summary

Salts in soils and irrigation water limits plant productivity. Salt tolerances are unknown for a majority of specialty crops representing a fundamental lack of information regarding best management practices. The project has the ability to rapidly identify salt tolerances by developing a novel methodology. The results will assist growers and decision makers seeking to increase water-use efficiencies by utilizing recycled water. Recycled water is typically higher in salts and currently is not deemed suitable for many specialty crops until salt tolerances are reported.

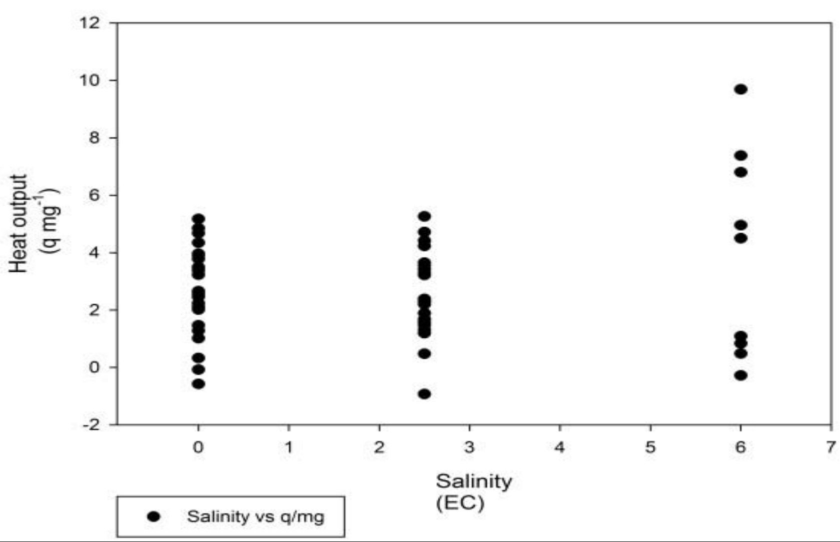
Currently, there is very little information regarding salt tolerances for a wide range of specialty crops. The main reason for the lack of information is that traditional methods for testing salt tolerances are resource and time intensive. Unlike traditional methods, staff have identified a new method for testing salt tolerances using isothermal microcalorimetry. Isothermal microcalorimetry is used to examine total metabolic rates of plant tissue samples and to study effects of a wide variety of naturally occurring or artificially added factors on those rates. The project developed a novel method of measuring respiration rates of plant tissues using microcalorimetry to rapidly (hours or days) assess the salinity tolerance of specialty crops species. The first two years were used to develop and validate the method; and during the nine months of the third year, staff established experimental field demonstrations as part of the wide outreach by the University of California (UC) Extension. Measureable benefits include pioneering a new scientific method, and identifying and disseminating salt tolerances previously unreported. Additionally, expanded knowledge of salinity tolerance improved sustainable production practices by allowing for increased use of recycled water for irrigation. By addressing a basic resource issues, salt tolerance, this project assisted decision makers in planning specialty crop agriculture by educating the public on growth limitations from salts.

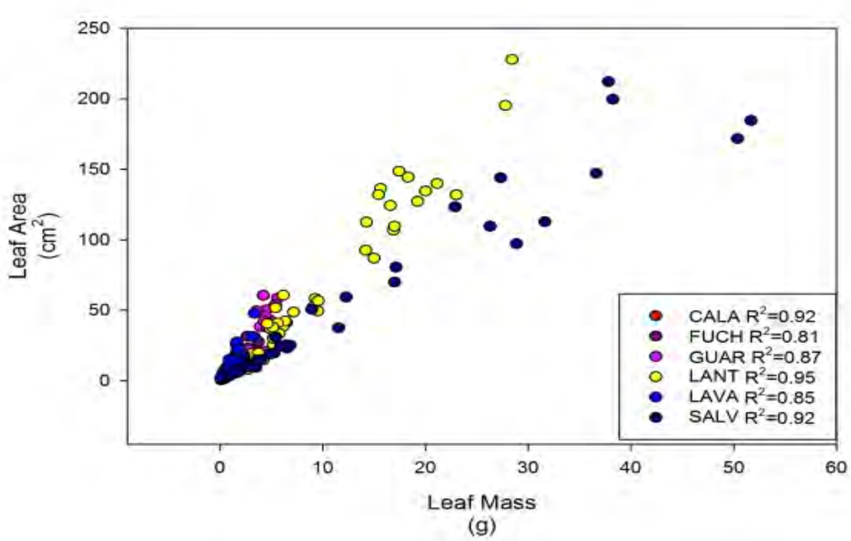
This project did not build on a previously funded Specialty Crop Block Grant Program project.

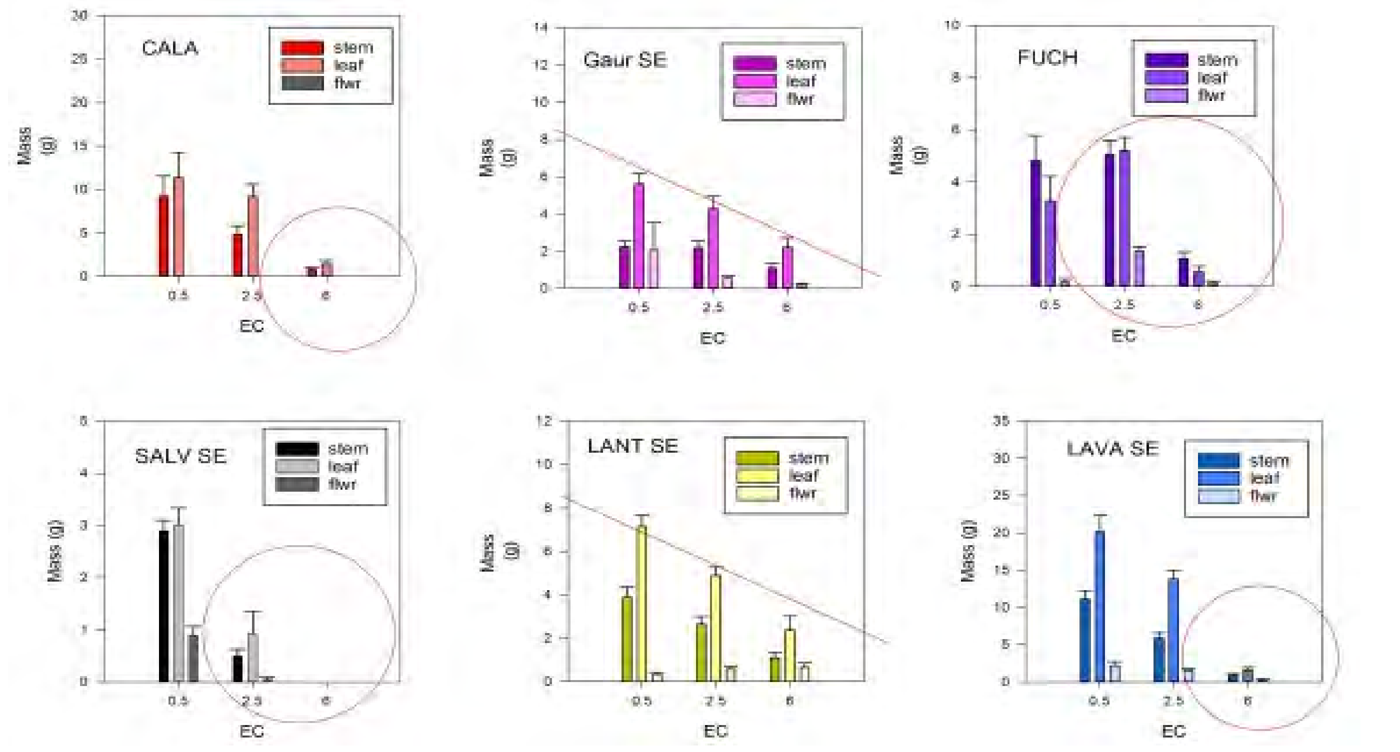
Project Approach

The first task was to develop microcalorimetry methods for specialty crops. Unlike many grain crops, which are annual grasses, specialty crops are more diverse in growth forms and life histories. Accordingly, researchers needed to determine if the plant parts used from the grain crop calibration were appropriate for testing of perennial herbs or shrubs, and trees. The first year of experimentation focused largely on this task. Staff tested a variety of specialty crop life forms, including woody perennial crops, herbaceous perennials, and seed grown annuals. Staff dissected and tested root tips, leaf buds, flower buds, and whole seedlings, when appropriate. The testing revealed that root tips, generally have the greatest metabolism and thus are the best tissues for testing in the microcalorimeter. Seedlings were also deemed excellent sample materials because their size matched the ampule chamber size, and the seedlings could be generated quickly.

The second task was to validate the microcalorimetry results with traditional salinity methods. Staff expanded the study to landscape plants commonly used within the Irvine Ranch Water District (IRWD), which requires the use of recycled water for irrigation in public spaces. The twelve species were chosen because they represent a variety of life forms (i.e. grasses, herbaceous perennials, and woody perennials). These plants were grown at the South Coast Research and Extension Center (SCREC) in Irvine, and at UC Davis (UCD). At SCREC, plants were established in a paired experiment where they were watered with either recycled or potable water. The recycled water was obtained from IRWD and was the same as what was provided throughout the district, thus creating a 'real world' situation. At UCD, plants were irrigated with three levels of sodium chloride (NaCl). Plants were grown all summer and then harvested to determine biomass differences. Also during this period, three Kale varieties were grown at UCD to test their whole plant biomass responses to elevated salinity. Staff had excellent results from the traditional methods, showing a strong correlation between increasing salinity and decreasing growth metrics.

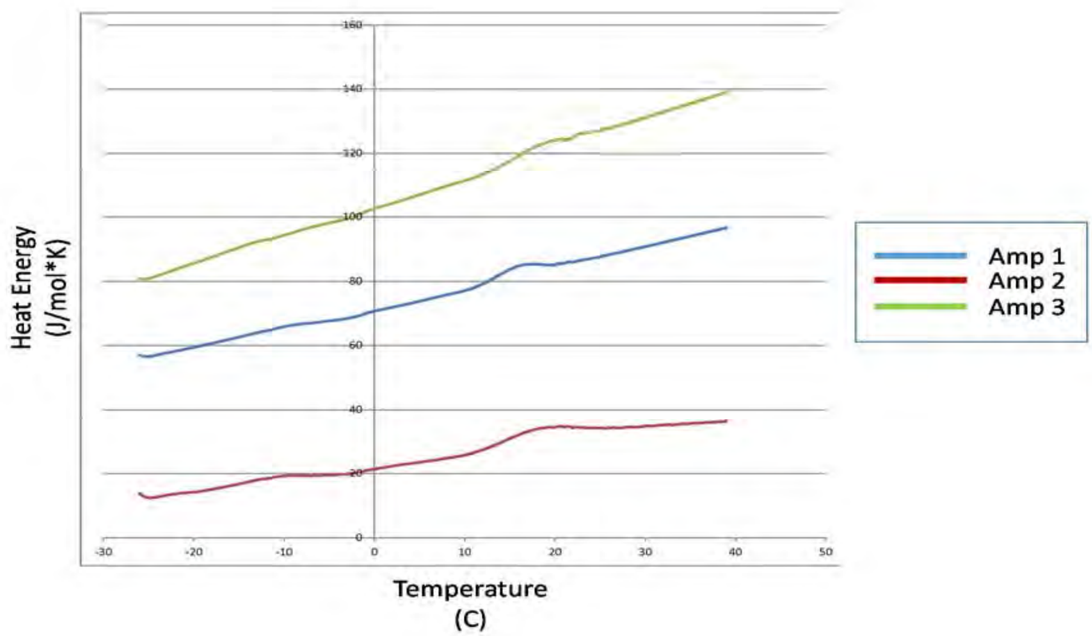


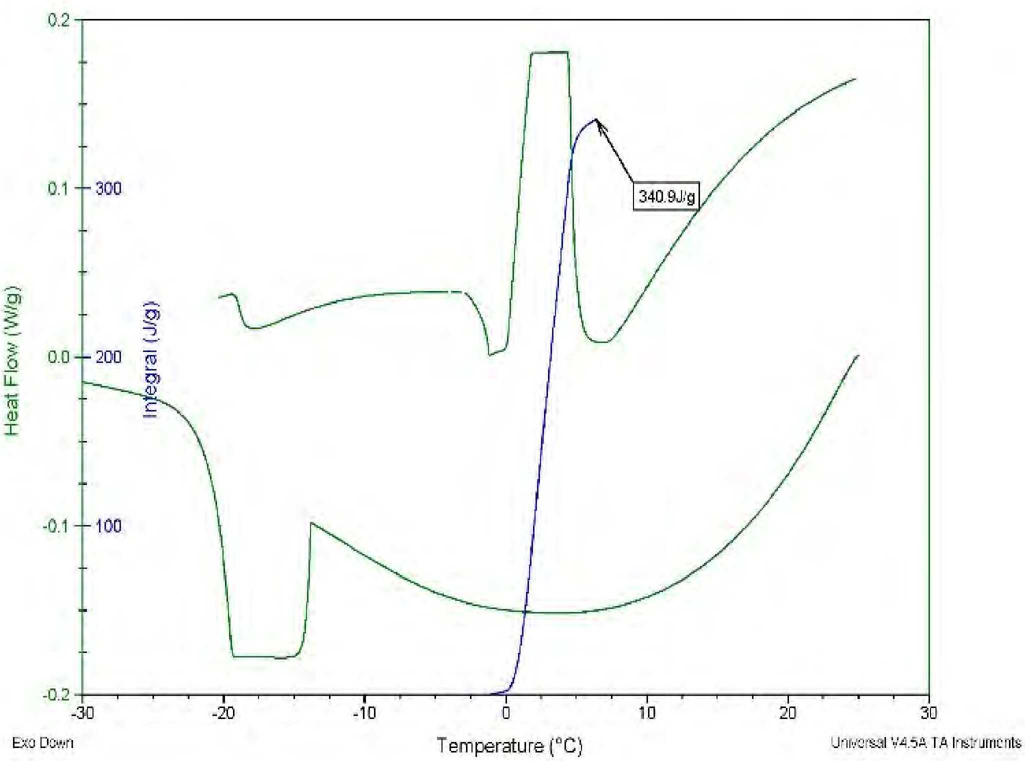




Three images of baseline data collected showing progress. The first image is heat rates of Kale cultivars response to increasing salinity. These values were collected from microcalorimetry. The second image is specific leaf area values for six species conducted in parallel growth trials at SCREC and UCD. The third image is decreasing biomass of same six species, in response to increasing salinity.

Interestingly, the validation procedure did not reveal clear correlation between calorimetry and whole plant methods. The mixed responses between calorimetry and whole-plant responses, as well as leaf-level measurements brought up questions about the reliability of the tools. Simply, staff wondered whether or not they could trust the results from the very different machines. Therefore, in year-two staff began an intensive calibration testing procedure. These tests revealed that three of the four calorimeters were inconsistent, and unreliable. Also during this time the leaf chlorophyll meter was lost for six months by the delivery service. These situations created an insurmountable experimental delay. Unfortunately, a new calorimeter costs rough \$50,000-\$100,000. Therefore, staff continued the rigorous testing of the remaining calorimeter, conducting comparisons of heat rates against a known substance (Al_2O_3), as well as against pure water (see pictures below).





Calibration results from tests of the remaining viable calorimeter. Top: Image of the heat energy rate output from the Al_2O_3 calibration. Bottom: Results from the heat of fusion tests with pure water.

Staff generated a new experimental timeline that was based on the ability of the one remaining, reliable, calorimeter and moved forward at one-fourth the pace. The third task was to rapidly assess important specialty crops. This process is currently on-going. Although the grant period ended at the end of June 2016, the rapid assessment period will continue. Since staff found that seedlings are the most suitable for the calorimeter, they are focusing on important annual plants, including lettuce, kale, zinnia, and other flowering species. Staff are meeting the goals for rapid assessment, completing tests for each cultivar/species within one week. Although, technical difficulties delayed the progress, staff are still very hopeful that the methodology developed with this grant will become a reliable and useful procedure.

The final task was to disseminate the information that was gathered. Because less information was generated than expected, staff have prioritized verbal dissemination rather than written. This has been accomplished by attending workshops on water-management and California agriculture. In particular, staff attended the United States Department of Agriculture's (USDA) Drought Management Workshop in Modesto, California. During breakout session, staff met with representatives from Almond commission, as well as UC Agriculture and Natural Resources (ANR) Farm Advisors to discuss the program and the application of microcalorimetry in their research programs. Staff also traveled to Watsonville area and met with local extension agents as well as three different large commercial growers in the area to discuss drought management options, including the microcalorimetry program. Furthermore, staff attended UC ANR Surface Renewal Method workshop to meet with other researchers from across the State who are also working on drought management strategies. Lastly, staff attended UCD's Evapotranspiration Remote Sensing Workshop, another gathering of experts in precision agriculture and drought management. These were all excellent, low cost, opportunities to meet with other researchers, farmers, extension agents, and industry representatives who are involved in water conservation and drought management.

Presentations were made to the California Associations of Nurseries and Garden Centers (CANGC) Research Committee at UC Riverside on Feb 4, 2015. There were about 20 people present. Staff also presented results from this project at the USDA, National Institute of Food and Agriculture groups (USDA NIFA NC1186 and NE1335) combined meeting in Long Island, NY with about 50 people attending. In Ventura Califoria, April 2016, staff presented results in a presentation to the UC ANR Environmental Horticulture working group, approximately 40 people attending. In addition to talks, staff also had the article in Greenhouse Production News: Oki, L., A. Filmer and L. Nackley. 2015. Environmental horticulture research at UCD. Greenhouse Product News. 25(12): 36-42. http://www.gpnmag.com/article/environmental-horticulture-research-uc-davis/ .

In addition to these meetings, staff are preparing the data from the experiments for publication in a peer-reviewed horticultural journal.

All work was performed specifically to benefit specialty crops by only testing and reporting salt tolerances of California specialty crops

The Post-doctoral research scholar was responsible for the primary work activities. The researcher managed the growth and data collection process for all plant species grown. The researcher was also responsible for the day-to-day management of the student and staff assistants.

The graduate student was responsible for the maintenance, care and testing of grape varieties in the microcalorimeter.

The Principal Investigator (PI) was responsible for quality assurance and quality control. The PI reviewed and commented on all of the tasks described above to ensure they were conducted in a manner of excellence, reflective of research at the UC.

Goals and Outcomes Achieved

Staff were able to meet one of the major performance goals when they developed the new method for measuring salt tolerance. Staff failed to meet one of the other performance goals, which was to test 100+ species. The technical difficulties were too great to overcome. This was limited because of A) staff only have one machine and B) only have two operators. Staff have secured additional funding to continue the work. The current rate is one cultivar/species per week, and staff are planning to hire an additional employee to double the rate. Therefore, although the timeline was too brief, the overall goal is still reachable.

Outcome measures were short-term. The goal was to be able to rapidly assess specialty crop salt tolerances.

It is difficult to quantify the actual accomplishments with the goals established. On one hand, staff fell short of the goals because they were not able to test as many species as expected, and therefore did not have as much information to disseminate. However, since staff were able to develop a novel methodology the foundation has been laid for building up to full goals.

In total, 34 cultivars were tested:
2 strawberry varieties
3 grape varieties
2 coast redwood varieties
13 landscape ornamentals: shrubs and grasses
3 turf species: fescue and ryes
6 leafy greans: kale, lettuce
5 cut flowers: gerbera, lavender, petunia

Staff have a validated method that allows them to test for the salt tolerances of plant species four times faster than traditional methods. This is based on a one-week microcalorimetry testing period, compared to a one-month growth trial.

Beneficiaries

This project benefited commercial growers or municipalities who are rapidly seeking to expand their use of recycled water for specialty crop irrigation.

According to the 2014-2015 Agriculture Statistics Review, the value for Nursery Products in 2014 was $3.22 billion and for Floral Products was $470 million for a combined total of $3.69 billion. This places the combined Nursery and Floral Crops as the number 5 agricultural crop commodity in the state. In addition, Nursery and Floricultural crops are in the top 10 agricultural commodities in 31 of California's 56 counties that reported agricultural production in the survey. With water becoming one of the most competitive natural resource in California, if the methodology is widely adopted and enables greater use of recycled water, the cost saving and beneficiaries are enumerable.

Lessons Learned

Clearly, there needs to be some contingency plans written into the contract should there be catastrophic failure of capital investments. Staff never would have predicted that three of four of the calorimeters would fail. However, they were not new machines and in hindsight staff should have written in an option to purchase a new calorimeter. This is not a trivial cost as a new calorimeter would have equaled or exceeded the annual salary for any of the student or post-doctoral researchers. Providing an emergency clause is an important lesson learned. Other positive lessons learned, are the value of stakeholder engagement. Staff coordinated with a number of specialty crop seed growers, who were able to share important insights on cultivars/species that may be more relevant for the industry. Another positive lesson learned was a reinforcement of the value of good project management. Staff had much greater productivity when they decomposed larger quarterly goals into smaller, weekly, tasks that had to be reported and discussed the following week. It is nothing new, but was something that worked well for the team.

One surprise outcome was that for a number of species the preliminary data showed that the plants treated with saline water had greater metabolic heat rates than plants treated with low-salinity water. This is contrary to the traditional physiological response that salt diminishes metabolic activity. Again, these are preliminary results, and at this time staff cannot explain this unusual phenomenon. Staff are investigating further to see if the novel method has in fact revealed some novel physiological responses.

To reiterate, it is important to have a back-up plan. Develop an executable project, but then take a moment to imagine if critical aspects of the work-flow or process were to be delayed by an external force, how would the project continue in the time limited by the funding cycle.

Additional Information

At this time, staff are preparing three separate manuscripts.
1) May be titled "Shriveled grapes are not always raisins: lessons learned from irrigating Vitus species with salinized water." It will be produced from the dissertation of the graduate student. It will focus on the physiological responses of table grapes (Vitus spp.) to recycled water. Target journals include, *California Agriculture,* or *Plant, Cell, Environment*, or *Environmental and Experimental Botany.*
2) Will likely be titled "Microcalorimetry as a novel method for testing plant salt tolerance" It will be a methods paper describing the novel methodology and the target journal is *ThermoChemica Acta*.
3) Will be a paper likely titled "Microcalorimetry for rapid assessment of specialty crop salt tolerance." Content will focus on the results from the rapid assessment of specialty crop seedlings, the target journals are *Scientifica Horticulturae*, or *HortScience*.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 53	**Project Title:** Characterization of Resistance in Cantaloupe and Honeydew to Cucurbit Yellow Stunting Disorder Virus and Sweetpotato Whitefly	
Grant Recipient: United States Department of Agriculture, Agricultural Research Service	**Grant Agreement No.:** SCB13053	**Date Submitted:** December 2016
Recipient Contact: James D. McCreight	**Telephone:** (831) 755-2864	**Email:** Jim.mccreight@ars.usda.gov

Project Summary

The fall melon crop in the low desert of California was eliminated in 2006 due to a combination of Cucurbit yellow stunting disorder virus (CYSDV), a newly introduced virus, and heavy feeding pressure by its insect vector, sweet potato whitefly biotype B (SPWF-B). The low desert of California (Imperial, Coachella and Palo Verde Valleys) has historically been an important spring and fall-season melon production area, with a 2010 gross value of $69.2 million for the spring; a fall crop could increase this to $104 million. The appearance of the aggressive SPWF-B in 1990 significantly reduced the fall crop through feeding damage; numbers of SPWF-B eggs and nymphs were 1500-fold greater than in Texas and Florida. CYSDV, spread by SPWF-B, appeared in California in fall 2006. Together, SPWF-B and CYSDV eliminated the fall melon crop in the low desert, and CYSDV threatens spring melon production when SPWF-B survives the winter in sufficient numbers.

There are no commercial melon cultivars with resistance to either SPWF or CYSDV anywhere in the world. Three non-sweet, vegetable type melons from Africa and India are resistant to CYSDV. Low-level resistance to SPWF-B expressed by two of these is inadequate for reducing the economic impact of whitefly feeding or virus transmission in California. Six new melons from India exhibited putative resistance to CYSDV in fall 2011 and 2012. Four produced large plants that finished the season in good condition, and appeared to exhibit resistance to feeding by SPWF-B in 2012; two had significantly fewer numbers of SPWF-B than the two accessions previously determined to have low-level resistance to SPWF. Fruit of the six accessions have some characteristics of sweet, dessert type melons and may be better sources of resistance for breeding CYSDV-resistant cantaloupe, honeydew and mixed melons adapted to California.

The project goals were to: 1) Determine the best source(s) of host plant resistance to CYSDV in melon from among the resistant candidates identified to date; 2) Characterize host plant resistance to SPWF-B identified in four accessions in 2012 and a fifth accession identified in 2014; 3) Cross candidate CYSDV and SPWF-B resistance sources with susceptible elite Western United States (US) shipping type melons (USWSM) for inheritance studies and introgression to USWSM; and 4) identify potential RNA interference (RNAi) targets in SPWF-B that will reduce whitefly fitness and block virus transmission.

Resistance to SPWF-B will result in fewer applications of insecticides to reduce direct damage from feeding and indirect damage from sooty mold that grows on the 'honeydew' excreted by SPWF-B onto leaves and fruit and results in reduced fruit yield and quality. Resistance to SPWF-B will reduce the adverse economic and environmental impacts of SPWF-B control. Resistance to CYSDV will reduce the adverse impact of the virus on plant growth, and consequently on fruit set (yield) and quality. Vector and whitefly resistance may restore the lucrative fall production season.

This project did not build upon previously funded Specialty Crop Block Grant Program project.

Project Approach

Field tests for resistance to CYSDV and whitefly:
Four field tests were planted in Imperial Valley at the University of California Desert Research and Education Center, Holtville.

CYSDV tests were evaluated in the fall seasons of 2014 and 2015. CYSDV-resistant plants were selected from different progenies of crosses between eight sources of resistance to CYSDV: PI 313970 (reported to be resistant by the project team), TGR 1551 and TGR 1937 (reported by a lab in Spain to be resistant), and five putative new sources of resistance (PI 122847, PI 123496, PI 124550, PI 145594, and PI 614486). Selection was based on percent of leaf area expressing virus symptoms and overall plant and fruit appearance. Three vegetative cuttings were taken from each selected plant for establishment in a greenhouse, and subsequent self-pollination to develop lines with uniform reaction, and cross-pollination with a susceptible cultivar USWSM type cantaloupe (Top Mark, Impac) and Green Flesh Honeydew. The cross-pollinated progenies were then self-pollinated to produce segregating families for recombination CYSDV resistance with the horticultural qualities of the susceptible cultivars.

None of the five putative sources of resistance were more resistant to CYSDV than the three reported sources of resistance. The three resistance sources were members of *Cucumis melo* subspecies *agrestis* Acidulus Group, which produces small, non-sweet, bitter fruit that are used at the immature stage of fruit development in soups and stews. PI 123496 was, however, notable for its larger fruit with a lightly netted fruit pale white exterior (Figure 1). PI 145594 is likely also a member of the *Cucumis melo* subspecies *agrestis* Acidulus Group, but it combined well with the susceptible cultivar Impac and produced netted fruit in the F_1 (Figure 2) and segregated a high number of fruit that resembled USWSM type fruit in the F_2 (Figure 2).

Figure 1. Fruit of PI 123496 had some of the characteristics of climacteric, dessert type melon fruit. The subspecies and group have yet to be determined.

Figure 2. Fruit of PI 145595 and its F_1 with Impac (left), and F_2 (right).

Controlled inoculation greenhouse/laboratory tests for CYSDV resistance:
Limited numbers of controlled inoculation tests were done in the greenhouse/lab due to difficulties in establishing a pure CYSDV isolate in the greenhouse/growth chamber. PI 313970, TGR 1551 and TGR 1937 were resistant to CYSDV in three controlled inoculation tests in fall 2014 (PI 313970; mean ELISA absorbance value @ 405nm was 0.018 *vs.* susceptible cultivar Top Mark with a mean value of 0.318) and summer 2015 (TGR 1551 and TGR 1937 mean value was 0.008 *vs.* Top Mark with value of 0.156). Thus, the low virus content in these three reported sources of CYSDV resistance was confirmed. Four of the five putative new sources of CYSDV resistance were tested through fall 2015 and early winter 2016. CYSDV was not detectable in PI 122847 (0.000 *vs.* Top Mark with a value of 1.059) and PI 145594 (0.000 *vs.* Top Mark with a value of 0.568) in two separate tests. PI 124550 had a high level of virus (0.593 *vs.* Top Mark with a value of 0.568). PI 123496 was not consistent for virus content: 0.154 *vs.* Top Mark with a value of 1.059 in the first test, and a value of 0.453 *vs.* Top Mark with a value of 0.523 in the second test. The difference between the two tests for virus content may have been a reflection of genetic variation within the accession or test-to-test variability.

Field tests for resistance to whitefly were done in the spring seasons of 2015 and 2016:
Eleven putative whitefly resistant melon accessions were compared with the susceptible USWSM type cantaloupe cultivar Top Mark in spring field tests in 2015 and 2016. Several of the 11 accessions tested in the field were reported to exhibit whitefly resistance in greenhouse tests. The tests were done as split plot designs, where one plot of each entry was treated with insecticides and the other was untreated (no insecticide). Adult whiteflies were sampled at approximately two-week intervals from May 24 through July 19, 2015. Significant differences were detected among the 12 entries for numbers of adults (in ten-second vacuum samples of the plant canopies; data not shown) and numbers of immatures per cm^{-2} of sampled leaf area. Numbers of immatures on the most susceptible and most resistant accession indicated different population dynamics under field conditions where whiteflies had a choice of host (Figure 3).

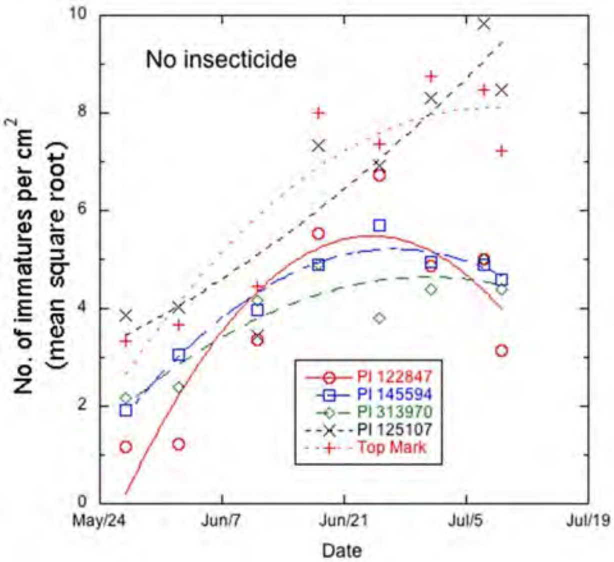


Figure 3. Number (mean square root) of immature whiteflies per cm^2 of sampled leaf area on four melon accessions and susceptible cultivar Top Mark.

Differences in numbers of adult and immature whiteflies were observed in both years. Samples were taken on eight dates in 2015 and one date in 2016. The five accessions with the lowest number of adults and the three with the highest number of adults in 2015 are presented in Figure 4. PI 122847 had the fewest adults through mid-June and was not different from the other "best" accessions through the final sampling date. 'Top Mark' and PI 125107 followed a similar pattern, while numbers of adults from PI 123689 continued to increase (Figure 4). The other four accessions were intermediate through the test (data not shown). Numbers of immatures followed a pattern of development through the test in 2015 that was similar to the adult numbers. PI 122847 had the fewest number of immatures initially, but was similar to PI 313970 and PI 145594 (Figure 3).

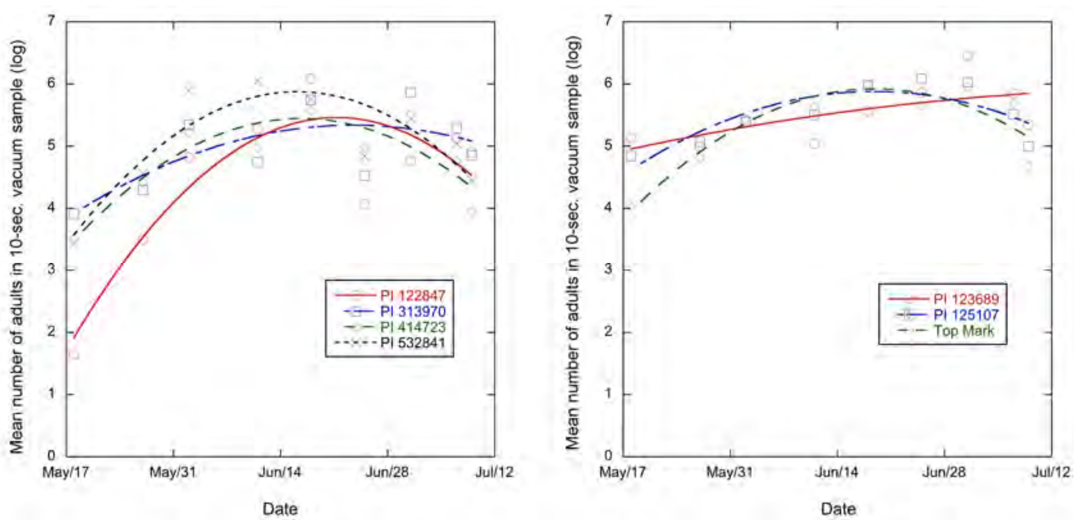


Figure 4. Mean numbers (log) of adults in ten-second vacuum samples of six melon accessions and 'Top Mark' at eight sampling dates from May 27 through July 9, 2015, highest (left) and lowest (right); DREC; no insecticide treatment.

In 2016, whitefly numbers were low through mid-June; the first samples were collected June 21 (Table 1). PI 313970 had the fewest number of adults, significantly fewer than 'Top Mark' and all of the other entries except PI 145594. PI 122847 had the fewest number of immatures but was not significantly lower than PI 313970 and PI 145594 (Table 1).

Table 1. Least square means of adults (log) in ten-second vacuum samples and immatures (square root) per 2-cm^2 area of single leaf samples taken from five plants in the center of each experimental plot (40 ft. in length), collected on June 21, 2016; means separation by Student's *t*-test (P= 0.05).

Accession	Adults (log)	Immatures
PI 116482	4.0 c	11.8 ab
PI 122847	4.3 bc	6.1 d
PI 123689	5.1 a	11.2 abc
PI 124107	4.0 c	11.5 abc
PI 145594	3.0 de	8.2 cd
PI 161375	5.4 a	12.4 ab
PI 313970	2.6 e	6.9 d
PI 414723	3.6 cd	10.7 bc
PI 532841	3.6 cd	11.0 bc
TGR 1551	4.8 ab	11.1 abc
TGR 1937	3.8 c	13.6 ab
Top Mark	5.1 a	14.6 a

Greenhouse testing of whitefly resistance in melon:
Twelve melon accessions were compared with whitefly-susceptible Top Mark in a series of greenhouse tests from summer 2015 through June 30, 2016. The accessions included the 11 in the field test plus PI 123496. This was a no-choice test, whereby the whitefly adults were confined in small, clip-on leaf cages. The whitefly's were able to feed freely and oviposit (lay eggs) in a defined area of the test leaf.

The number of eggs was counted as a measure of oviposition resistance. Development of eggs through to emergence of the next generation of adults was monitored to estimate the mean survival from egg to adult; and the growth index, a measure of the rate of development from egg to adult, constituted two measures of antibiosis to whitefly. The three measures of resistance to whitefly were expressed as a percentage of the susceptible commercial USWSM type melon 'Top Mark'. These data were summarized as 95% confidence intervals (CI) for each of the three host plant estimates of resistance to whitefly. Whereby comparisons between accessions could be made using the 'rule of eye' method. Intervals that overlapped with a mean were not different, and CI that overlapped by half of one interval arm were significantly different at $P = 0.05$.

Oviposition expressed as a percentage of 'Top Mark' data varied among the tests for each accession (Figure 5). Comparisons of CI indicated TGR 1937, PI 161375, PI 122847 and PI 124107 to be potentially useful. PI 123496 showed a wide variation that may have been an indication of genetic heterogeneity in the accession, as many US melon introductions are known to be highly variable for many plant and fruit characters. TGR 1551 was used as a source of resistance to a different biotype of the whitefly (designated Q), in Spain and expressed useful variation, though like PI 122847, exceeded oviposition on 'Top Mark' in one test. Survival expressed as a percentage of 'Top Mark' data likewise varied among the tests, with many of the entries being comparable to 'Top Mark' (Figure 6). TGR 1551 and TGR 1937 were exceptional in this regard; both were from Zimbabwe, whereas the other accessions were from Asia (India and Korea). Survival on the other 10 accessions was essentially the same as on 'Top Mark'. Survival was used as the criterion for genetic assessment of resistance to whitefly biotype Q in TGR 1551.

PI 123689 and TGR 1551were comparable for growth index (Figure 7). PI 414723 was potentially of interest, but was highly variable.

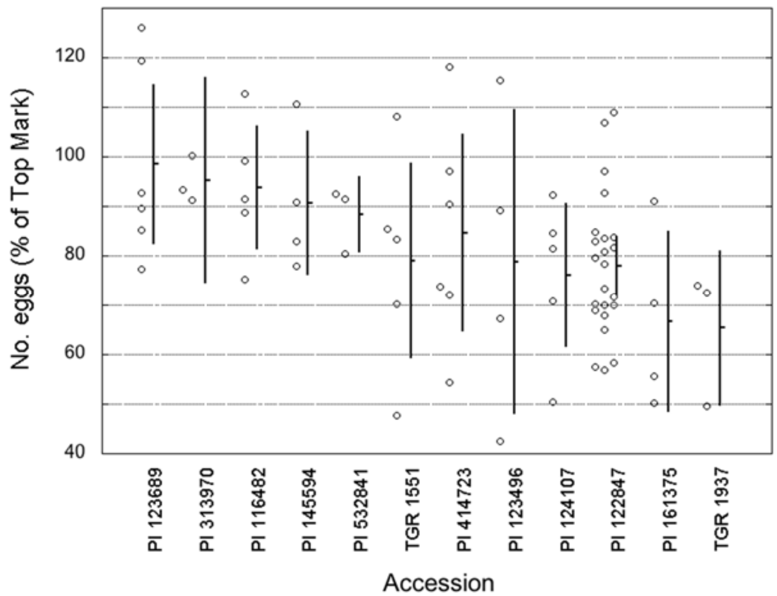


Figure 5. Confidence (95%) intervals and means for whitefly oviposition on 12 melon lines expressed as percent of susceptible commercial USWSM type melon 'Top Mark'.

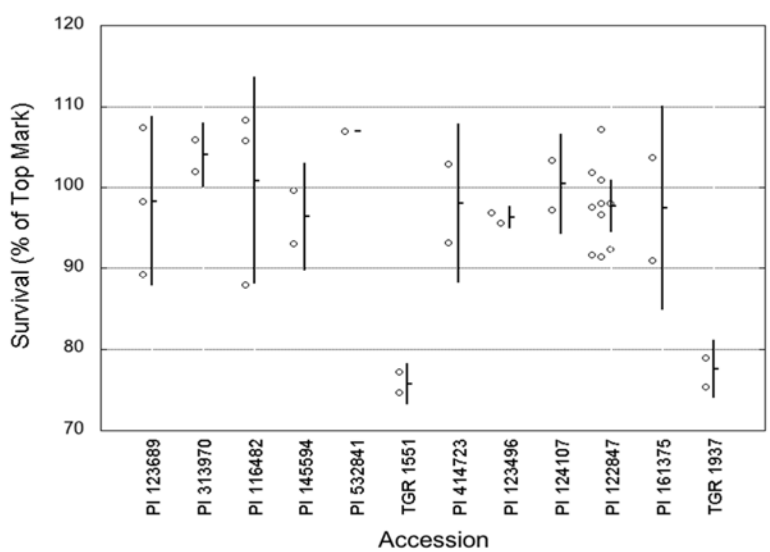


Figure 6. Confidence (95%) intervals and means for whitefly larval survival to adult on 12 melon lines in greenhouse tests expressed as percent of 'Top Mark' in each respective test; data points represented the means of different tests.

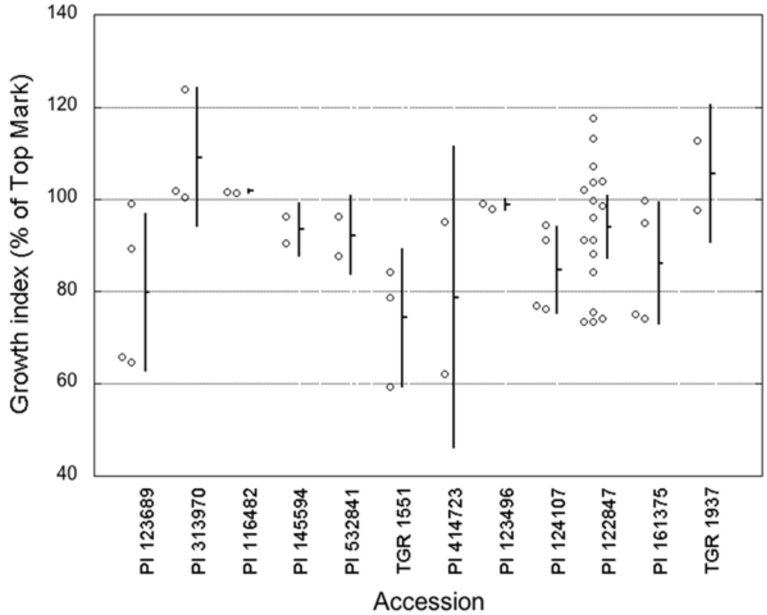


Figure 7. Confidence (95%) intervals and means for whitefly growth index on 12 melon lines expressed as percent of 'Top Mark'.

Identification of effective RNA targets that will reduce whitefly fitness and block virus transmission, and RNAi construct design and efficacy evaluation in melon:
A total of 262 genes were differentially expressed between whiteflies that fed for one, three, or seven days on either healthy (virus free) melon plants and melon plants infected with the whitefly-transmitted virus, CYSDV. Expressed genes were compared with those of previous studies on *Tomato chlorosis virus* (ToCV) a closely related virus from tomato in which over 1,000 genes were differentially expressed between whiteflies that fed on healthy tomato and tomato infected with ToCV at one and three days. This allowed the project team to identify genes differentially expressed between both healthy plants and plants infected with each virus, and should indicate genes and possibly pathways that are commonly altered in whiteflies in response to feeding on plants infected with this type of virus (genus *Crinivirus*, family *Closteroviridae*). Direct comparison of significantly differentially expressed genes identified 59 genes that were differentially expressed in whiteflies after feeding on either ToCV or CYSDV. This will lead to a better understanding of how whiteflies are influenced by the presence of the virus in the plant.

Another advantage of using transcriptome analysis on whiteflies in response to virus infection was that this provided information on the entire whitefly transcriptome. This information will be useful for design of RNAi approaches that can be evaluated as a possible strategy for whitefly control in cucurbits and other crops. Cucurbits are some of the most severely impacted crops in the US with losses resulting both from direct damage and plant collapse caused by whitefly feeding, as well as loss to production caused by whitefly transmitted viruses, including CYSDV and other viruses. RNAi holds a promise as a technique with tremendous potential to control sap sucking pests, such as the whitefly, *B. tabaci* on cucurbit production. To this end the project team used information gained from analysis of the whitefly transcriptome in response to feeding on CYSDV-infected melon plants to design and begin testing plants for evaluation of RNAi

constructs that caused high levels of mortality in adult whiteflies that may also reduce numbers of immature whiteflies (eggs and nymphs).
Double stranded RNA (dsRNA) was designed and ordered from a vendor. Two kinds of constructs were evaluated separately to determine efficacy for whitefly control:
Concatemers, which involved sections of more than one gene in tandem (Figure 8) and individual constructs (data not shown). For individual constructs, those that showed some promise individually were combined to determine if improved control could be obtained when used together (Figure 8). Constructs were suspended in a 20% sucrose solution at a concentration of 40 µg in 100 µl sucrose solution. Twenty whiteflies were placed into individual glass vials and the vials covered with a thin layer of Parafilm®. A second layer of Parafilm® was placed above the first and the 100 µl sucrose solution was added between the layers. Whiteflies were allowed to feed on the sucrose solution through the membrane for five-days, with daily monitoring of mortality compared with controls treated with either sucrose solution alone, or sucrose solution with a dsRNA construct from watermelon (WM) that did not correspond to anything in the whitefly genome (Figure 8).

RNAi construct design and efficacy evaluation:
Six concatemer constructs were developed for RNAi control of whiteflies based on information gained through transcriptome studies. Concatemer constructs were tested using the sucrose-based *in vitro* feeding assay method for seven days as described above, in which each construct was suspended in a sucrose solution and acquired by whiteflies in a vial feeding through a Parafilm® membrane (Figure 8).

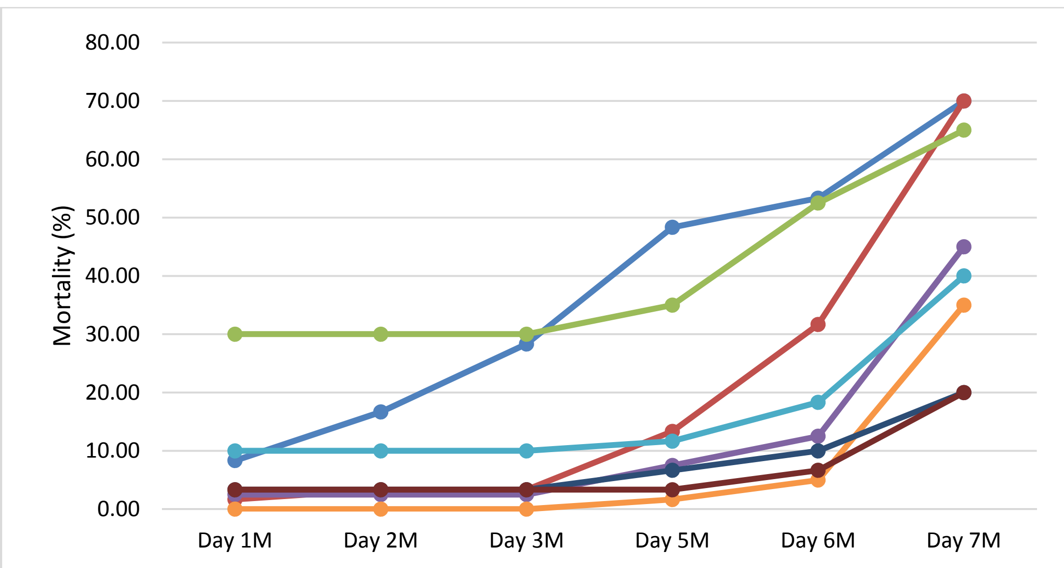


Figure 8. Whitefly mortality (%) in response to artificial feeding on seven concatemer constructs (see Table 1 for color codes), where 40ng of each construct in 100 µl of 20% sucrose solution used in each feeding experiment. Sucrose was a control without addition of dsRNA. WM is a watermelon gene dsRNA used as a negative control. Twenty whiteflies tested per vial; three replications.

Table 2. Percent mortality for six concatemers and controls shown in Figure 8.

	Day						Color
Construct	1M	2M	3M	5M	6M	7M	code
1	8.33	16.67	28.33	48.33	53.33	70.00	Lt. Blue
2	1.67	3.33	3.33	13.33	31.67	70.00	Orange
3	30.00	30.00	30.00	35.00	52.50	65.00	Gray
4	2.50	2.50	2.50	7.50	12.50	45.00	Yellow
5	10.00	10.00	10.00	11.67	18.33	40.00	Dk. Blue
6	0.00	0.00	0.00	1.67	5.00	35.00	Green
WM	3.33	3.33	3.33	6.67	10.00	20.00	Turquoise
Sucrose	3.33	3.33	3.33	3.33	6.67	20.00	Red

In addition, 35 individual dsRNA constructs were evaluated using the same *in vitro* feeding assay described above. The most effective constructs out of the 35 were used in combinations of two for artificial feed method. Results are shown below with combination tests represented by codes (Figure 9).

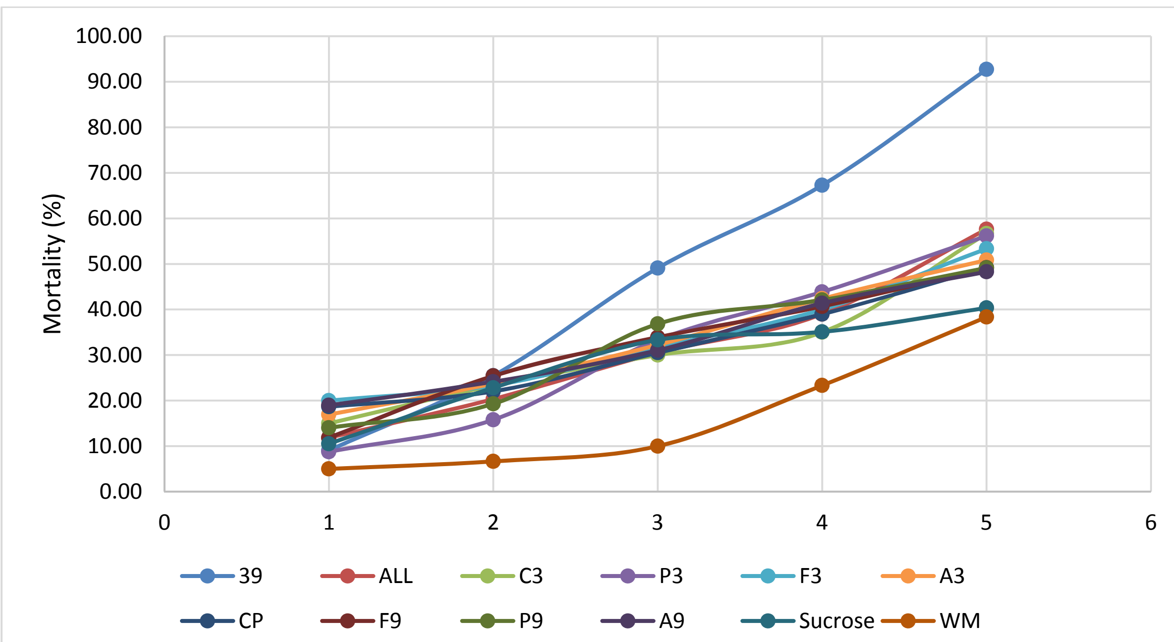


Figure 9. Whitefly mortality (%) in response to artificial feeding on ten paired RNAi constructs (Table 3), where 40ng of each of two constructs combined together in 100 µl of 20% sucrose solution in each feeding experiment. Sucrose is a control without addition of dsRNA. WM is a watermelon gene dsRNA used as a negative control. Twenty whiteflies tested per vial; three replications.

Table 3. Percent mortality for experiment involving combined constructs shown in Figure 6.

	Day				
Construct	1M	2M	3M	4M	5M
39	9.09	25.45	49.09	67.27	92.73
ALL	11.86	20.34	30.51	38.98	57.63
C3	15.00	23.33	30.00	35.00	56.67
P3	8.77	15.79	33.33	43.86	56.14
F3	20.00	23.33	31.67	40.00	53.33
A3	16.95	23.73	32.20	42.37	50.85
CP	18.64	22.03	30.51	38.98	49.15
F9	11.86	25.42	33.90	40.68	49.15
P9	14.04	19.30	36.84	42.11	49.12
A9	18.97	24.14	31.03	41.38	48.28
Sucrose	10.53	22.81	33.33	35.09	40.35
WM	5.00	6.67	10.00	23.33	38.33

In summary, the ability to evaluate the transcriptome of whiteflies led to the identification of 262 whitefly (*B. tabaci*) genes that were specifically up- or down-regulated in response to feeding on CYSDV-infected melon. Fifty-nine of these genes were also identified as specifically up- or down-regulated from a previous study in response to feeding on tomato infected with a related virus. This suggested very specific responses by the whitefly to the presence of this type of whitefly-transmitted virus in plant sap and may have implications to block or interfere with the virus acquisition or transmission process. This information was also useful in identifying genes that may be useful targets to induce whitefly mortality through an RNAi system. This information will be used in preparation for additional studies to evaluate delivery methods that may facilitate RNAi-based control in melon and other crops.

All grant project expenditures were tracked and monitored to ensure that grant funds were used to solely benefit the competitiveness of specialty crops.

Project Partners:
The Principal Investigator, directed the project, organized, planted and evaluated the field plantings, evaluated for reactions to CYSDV, directed the greenhouse whitefly studies, and analyzed the data.

Co-Principal Investigator, assayed plants samples for virus content, carried-out the controlled CYSDV-inoculation studies, and directed the RNAi studies

Contractor, coordinated field activities, managed the chemical control of whitefly in the field tests, and sampled the whiteflies in the field tests.

Goals and Outcomes Achieved

All proposed project activities were completed in order to achieve the performance goals and measurable outcomes. All project initiatives and objectives will be beneficial in the long run.

The project team was successful in achieving goals 1, 2 and 4 (Goal 4 was an additional goal added to further enhance the project. All four goals were identified in the Project Summary). Transfer of CYSDV resistance (introgression) to high quality shipping melons (Goal 3) will continue to progress slowly due to recessive genetic control of CYSDV resistance. Considerable work remains for whitefly resistance. Reported sources of resistance were compared with potential new sources of resistance that the project team identified in field and greenhouse tests, but it was not clear which was the best way to address this trait. Therefore, inheritance of resistance to whitefly remains to be determined.

1. CYSDV resistance: three sources of resistance were reported in the literature, including one reported by this project prior to the grant. Now additional sources have been identified, one with better fruit quality than the original three sources.
2. Whitefly resistance: a few sources of resistance were identified in the literature under different conditions. The team identified additional putative sources of resistance in response to whitefly feeding under high populations in the field. PI 313970 and PI 122847 appeared to provide some level of resistance in the field. Greenhouse studies indicated little difference among the lines for oviposition resistance. TGR 1551 and TGR 1937 were clearly superior for antibiosis to larval development (survival; Figure 6). TGR 1551 was one of the, perhaps, three accessions that exhibited a form of antibiosis that slowed larval development (lower growth index; Figure 7). These results suggest the possibility that the resistance in PI 313970 and PI 122847 may have been due to antixenosis (non-preference). When given a choice, the whiteflies would move to a more preferred host. TGR 1551 and TGR 1937 clearly exhibited antibiosis to larval development, with TGR 1551 also exhibiting a second form of antibiosis that reduced the growth index of whitefly larvae.
3. RNAi control of whitefly: this approach was a rapidly developing new means for insect control of virus vectors. Fifty-nine whitefly genes were identified up- or down-regulated by acquisition of the CYSDV that may be exploitable for control of whitefly.

Successful Outcomes:

1. Confirmed that putative new sources of resistance to CYSDV were not better than the first three sources reported in the literature, in terms of virus content and symptom expression. But the fruit and plant characteristics of one of the putative new sources of resistance produced fruit that had many characteristics of USWSM type melons that may prove helpful for combining CYSDV resistance with desired fruit quality (size, color, sweetness, etc.).
2. Confirmed whitefly resistance field and greenhouse studies of putative and reported sources of resistance, and gained insight about the mechanisms of resistance.
3. Identified the potential for control of whitefly through RNAi-based approach to whitefly control.

Beneficiaries

1. The California melon industry will benefit from a clear understanding of the nature of CYSDV and whitefly resistance in melon, the breeding progress made, and the potential for RNAi-based approaches to whitefly control.
2. The California melon seed industry will benefit from the knowledge of additional sources of resistance to CYSDV. Many of these companies were international in scope and could apply this information to their other markets affected by CYSDV and whitefly.

Beneficiaries: The large groups that will benefit from this project are the California melon growers (circa 200) and shippers (circa 50), and melon breeding companies (circa 10). In addition, when CYSDV- and whitefly-resistant is deployed in elite melon cultivars, field workers will benefit from a renewed fall melon industry that, potentially, will be grown with reduced pesticides in Imperial, Coachella and Palo Verde Valleys. Successful development and application of the RNAi-based approach to whitefly control will also reduce pesticides usage and could, potentially, result in later and lower rates of CYSDV infection, thus, improving yield

Lessons Learned

Development of RNAi techniques/technology enabled the project team to make significant evaluation of the potential for this approach to whitefly control. This is potentially an eco-friendly approach that has potential to greatly reduce insecticide applications.

Additional Information

No additional information.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 54	**Project Title:** Biological Control of Brown Marmorated Stink Bug		
Grant Recipient: California Department of Food and Agriculture		**Grant Agreement No.:** SCB13054	**Date Submitted:** December 2016
Recipient Contact: Charlie Pickett		**Telephone:** (916) 262-2053	**Email:** charlie.pickett@cdfa.ca.gov

Project Summary

First introduced from Asia to the Mid-Atlantic States in the mid 90's, the Brown Marmorated Stink Bug (BMSB) is well established in Oregon and Washington, and at the time of this submission had been reported in seven cities in Southern California, and at one site in northern California. Due to its polyphagous appetite and ability to rapidly spread, most small fruits, fruit trees, nut trees, and field crops in California are threatened by this pest. The significant crops at risk are stone and pome fruits, tomatoes, peppers, grapes, nut trees, and citrus. BMSB has over 300 reported hosts including deciduous trees and weedy grasses, usually feeds on fruit, but can feed on all parts of plants. It can lay eggs on non-plant materials and seeks man-made structures where it overwinters, all which enable long distance travel. BMSB can be controlled using pyrethroids and carbamates, but heavy reliance on these products is not desirable since it will likely lead to chemical resistance and disruption of existing natural enemies. A survey will provide information on where BMSB is located, how fast it's spreading, and non-crop host plants. Providing a biological control alternative has the potential to greatly reduce pesticide costs to both the agricultural industry and in urban settings. Three species of *Trissolcus* have recently been found in China attacking BMSB eggs at high rates: 50-80%. Preliminary results show candidate parasitoids have a strong preference for BMSB. Native egg parasitoids in eastern U.S. typically attack less than 5% of their hosts. The California Department of Food and Agriculture (CDFA) intend to release these egg parasitoids after completing host range testing in California.

No information was available on the distribution of BMSB in California when this projected was funded. The BMSB had been reported in a number of locations in California, but there were no data on how rapidly it was spreading and building up in the state, as well as its proximity to centers of agricultural production. The pattern of infestation by this pest in eastern United States strongly suggested BMSB represents a serious threat to California specialty crop production. From the time BMSB was first reported in Pennsylvania in the mid 90's, about 15 years passed before the pest dispersed from urban centers and started causing serious damage to commercial agriculture. Economic damage had been recently reported for apples, peaches, cherries, tomatoes, pecans, and hazel nuts in eastern U.S. Maryland and West Virginia in 2009 reported serious economic loss to stone and pome fruits, as did Pennsylvania, New Jersey, and Virginia. BMSB, like other pentatomids, feed and cause economic damage primarily to the fruit of plants. They feed by piercing the tissue of plants and extracting their fluids. The bugs inject saliva into plant tissue to aid in digestion, causing browning and discoloration of fruit. Adults and all but the first instar nymphal stages also feed on leaves, stems, petioles, flowers, and seeds thus aiding in their survival and spread. Damage to fresh market fruit leaves them unmarketable and more sustained damage can cause rejection of fruit used in processing. Damage can be light to severe with complete crop loss. Fruit flesh may become soft and its surface concave. Severe damage causes fruit to abort. Secondary infections by pathogens are common. BMSB has been documented to change the flavor in some crops, which could prove important to the wine industry. However studies have yet to demonstrate that their associated odors will affect the final product. The anticipated damage caused by this invasive pest will undoubtedly result in greater pesticide usage and thus additional production costs to many growers throughout California.

Although conventional pesticides can control BMSB in fruit trees and field crops, their cost and undesirable side effects create hardship to the agricultural industry. Newly discovered egg parasitoids commonly associated with BMSB in eastern Asia, its native home, showed much promise for use in the United States. One of the most sustainable, long term solutions for controlling invasive, exotic pests is the reuniting of coevolved natural enemies with their prey or hosts. Several species of *Trissolcus* had been recently discovered attacking BMSB in China and were undergoing testing by the United States Department of Agriculture (USDA) Agricultural Research Service. However, to obtain a field release permit, the same types of tests needed to be done on non-target resident stinkbugs in Western United States. The same parasitoids were available to California for testing at the time this proposal was submitted for review.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

Two of the three main objectives were addressed. The state was surveyed for BMSB and its resident natural enemies through use of pheromone baited traps, pest detection reports coming into CDFA, sentinel eggs, and field cameras. Secondly, the host specificity of the BMSB egg-parasitoid *Trissolcus japonicus* was evaluated for nine non-targets using a combination of 'no-choice' and 'choice' tests. *Trissolcus japonicus* was not released because host specificity testing was not completed and a petition for a field release permit was not pursued.

Each year the number of traps placed around the state increased as staff learned of new BMSB populations and their spread. During the last year of field work, 2015 (see Figure 1) 59 pheromone baited traps were placed in 19 counties (# traps) and serviced monthly replacing lures and collecting trapped arthropods: Alameda (1), Butte (6), Contra Costa (1), El Dorado (4), Fresno (3), Glenn (6), Kern (3), Lassen (4), Marin (2), Merced (1), Plumas (4), Sacramento (5), San Joaquin (3), Santa Clara (1), Siskiyou (1), Stanislaus (1), Sutter (1), Tulare (1), and Yolo (11). Most of these traps were located in urban settings though some (Butte, Glenn, and El Dorado counties) were placed near stone, pome, or other fruit tree orchards. In the southern half of the state a total of 45 monitoring traps were deployed and serviced monthly as above in 10 counties: Merced (5), Madera (1), Fresno (3), Tulare (3), Kern (8), San Luis Obispo (2), Ventura (2), Los Angeles (15), Riverside (2), San Diego (15). These traps are in the vicinity of various agricultural crops including citrus, pistachio, kiwi, peach, apple, avocado, grape, banana, and strawberry. BMSB life stages (egg masses, nymphs, and adults) have only been recovered from Los Angeles trap locations.

The number of counties with reproducing BMSB populations increased from 2 in 2013 to 9 as of spring 2016. All reports to date have come from traps or individuals in urban centers, or bordering commercial agriculture. There have been no reports of economic damage to agricultural commodities. Please see Figure 1 below.

Fig. 1. BMSB trap catches as of spring 2016.

Populations appear to be building fastest from Stanislaus County north to Butte County where there is a concentration of stone fruit and nut crops surrounding a string of small to large cities. The number of BMSB trapped per sample (averaged over year) in central and northern California shows most bugs were trapped in Sacramento and Stockton (San Joaquin County) (Fig. 2). Although Sacramento saw one of the highest populations recorded in 2013, it was almost entirely limited to one square block. Most of the drop in BMSB catches in the Sacramento area from 2013 to 2014 was due to the removal of several traps, and the addition of others by a cooperator (data not included), and the dispersal of the population to outlying areas. However, results from Stockton show a continuous increase in trap catch rates from 2013 to 2015, most likely reflecting a broader, longer established population of BMSB (Fig. 3). Significant populations have been found in Modesto, Stanislaus County and San Jose, Santa Clara County, and in Davis, Yolo County. High populations have also been found in Yuba City (Sutter County) and Chico, Butte County. BMSB has just been trapped for the first time in Napa County, and at a winery in Yolo County.

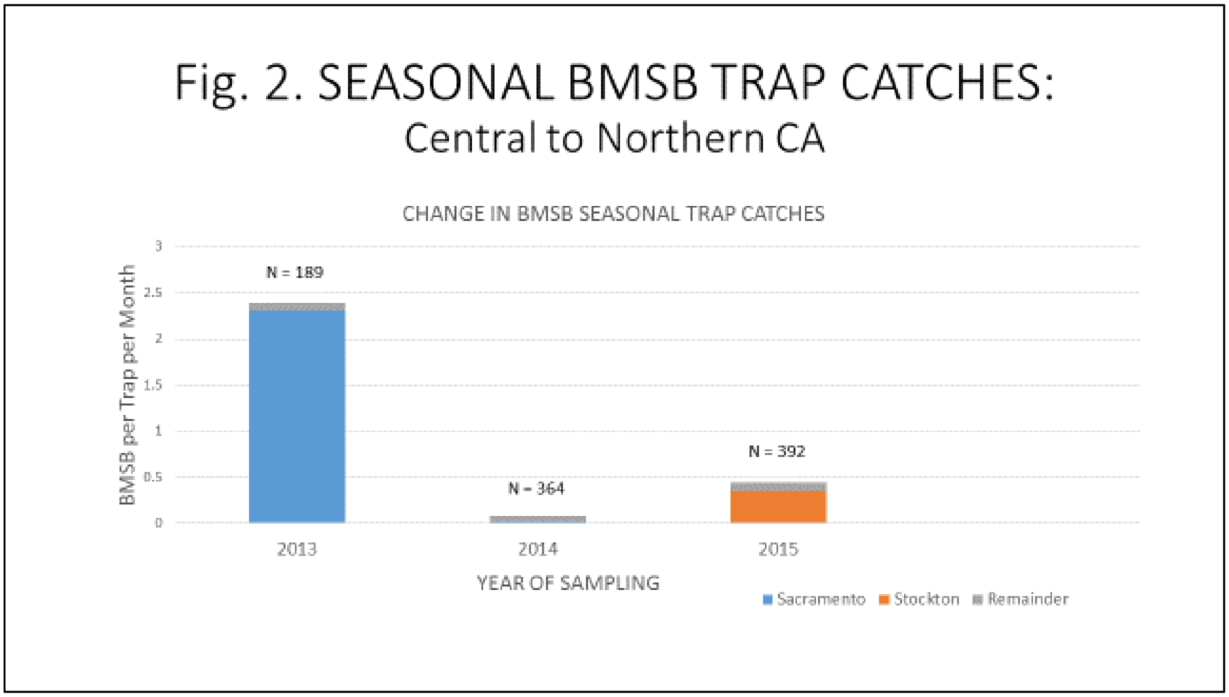


Fig. 2. SEASONAL BMSB TRAP CATCHES:
Central to Northern CA
CHANGE IN BMSB SEASONAL TRAP CATCHES
BMSB per Trap per Month
N = 189
N = 364
N = 392
0
0.5
1
1.5
2
2.5
3
2013
2014
2015
YEAR OF SAMPLING
Sacramento
Stockton
Remainder

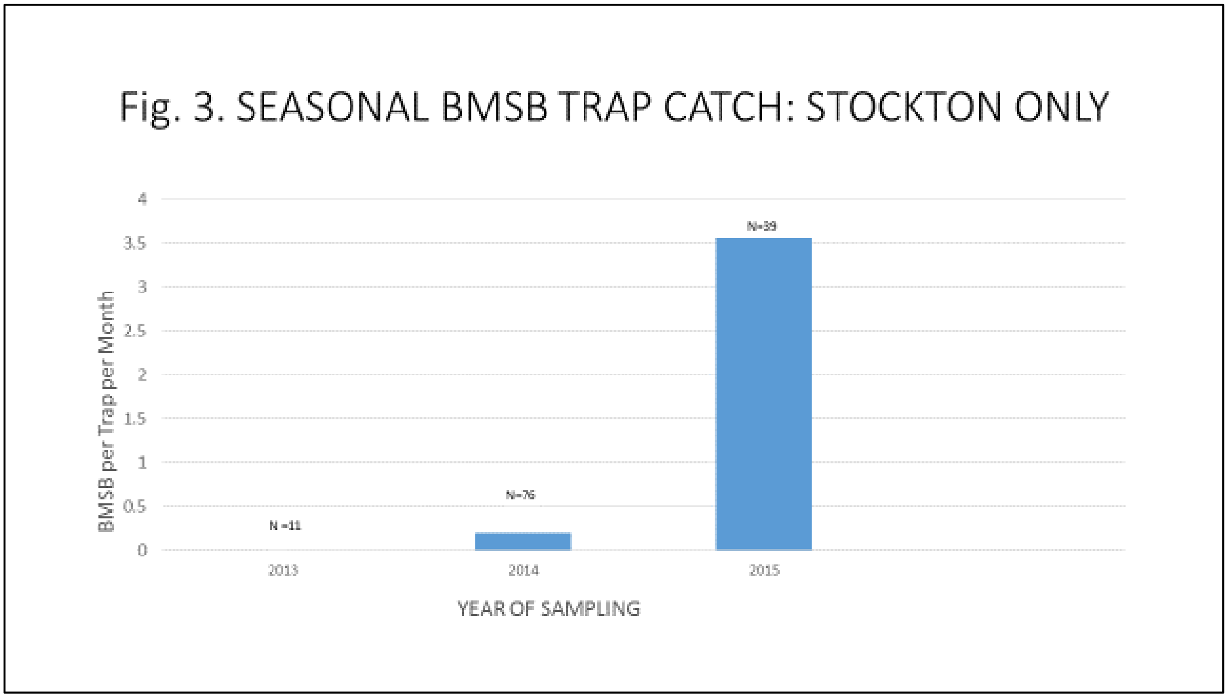


Fig. 3. SEASONAL BMSB TRAP CATCH: STOCKTON ONLY
BMSB per Trap per Month
N =11
N=76
N=39
0
0.5
1
1.5
2
2.5
3
3.5
4
2013
2014
2015
YEAR OF SAMPLING

Across most locations in central and northern California, the two most common natural enemies picked up in BMSB traps have been tachinid flies (*Euclytia flava*) and sphecid wasps (*Astata occidentalis*). From 2013 to 2015 and averaged over 11-21 counties, trap catches of *Astata* spp. varied from 0.27 to 0.8 per trap per season, while *Euclytia flava* varied from 0.18 to 0.64 per trap. One species of *Astata*, *A. unicolor*, was imaged dragging a BMSB nymph into its den in downtown Sacramento. This genus is known to specialize on stink bugs as prey.

Sentinel eggs were placed at 17 locations in northern California and 5 in southern California across 19 counties. In total, over 745 cards with sentinel eggs were placed in the field in 2015 and a similar number in 2014. In 2015, 15 were attacked by native parasitoids in the genera *Trissolcus*, *Anastatus*, and possibly other members of Scelionidae. Parasitoids emerging from sentinel eggs in northern California have been identified to species: *Trissolcus bracymenae* and *T. euschisti*, and *Anastatus pearsalli* (Eupelmidae) both common egg parasitoids of stink bugs in California. Two of 286 deployed cards (0.7%) from northern California were attacked and 13 of 282 (4.6%) in the southern part of the state. Imaging of sentinel cards was conducted at 6 of 17 sentinel card locations in northern California. The most common predator recorded feeding on eggs in the Sacramento regions was the carabid beetle, *Laemostenus complanatus*, followed by the earwig, *Eurborellia annulipes* (Labiduridae). A second earwig, *Forficula auricularia*, was recorded near Chico in an area bordering commercial orchards. On one occasion, a field cricket, most likely *Gammarotettix* sp., was imaged at the Chico site. Ants have been seen near sentinel cards but never eating or removing eggs. At one home site in Sacramento, a rat (most likely *Rattus norvegicus*) repeatedly removed all eggs from cards. This unusual 'predator' may have been drawn onto this property due to a chicken coop. On average 7% of eggs were removed through predation, excluding the rat's impact, and 11% including its impact.

Trees were surveyed in Sacramento once in the fall at peak BMSB populations in 2013, 2014 and 2015. The cities of Yuba City and San Jose were surveyed only once each because large populations of BMSB were not found precluding collection of data on bug – tree associations. Of 26 – 34 species examined over these years, twelves trees in Sacramento were found supporting populations of BMSB. These were ranked each year based on the percentage observed with BMSB on them then pooled over all three years: [(number of trees associated with BMSB/total recorded for that species)* 100]. Tree of heaven, Chinese pistache, and crepe myrtle were ranked highest, in descending order: 54%, 40%, and 20%, respectively. BMSB also had strong associations with sunshine elm (*Ulmus propinqua*) and trident maple (*Acer buergerianum*). All of these are Asian in origin.

Safety testing evaluations for *Trissolcus japonicus*, a BMSB egg-parasitoid sourced from China, were conducted from June 2014 to June 2016 at the UC Riverside Quarantine and Insectary Facility using a unique group of non-target stink bug species that is representative for the southwestern region of the U.S. These evaluations were part of the required environmental risk assessment that must be completed before *T. japonicus* can be released for BMSB control in California under a future permit issued by the USDA Animal and Plant Health Inspection Service. Selected non-target species included *Agonoscelis puberula, Antheminia remota, Bagrada hilaris, Banasa dimiata, Chlorochroa uhleri, Nezara viridula, Mecidea sp., Podisus maculiventris* and *Thyanta pallidovirens.* Among these*, A. remota, C. uhleri, B. dimidiata, Mecidea sp., P. maculiventris* and *T. pallidovirens* are native to the U.S., while *A. puberula, B. hilaris* and *N. viridula* are native to Africa. Adult stink bugs of these species were collected from several field sites in California under CDFA-approved permits and maintained in rearing cages for production of egg masses used for parasitoid exposure trials.

Safety testing evaluations were designed to follow an ecologically-meaningful, two-tier approach involving 'no-choice' and 'choice' tests. First, the purpose of 'no-choice' exposure was to unambiguously assess the inherent ability (yes/no) of the parasitoid to produce viable offspring (a measure of parasitism success) from non target hosts in the absence of the target pest, BMSB. Parasitism results collected from the first tier of testing help narrow down the list of non-target species that require further evaluation. For example, non-target stink bug species that were never parasitized successfully by *T. japonicus* in laboratory 'no-choice' trials (designed to inflate the risk of encounter with *T. japonicus* to 100%) are expected to face no significant threat (i.e., parasitism) from encounters with *T. japonicus* in the field, should they occur incidentally, on the basis that no viable parasitoid populations are expected to result from chance encounters between *T. japonicus* and these non-target host species from California. Consequently, the second tier level of safety testing focused only non-target species that were successfully parasitized by *T. japonicus* in 'no-choice' trials. 'Choice' exposure trials provided further information on the degree of preference and ability *T. japonicus* has for attacking BMSB host eggs in the presence of non-target species. An outline of the experimental setup for both safety tests is given below.

In no-choice trials, individual naïve female *T. japonicus* were first given direct access to a single non-target stink bug host egg mass in a dram vial, with no BMSB eggs. On the second day, as part of positive control treatment exposures, each female *T. japonicus* was transferred to another dram vial containing a single BMSB egg mass, i.e., the target pest species and coevolved reproductive host of this egg-parasitoid species. Control exposures with BMSB eggs confirmed that experimental female parasitoids were functionally healthy (i.e., able to parasitize eggs and produce viable offspring from BMSB eggs) during the experimental testing period and support the validity of conclusions drawn from collected parasitism data. In standardized 'choice' exposure trials, naïve female *T. japonicus* were given a binary choice of potential host eggs, i.e., a BMSB egg mass was paired with a non-target stink bug egg mass. The conclusions stemming from no-choice and choice test were made by comparing egg parasitism rates between BMSB and non-target species.

Under this experimental framework, 230 no-choice replicate sets (i.e., a total of 460 drams and roughly more than 12,000 eggs from BMSB and non-target stink bug species combined) were set up to evaluate the host range of *T. japonicus*. *T. japonicus* adults never eclosed from host eggs of *A. puberula*, *B. hilaris*, or *N. viridula* and this implies that *T. japonicus* poses no risk to these non-target stink bug species. In contrast, egg masses of *A. remota*, *B. dimiata*, *P. maculiventris*, *Mecidea* sp. and *T. pallidovirens* were, in some cases, successfully parasitized by female *T. japonicus* and produced both male and female offspring. Nevertheless, for these replicates, egg parasitism levels were consistently higher for *T. japonicus* on control BMSB eggs (i.e., >40% of all BMSB eggs were parasitized) even though these parasitoids had previous exposure to non-target host eggs and could have parasitized all of those non-target eggs. This result points to the underlying affinity *T. japonicus* has for BMSB as its coevolved natural enemy.

With one exception, preliminary choice trials (53 replicate sets; ~1,000 stink bug eggs) involving *T. pallidovirens*, *P. maculventris*, and *Mecidea* sp. also indicated that levels of parasitism were higher on BMSB than on these non-target hosts. In the case of *B. dimiata*, successful egg parasitism from *T. japonicus* reached ~30% (of all eggs used in these trials) and a similar level was detected for BMSB. However, choice testing is not complete for *B. dimiata* and these results simply indicate that the potential interaction *T. japonicus* may have with this non-target species will require future study to estimate the likelihood of these encounters (risk) under field conditions.

Activities of this project only benefited specialty crops. To ensure this project solely benefited California specialty crops, CDFA's surveys focused on counties with specialty crops at risk. Traps were placed in the vicinity of various specialty crops including citrus, pistachio, kiwi, peach, apple, avocado, grape, banana, and strawberry.

Project partner Post-Doctoral from UC Riverside and his research staff conducted the host specificity testing for *T. japonicus* and surveillance of BMSB populations from Los Angeles County as part this grant.

Goals and Outcomes Achieved

The primary goal of this project was to introduce into California a novel, highly specific, biocontrol agent of the BMSB. Two of the three objectives are discussed below: (1) mapping the distribution of BMSB in California, and surveying for resident natural enemies, and (2) host specificity testing. No activities associated with the third objective concerning release of the candidate biocontrol agent were conducted.

The mapping of BMSB throughout California was achieved. With the help of the University of California Cooperative Extension, and using CDFA's Pest Detection Reporting database, the areas in the state knowingly affected by BMSB were tracked. By mapping these results over three years, one can see a clear expansion in the distribution of BMSB. The most concentrated populations appear to be along the eastern side of the Sacramento Valley, north into Butte County. BMSB is predicted to spread to the foothill regions of northern California based on climatic factors in common with its natural distribution in China (Zhu et al. 2012). Shown in Figure 4 is the predicted distribution for BMSB in western United States. The black dots show established populations as of 2012 and the red triangles are results from our survey showing established populations as of late 2015. This stink bug is naturally associated with trees, thus the large numbers of trees planted in the urban centers of this region, along with the high acreage of orchards provides a natural setting for the spread and expansion of this pest.

Through trapping and use of sentinel egg cards an initial survey has been completed on the types of natural enemies attacking BMSB in Sacramento and near Chico. All of these data come from urban areas, or the interface between urban and agriculture. Three predators and three parasitoids have been identified as attacking and feeding on BMSB. A carabid beetle and two species of earwigs were imaged feeding on eggs, and a predacious wasp and parasitic fly were repeatedly caught in traps, indirect evidence they may play a role in reducing numbers of BMSB. However, less than 5% of egg masses were attacked by the resident parasitoids and less than 11 % of eggs were eaten by predators, leaving much of the population surviving to later instars. Parasitoids rarely attack nymphal or adult stages.

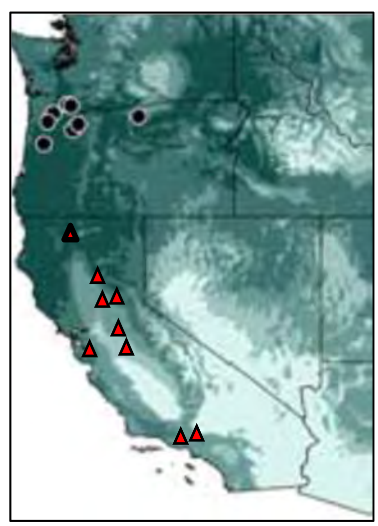


Fig. 4, from Zhu et. 2012. Red triangles show established BMSB based on this study and black dots from previous surveys.

Surveys of street trees were conducted each of the three years in mid-town Sacramento. The town of Yuba City and San Jose were surveyed once each, but large populations of BMSB were not present when this was done, precluding estimates of bug – tree associations.

Colonies of BMSB and nine non-target stink bugs were established and maintained at UC Riverside for host specificity testing of *T. japonicus.* California is one of several states conducting the risk-assessment of this prospective BMSB biological control agent which is intended for release in several areas across the U.S., including California, where the economic threat from growing BMSB populations is increasing and this pest is a significant concern for specialty crop industries. Therefore, active communication has been maintained with other U.S. BMSB research groups from OR, FL, DE and MN to ensure key non-target species and standardized testing methods have been included as part of the safety testing for *T. japonicus* in California. The majority of 'no-choice' trials were completed along with an initial portion of 'choice' trials. Completion of 'choice' tests will require an additional field season, after which a release permit can be secured. Current results from 'no-choice' and 'choice' testing have demonstrated that *T. japonicus* has a selective ability to attack BMSB eggs over those from non-target stink bug species. This favorable outcome is encouraging for implementing an effective BMSB classical biological control program to protect and enhance the competiveness of California's specialty crops.

The primary goal of measuring host specificity has taken longer than anticipated. This involves both no-choice and choice tests. The first part has been completed, but the second is required for a field release permit. The final goal is reduction of BMSB through releases of a permitted parasitoid, *T. japonicus*.

The goal of producing a map showing the distribution of BMSB has been completed. However, due to the continuous spread of BMSB, this map will become outdated shortly. Good progress was made in determining natural enemies with potential to attack BMSB. An estimate was made on how effective they were in reducing BMSB eggs. Host specificity testing was largely completed, but more work needs to be done. Without a field release permit, the last objective, release of *Trissolcus japonicus* is not possible.

Prior to this project, no maps existed on the distribution of BMSB in California or the rate of its expansion. Although information on locations of BMSB interceptions was available, no effort had been made to summarize it in a meaningful way. Well established, reproducing populations now occur in nine counties, up from two when this project started. This represents a 4.5 fold increase over nearly 3 years. To date, no agricultural commodities have reported economic damage from this pest. This could change soon, considering the rate of this pest's expansion. The types of resident natural enemies attacking BMSB have been documented in eastern United States, but not in California. The first records for native parasitoids have been recorded and these are similar to species on the east coast. No one had imaged predators feeding on sentinel egg masses at the beginning of our study. The predacious beetle and earwigs, plus the rat, feeding on these eggs is information new to science and the agricultural community

The rate of expansion of the BMSB population was measured over the course of this project. At the outset, only two counties were known to have established, reproducing populations and now there are nine, a 4.5 fold increase in number of counties in less than three years. In Stockton BMSB trap catch rate per month went from 0 to 3.5 from 2013 to 2016. At least one new predator was imaged feeding on BMSB eggs, *Laemostenus complanatus*, most likely a new record for North America. This species is usually found in urban centers which could prove beneficial for control of BMSB since this stinkbug enjoys overwintering in human domiciles. These predators appear to be correlated with populations of BMSB in Sacramento, based on trap catches (Ingels, unpubl. data).

In addition, more than 400 safety testing evaluations (replicates) were conducted for *T. japonicus* and this effort generated a greater understanding of the potential risk this candidate biological control agent represents for non-target species. *A. remota*, *B. dimiata*, *P. maculiventris*, *Mecidea* sp. and *T. pallidovirens* were parasitized by *T. japonicus*, but rates of successful parasitism were higher on BMSB and frequently reached 100% (of all eggs from an eggs mass). These results were anticipated because BMSB is the coevolved host of *T. japonicus.* These documented findings will form the basis of a science-based risk assessment report that will accompany the permit request for release of *T. japonicus* in California.

Beneficiaries

The agricultural community should find the map of BMSB in California and host trees helpful in both developing pest management strategies and justifying funding or action towards developing control strategies. Results from the host specificity testing will ultimately help in the national effort to obtain field release permits for *Trissolcus japonicus*.

Homeowners throughout the state, especially the northern third, will benefit from information gained on natural enemies. It's clear there are some predators capable of feeding on eggs of BMSB and should be conserved.

There are over 55,000 growers of specialty crop trees that will benefit from the map produced during this project. All can now make more informed decisions on how to to deal with BMSB as it begins to move out from urban centers bordering these commodities. Also, everyone will benefit from this projects goals once the parasitoid *T. japonicus* is eventually released and widely established.

Lessons Learned

The time required to conduct the specificity testing was greater than anticipated. Much of that was consumed by finding, then establishing numerous stink bug cultures needed for choice tests.

The one objective not achieved was obtaining a field release permit. This can only be done once both no-choice, then choice tests are completed. The latter wasn't. However, the project team made a great deal of progress towards this end and are positioned to quickly complete these tests and submit a petition for a field release permit.

Additional Information

A review paper on our project's accomplishments was published in California Agriculture: http://calag.ucanr.edu/Archive/?issue=70_1 Biological control program is being developed for brown marmorated stink bug. California Agriculture volume 70 (1).

Literature Cited:

Zhu, G., W. Bu, Y Gao, and G. Liu. 2012. Potential geographic distribution of brown marmorated stink bug invasion (Halyomorpha halys). Plos One: volume 7 issue 2, 10 pp.

Selected Presentations (e.g., commodity boards, professional meetings, pesticide applicator workshops):

Hoddle M.S. What is biocontrol and how do we use it in the urban landscape? CAPCA LA Meeting, LA Arboretum 301 N. Baldwin Ave., Arcadia CA. 16 Nov. 2016.

Hoddle, M.S. What's bugging California?: Invasive pests in the garden. Ameal Moore Nature Center, Sycamore Canyon, Riverside. 21 Jan. 2017 (this was a 3 hr extension session 11:00am to 2:00pm, powerpoint presentation and displays of pickled and pinned insects of new invasive pests in California)

Lara, J.R., C. Pickett and M.S. Hoddle. Biological control of brown marmorated stink bug in California: Status and prospects. International Congress of Entomology, symposium. Orlando, FL. September 26, 2016.

Lara, J.R., M. Kamiyama and M.S. Hoddle. Brown marmorated stink bug update (pistachios). Pistachio Working Group Meeting. July 13, 2016.

Lara, J.R., C. Pickett and M.S. Hoddle. 2015. California BMSB biocontrol research updates. BMSB NEIPM Working Group Meeting. Winchester, VA. December 2, 2015

Lara, J.R.,C. Pickett, and M. S. Hoddle. Progress of monitoring and biological control research of the brown marmorated stink bug, Halyomorpha halys, in southern California. ESA 63rd Annual Meeting. Minneapolis, MN. November 17, 2015.

Lara, J.R., and M.S. Hoddle. Brown marmorated stink bug (BMSB) biological control and invasion updates from southern California. California Association of Pest Control Advisers Meeting. Santa Paula, CA. September 9, 2015.

Lara, J.R., and M.S. Hoddle. Biological control of brown marmorated stink bug in California. Pesticide Applicators Professional Association Meeting. San Diego, CA. July 8, 2015.

Lara, J.R., M.S. Hoddle, and C. Pickett. Brown marmorated Stink Bug (BMSB): monitoring & biological control research progress in southern California. USDA Specialty Crop Research Initiative (SCRI) Planning Meeting for BMSB Research. Portland, OR. April 29, 2015.

Lawson, M. and C. H. Pickett, 2016. Brown Marmorated Stink Bug. Yolo County Outreach event.

Pickett, C. H. New invasive pests important to California Agriculture. UC Cooperative Extension, Merced, October 2013.

Pickett, C. 2013. Brown marmorated stink bug: potential damage in California. UC Cooperative Extension, Lake County Annual Laws & Regulations Grower Meeting, Lakeport, CA. December 2013.

Pickett, C. 2014. Two emerging pests of economic importance to California. PAPA meeting, Susanville, CA.

Pickett, C. 2014. Brown marmorated stink bug: potential for biological control. California Wine Commissioner meeting, Lodi, CA. May 2014.

Pickett, C. 2015, R. Lara-Ariga, M. Hoddle, K. Daane, and Sin-geng Wang. Brown marmorated stink bug and Olive fruit fly. Turlock grower fair. November 2015.

Posters at Industry and Professional Meetings:

Pickett, C. H. M. S. Hoddle, J. Lara-Artiga, and M. Stadtherr. 2014. Distribution of brown marmorated stink bug in California and its extant natural enemies. Entomological Society of America National Meeting. Portland, Oregon.

Ingels, C. J. Lara Artiga, C. Pickett, and M. Hoddle. 2015. Brown marmorated stink bug: serious threat but biological control shows promise.

Blog (University of California):

Pickett, C. H., C. Ingels, M. Hoddle, and J. Lara-Artiga. 2016. UC and CDFA researchers make progress in fight against exotic brown marmorated stink bugs.

http://calnat.ucanr.edu/green_blog/?blogtag=Brown%20marmorated%20stink%20bug&blogasset=18704

Publications:

Pickett, C. H. Potential for biological control of brown marmorated stinkbug in California. April 2014. LoCA: The Wines of Lodi, California Newsletter.

Lara-Artiga, J., C. Pickett, C. Ingels, D. R. Haviland, E. Grafton-Cardwell, D. Doll, J. Bethke, B Faber, S. K. Dara, and M. Hoddle. Biological control program is being developed for brown marmorated stink bug. 2016. California Agriculture. January-March, pp. 15-23.

Webpage:

http://www.stopbmsb.org/where-is-bmsb/state-by-state/ca/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 55	**Project Title:** Development and Implementation of a Strategy for Durable Resistance to Lettuce Downy Mildew in California	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13055	**Date Submitted:** December 2016
Recipient Contact: Richard Michelmore	**Telephone:** (530) 752-1729	**Email:** rwmichelmore@ucdavis.edu

Project Summary

Lettuce is grown as extensive monocultures in California, often with several crops per year. Such intensive production makes the crop susceptible to major disease epidemics. Downy mildew, caused by the obligate oomycete pathogen, *Bremia lactucae (B. lactucae)*, is the most serious foliar disease of lettuce in California and worldwide. Resistant cultivars and chemical applications are currently used to combat this disease. However, the pathogen is highly variable and can rapidly change to overcome such crop protection measures. It is necessary to characterize and monitor the population of *B. lactucae* to determine which resistance genes and sources of wild germplasm will provide effective durable resistance against the pathogen population in California. This is especially important for the ever increasing number of organic growers who cannot supplement resistant cultivars with chemical applications.

Lettuce (Lactuca sativa L.) is one of the top ten most valuable crops in the United States with an annual farm-gate value of over $2.9 billion. Over 80% of lettuce production occurs in California and Arizona. A large component of the economies in the lettuce production areas, such as the Salinas, California and Yuma, Arizona valleys, directly or indirectly depend on the production and processing of lettuce. Disease resistance is a major factor in determining profitability of lettuce production. Therefore it affects the farm supply industry and related industries where workers spend their income. Consequently, the deployment of more disease resistant cultivars as the result of this project will have direct, indirect, and induced economic benefits.

When genetic sources of disease resistance are available, breeding is the cheapest, cleanest, safest, and most dependable method of crop protection available. However, since *B. lactucae* is continually changing genetically in response to the deployment of resistant cultivars, constant monitoring of the pathogen and incorporation of new resistance genes into breeding programs are essential.

The project was eminently feasible and timely. The protocols for manipulating and characterizing this obligate biotrophic pathogen was a routine in the University of California (UC) Davis lab. Project staff have been monitoring *B. lactucae* in California since 1982; however, due to the labor resources required this had been done on an opportunistic basis and usually less than 50 isolates could be analyzed per year resulting in an incomplete picture of what was happening. It was apparent, however, that seemed to be increasing amounts of novel variation in virulence phenotype. New technologies are now available for rapid, inexpensive DNA sequencing and high-resolution genotyping of isolates. Project staff have sequenced the genome of *B. lactucae* and the understanding of the molecular determinants of pathogenicity is advancing rapidly. It is now possible to characterize isolates for candidate genes determining virulence. This provides the opportunity to establish a pipeline of resistant lettuce cultivars based on knowledge of pathogen variability that will increase the evolutionary required of the pathogen to become virulent; therefore this project results will enhance the durability of resistance and consequently reduce reliance on chemicals.

Plant breeding is a long-term endeavor that relies on inputs of wild germplasm with useful characteristics such as disease resistance and well-adapted cultivars as recipient material. It is increasingly data and technology driven. This project provided comprehensive data on variability of *B. lactucae* in California. This informs and will be the foundation for the on-going lettuce breeding efforts that are funded by the California Leafy Greens Research Program (CLGRP).

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

Project Approach

Collection of isolates from all growing areas of California: During the project period, the project staff made monthly collecting trips covering all of the major lettuce production areas of California that were coordinated with Cooperative Extension Agents and Pest Control Advisors (PCAs). They also developed a network of collaborating PCAs, seed company personnel, and pesticide company personnel who supplied additional isolates. From October 2013 to June 2016, a total of 484 isolates were collected and analyzed at UC Davis. In addition, collaborators, Enza Zaden USA, Monsanto Vegetable Seeds, Mission Ranches, Rijk Zwaan, and Syngenta, characterized 141 isolates and contributed their phenotypic data to this project. The total number of isolates characterized phenotypically during the project period was 627.

Phenotyping of isolates for virulence phenotype, mating type, and fungicide sensitivity: The virulence phenotype for all 484 isolates and the mating type of 457 isolates have been completed. Sensitivity to the fungicide, metalaxyl, began to be tested on isolates collected at the end of 2014 due to availability of the product. Fungicide sensitivity for the 296 isolates collected has been completed.

Of the eight designated Pathotypes of *B. lactucae*, only Pathotypes VII and VIII were detected from multiple locations. Pathotypes V and VI were only found in the desert areas of California. Pathotypes I to IV were not detected.

From 2013 to 2015, about 60% of isolates had novel virulence phenotypes that did not match the known Pathotypes. In 2016, 87% of isolates had novel virulence phenotypes and Pathotypes V and VI were not detected. Both mating types were detected at an approximately 1 to 7 ratio of B_1 to B_2 isolates, sometimes from the same field, indicating the potential for sexual reproduction and increased variability. Sexual reproduction therefore seems to be playing a larger role in changing the virulence spectrum than it has in the past. Isolates of opposite mating type, collected in 2014 from the same field near King City in Salinas Valley, were crossed in the lab to investigate the potential of sexual reproduction to generate novel phenotypes. Results from this cross demonstrated that fit progeny can arise from sexual mating. The 15 progeny isolates analyzed had a wide range of virulence phenotypes; some were similar to the designated Pathotypes, but most were novel. Both B_1 and B_2 mating types were observed in the progeny as were isolates with high levels of mefenoxam insensitivity.

Analysis of field isolates for mefenoxam sensitivity demonstrated that there are both sensitive and insensitive isolates distributed across the production areas of California at about a 1 to 2 ratio. Comparisons between field isolates with similar phenotypes to the progeny isolates showed that there is higher similarity between the progeny isolates and field isolates collected in 2016 than to those collected in other years. This was consistent with sexual reproduction generating new novel phenotypes. The current *B. lactucae* population is very different than what it has been in the past, and steps to denominate new Pathotypes to reflect these changes are underway.

Genetic analysis of isolates by sequencing: Fifty-nine California isolates (41 historic isolates and 18 representative contemporary isolates) have been sequenced to gain an understanding of past and current variation at the DNA level. In addition, 47 archival isolates from the world-wide collection at UC Davis were sequenced to understand variation of Californian isolates in a global context. These DNA sequences were shared with United States Department of Agriculture (USDA), Agricultural Research Service located in Salinas, California to analyze variation in mitochondrial genome sequences and develop diagnostic molecular markers for lettuce downy mildew. These data revealed two distinct lineages of California isolates that were separate from the majority of European and other isolates. However, the mitochondrial genotypes did not align with the known Californian Pathotypes indicating convergence of nuclear-encoded virulence phenotypes.

Screening of lettuce germplasm: Project staff received 110 new accessions of Lactuca germplasm that were grown in the greenhouse to increase their seed and then screened for resistance to *B. lactucae*. Thirty-four germplasm accessions from Kyrghystan, Georgia, and Uzbekistan were screened with three isolates: an archival and contemporary Pathotype VIII and a novel contemporary isolate. This second isolate represented the most predominant virulence phenotype occurring this year. Ten of these 34 accessions were identified as being potential new sources of resistance. All 34 lines plus 67 additional accessions from Azerbajain were screened. UC Davis has completed the initial round of screening for 59 of the 67 lines collected in Azerbajain; 14 of these were resistant to the three isolates tested. In the coming months UC Davis will re-test the resistant lines against these and two additional isolates, one of which represents the most predominant B_1 isolate that we detected. Those that remain resistant to the five isolates will be used to screen for resistance in UC Davis introgression program.

Initiation of introgression of new resistance: Currently, ten of the new sources of resistance identified during this project are being introgressed into romaine, butterhead, red leaf, iceberg, and green leaf lettuce types. This will continue to go on past this project duration and supported with outside funding. Resistance from different sources are being introgressed into the different lettuce types in order to diversify the selection pressure on the pathogen population and prevent a variant developing on one type being virulent on all types. Seven are in the third back-cross generation, while the remaining three are in the second back cross generation. In addition to the four isolates used to screen the germplasm, two more contemporary isolates are being used to screen progeny of each cross.

All data collected from this project, including the germplasm accessions with new sources of resistance, have been deposited into the web-accessible database that the project team continues to develop (http://bremia.ucdavis.edu/). Virulence phenotypes have been displayed as they were generated allowing stakeholders to access the data expediently. Results were included as part of the annual reports to the CLGRB and presented at the biannual CLGRB board meetings.

Since March 2014, the project team participated in the biannual meetings of the International Bremia Evaluation Board, US branch (formally ABEB, now IBEB-US), which is an organization coordinated by lettuce breeding companies to utilize the information generated by the project to officially denominate Pathotypes of *B. lactucae*; these will then be used to characterize commercial lettuce cultivars as being resistant or susceptible to predominant strains of downy mildew. The results were also discussed at the first meeting of the IBEB in Murcia, Spain, in April 2015 so as to coordinate nomination of predominant strains of the pathogen worldwide.

This project does not benefit commodities other than specialty crops.

Goals and Outcomes Achieved

Goal 1): To develop a comprehensive knowledge of the variability of the pathogen, *B. lactucae*, that causes downy mildew in California. Performance measure: Collection, phenotyping, and genotyping of approximately 25 isolates sampled from throughout California on a monthly basis for 2.75 years. Benchmark: A detailed understanding of pathogen variation in terms of candidate genes responsible for virulence and avirulence. Target: Identification of 10 representative isolates of *B. lactucae* for use in screening germplasm for resistance.

Project staff made monthly collections of lettuce infected with downy mildew in the major production areas throughout California. All isolates were phenotyped using standardized protocols for virulence phenotype, mating type, and mefenoxam sensitivity. Representative isolates were identified and sequenced by UC Davis DNA Technologies Core. Sequence data have been and are currently being analyzed by the project team and the USDA-Agricultural Research Service in Salinas, California.

Goal 2): To generate knowledge as to which wild germplasm accessions of Lactuca spp. will be donors of effective resistance genes for breeding programs. Performance measure: Identification of at least 100 accessions that are resistant to the 10 representative isolates of *B. lactucae*. Benchmark: Completion of screening of germplasm for resistance to all 10 isolates. Target: Inputs for a pipeline for generating advanced breeding lines with new resistance genes.

Five isolates were identified as representative of the most predominant and virulent isolates collected during the project's duration and were inoculated onto new germplasm accessions. Collectively, they were virulent on all the previously known resistance genes. Individual accessions were chosen as sources for introgression of resistance into genotypes adapted for California.

Goal 3): To implement a new resistance breeding paradigm that is driven by pathogen population and lettuce germplasm data to provide more durable disease resistance. Performance measure: Initiation of at least five parallel backcross programs to introgress and combine new resistance genes into each of the four major types of lettuce (over 20 total). Benchmark: Release of resistant germplasm accessions within the timeframe of the project and advanced breeding lines with multiple new resistance genes within five years of the end of the project. Target: Durable resistance of lettuce to downy mildew and reduced fungicide use.

Ten resistant accessions have been crossed with California cultivars of butterhead, iceberg, red leaf, green leaf, and romaine lettuce types. Progeny of each back cross were screened with the same representative isolates used to initially screen the germplasm. Each generation takes approximately six to nine months and will therefore continue after the conclusion of this project. The outcome measures for goals 2 and 3 will continue beyond the duration of this project funded with other sources. So far, 34 germplasm accessions have been screened and ten new sources have been identified (Goal 2). These new sources have been incorporated in UC Davis's lab's CGLRB-funded breeding program and advanced breeding lines are scheduled to be released in the next three to five years (Goal 3).

Goal 1): The proposed number of isolates to be collected and analyzed per month was 25; therefore the total after 2.75 years would be 825 isolates.

The actual number of isolates collected was 484 and seed company collaborators characterized an additional 141 isolates and contributed their phenotyping data to the project; therefore the total number of isolates for this project was 627. This number was lower than the target mainly due to low amounts of disease in the summer and fall months each year because of the abnormally dry conditions in the coastal production areas.

Goal 2): The expected number of representative isolates for use in screening germplasm was ten. The actual number used was six. Six isolates representing the major virulence phenotypes could be used that were collectively virulent on all of the known resistance for germplasm screening. The number for new sources of resistance was projected to be over 100.

Ten were actually identified. Less than 200 new germplasm accessions were acquired during this project. Consequently, not many new sources of resistance could be found.

Goal 3): The initiation of the introgression of ten new sources of resistance exceeded the proposed goal. Project staff have successfully completed objective in conducting monthly surveys over the 2.75-year long project resulting in the characterization of 627 isolates. Project staff have gained a detailed understanding of variation in the current population of *B. lactucae* in California that indicated which resistance genes will be effective and when fungicide applications would be useful. Both mating types were found in a $B_1 : B_2$ ratio of approximately 1:7, indicating the increasing importance of sexual reproduction in generating variation in the *B. lactucae* population in California. The frequency of novel virulence phenotypes that differed from a designated Pathotype increased from 2013 to 2016 (39%, 45%, 47%, and 87%, respectively). New Pathotypes are currently undergoing the denomination process in order to address this change. Ten new sources of resistance that provide resistance to all tested isolates have been identified and are currently being introgressed into cultivars of five different lettuce types.

Beneficiaries

The seed companies have a clearer picture of which resistance genes are currently effective as well as several new resistance genes to incorporate in their breeding programs. Advanced breeding lines resistant to the current pathogen population in California are being generated, which will assist the smaller seed companies that do not have long term breeding programs that access wild accessions. It will also increase the diversity of lettuce varieties that developed for California and made available to growers and consumers. The growers, particularly organic ones, have information as to which cultivars are likely to be resistant. Conventional growers will have disease resistant crops that are more economical to grow because they will not require applications of expensive chemical protectants. Also, growers are less likely to experience yield losses due to their disease resistance being rendered ineffective by changes in the pathogen population. Consumers will benefit from reduced applications of chemical protectants and higher quality lettuce.

The project facilitated the formation of the American Bremia Evaluation Board (ABEB) in 2014 by breeding companies and UC Davis. This is a breeding company coordinated group that will nominate official Pathotypes for *B. lactucae* in the western United States using a similar protocol to that used in Europe by the IBEB. In May 2015, there was a joint meeting of ABEB and IBEB and it was decided to coordinate the activities of both groups under a single IBEB umbrella with two sub-groups IBEB-EU and IBEB–US responsible for activities in Europe and the US, respectively. Both groups will use the same core differential set of resistant cultivars so that data can be compared. When isolates of the same virulence phenotype are observed in multiple years and locations in California that overcome important Dm genes, they will be nominated for designation as a new Pathotype. A reference isolate will be distributed to the companies to confirm the phenotype and its stability; if confirmed it will be designated as an official Pathotype and used in cultivar resistance descriptions.

There are three beneficiaries of this project: 18 seed companies, numerous growers, and a broad cross section of society as consumers that access the website.

Lessons Learned

Project team was able to shorten the time necessary to phenotype an isolate by half (from 3 months to 1.5) by streamlining culturing processes. However, phenotyping 25 isolates per month proved not to be feasible. Consequently, the project team aimed at 15 to 20 isolates per month; this seemed to provide an informative picture of variation present. Over the whole project period, the average was 15 isolates per month; due to the recent increase in novel phenotypes, it may be necessary in the future to increase this to 20 isolates per month.

At the beginning of the project the B_1 mating type was thought to be rare and sexual reproductive inconsequential in generating variation in California. However, this project clearly demonstrated the presence of the B_1 mating type and the potential for sexual reproduction. It also documented the recent big increase in pathogen variation. Sexual reproduction also results in the production of oospores that can survive in the soil for multiple years. This will tend to alter the epidemiology of the disease, increasing the potential for earlier and more widespread epidemics.

It was previously thought that infections within single fields were genetically uniform resulting from single initial infections. However, the project found multiple instances where more than one virulence phenotype was identified from individual fields indicating several infections and complex epidemiology within lettuce production areas.

The goal of understanding the extent of variation of *B. lactucae* was achieved. However, the total number of isolates collected and analyzed was a little below that originally proposed. This was partly due to the drier than usual conditions as well as intensive use of fungicides making it harder to find isolates. In addition, analyzing the large number of isolates proved to be more labor intensive than anticipated and maxed out the labor and space resources. Future monitoring should aim to phenotypically characterize 15 to 20 rather than 25 isolates per month. In addition, the development of Polymerase Chain Reaction (PCR) based molecular markers would allow the more processing of numerous isolates and allow selective phenotyping of novel genotypes.

The number of new germplasm accessions screened was less than proposed. This was due to the difficulties in acquiring new accessions due the increasingly restrictive constraints of conventions regulating international germplasm movement. Project staff have screened all of the new accessions that were acquired; this resulted in the identification several new sources of resistance. Acquisition of new germplasm is a slow process that should continue to be pursued through official channels.

Additional Information

Additional information about Bremia database can be accessed through the website http://bremia.ucdavis.edu/.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 56	Project Title: Release of a Promising Natural Enemy for Biocontrol of Olive Fruit Fly	
Grant Recipient: The Regents of the University of California, Berkeley	**Grant Agreement No.:** SCB13056	**Date Submitted:** December 2016
Recipient Contact: Kent M. Daane	**Telephone:** (559) 284-5931	**Email:** kdaane@ucanr.edu

Project Summary

Table and oil olives are unique California specialty crops threatened by the olive fruit fly (OLF), which invaded California around 1998. Table olives have a near zero tolerance for the OLF and are primarily located in the Central Valley, where the summer heat helps to suppress the OLF populations. Over the past decade, oil olive acreage has increased tremendously, with many orchards located in the cooler coastal regions where fly populations have grown to excessive numbers. Current management strategies have relied on frequent applications of insecticide bait (spinosad) sprays, which has resulted in the development of the fly's resistance to spinosad, increased control costs and non-target impacts. Moreover, the effectiveness of insecticide-based programs has been hindered by abandoned and residential olive trees that act as reservoirs for fly populations. In order to develop sustainable management strategies, classical bio-control programs were initiated in 2003 to introduce effective natural enemies for the control of this invasive pest. Several agents were evaluated and screened at the University of California, Berkeley's (UC Berkeley) quarantine facility. The project team, identified one of the most promising natural enemies, a parasitic wasp *Psyttalia lounsburyi* (*P. lounsburyi*) that could specifically attack and kill OLF maggots.

Through the course of this project, the project team continued efforts to mass-produce, release and evaluate the establishment and spread of *P. lounsburyi* in coastal olive growing regions where the olives were usually heavily infested and where the parasitoid was most likely to impact OLF populations. The project objectives were to 1) determine factors needed for parasitoid establishment (e.g., landscape, climate, olive varieties) and develop optimal release strategies (e.g., numbers of parasitoids released, seasonal release periods); 2) quantify field dispersal patterns and seasonal dynamics; and 3) release, monitor the establishment, and record the impact of *P. lounsburyi* in released areas.

The olive industry in California had been almost pest free prior to the introduction of OLF. Major olive insect pests such as the olive scale, *Parlatoria oleae* Colvée, and the black scale, *Saissetia oleae* (Olivier) had been substantially suppressed by introduced parasitoids. OLF had successfully spread throughout all parts of California where olives were grown, and was capable of infesting 100% of the fruit on a tree, rendering the harvest unmarketable. At the time of this project, management recommendations included application of GF-120 once weekly or twice monthly from two weeks prior to olive pit hardening (early June) until fruit was harvested in the fall (for table olives) or winter (for oil production). California's olive industry also faced fierce competition from the European markets. The added expense to control OLF was a hardship for growers and had forced some individuals out of olive production entirely.

The project's goal was to introduce and establish specialized natural enemies of OLF in California. Existing insecticide-based programs targeted only the adult fly and could be limited by the fact that many ornamental olive trees in non-crop habitats provided the pest a large reservoir. This highlighted a need for an area-wide control approach. Biological control had the potential to play an important role in Integrated Pest Management

(IPM) by reducing larval fly populations in natural reservoir habitats, even if not in cultivated crops. Significant levels of natural enemy activity in any of the key habitats could reduce numbers of flies that migrated into crop habitats, making it easier and more economical to manage the fly with a combination of other IPM methods.

A previously funded 2010 Specialty Crop Block Grant Program Project 2: *Olive Fruit Fly: Managing an Ancient Pest in Modern Times*, imported and screened in quarantine seven parasitoid species. Approval for the release of two species was granted by the United States Department of Agriculture: Animal and Plant Health Inspection Service's (USDA APHIS). *Psyttalia humilis* and *P. lounsburyi* were released and evaluated. *P. lounsburyi* was established near San Luis Obispo and San Mateo California, and shown to be the most promising parasitoid following only a limited release. The previous project's findings suggested that *P. lounsburyi* should establish in California regions with mild climates (e.g., coastal olive regions), where larger and more damaging OLF populations were found.

The current project built upon the previous work and aimed to rapidly expand the geographical range of *P. lounsburyi* in California. In fact, extensive field surveys showed that this parasitoid has permanently established in at least ten (previously two) coastal counties from Marin to Ventura and has widely spread from the two earliest release sites in San Mateo and San Luis Obispo. Parasitism had also increased over the years in the two earliest released sites.

Project Approach

In years 1-3: extensive field releases of *P. lounsburyi* were conducted in eight coastal (Sonoma, Marin, San Mateo, Santa Cruz, San Luis Obispo, Ventura, Riverside and San Diego) and two northern interior (Napa and Yolo) California counties. Release sites were selected based on identified field attributes that contributed to successful establishment. At each site, rigorous pre-release sampling and post-release monitoring on parasitism and OLF populations was conducted to determine the establishment and spread as well as the impact of the parasitoid.

In year 3: extensive post-release surveys were conducted at different times and distances from the two earliest released sites in San Mateo and San Luis Obispo to quantify the field dispersal patterns and seasonal parasitism dynamics. Lastly, all field-collected data was analyzed to determine the factors influencing parasitoid establishment.

The project's major activities and tasks included the rearing and shipment of the parasitoid *P. lounsburyi*, field release, and monitoring of the establishment, dispersal patterns and impact of released parasitoids.

(1) Parasitoid rearing and shipment: the parasitoid was mass-reared at the United States Department of Agriculture, Agricultural Research Service (USDA-ARS), European Biological Control Laboratory (EBCL) in France, and then received and processed at the UC Berkeley's Insectary & Quarantine Facility for field release in California. In total, 206,283 individual wasps (136,707 males and 69,576 females) were produced and 39,638 individual wasps (9,531 males and 30,107 females) were shipped to California for field release (Table 1). Rearing methods of this parasitoid were greatly improved in 2014 and as a result, more parasitoids were produced and shipped to California for field release in 2014 and 2015 than in 2013. About 30.8% of shipped parasitoids died either on route or shortly after arrival at the UC Berkeley Insectary Facility. Five shipments were received each year, once per month from August to December (Table 1).

(2) Field release: the parasitoid was released at 40 different sites in 10 different counties, including Yolo, Napa, Sonoma, Marin, San Mateo, Santa Cruz, San Luis Obispo, Ventura, Riverside and San Diego (Figure 1, Table 2). Upon arrival, all live wasps were released within 1-2 days and a total of 22,809 female wasps were released. Releases began in August when adequate numbers of infested fruit became available in California, and ended in December after most commercial fruit had been harvested (Table 2). Ideal release sites included clusters of ornamental trees (e.g., roadsides, parks and residential areas), organic commercial olive groves, or abandoned olive groves (trees in these sites were often heavily infested by the OLF but were treated with insecticides). Therefore, the majority of releases were made in those sites, but releases were also made in several managed olive groves in Riverside, Sonoma, Marin and Napa (Table 2).

Table 1. Parasitoid (*P. lounsburyi*) mass-reared at EBCL and shipped to California for field release

Year	Shipment	Day	Produced			Shipped		
			Males	Females	Total	Males	Females	Total
2013	1	8/22	3,041	1,719	4,760	342	354	696
	2	9/17	8,298	3,882	12,180	518	832	1,350
	3	10/16	3,437	2,115	5,552	514	736	1,250
	4	11/13	3,767	2,446	6,213	228	719	947
	5	12/10	4,811	3,572	8,383	1,014	1,233	2,247
2014	1	8/12	9,209	5,754	14,963	1,275	3,000	4,275
	2	9/2	10,214	3,725	13,939	1,079	2,149	3,228
	3	10/7	13,195	5,435	18,630	346	2,511	2,857
	4	11/12	13,352	7,716	21,068	85	762	847
	5	12/1	14,058	5,606	19,664	1,272	4,274	5,546
2015	1	8/4	5,775	3,133	8,908	336	1,560	1,896
	2	9/1	10,885	6,144	17,029	554	2,926	3,480
	3	9/29	11,193	5,953	17,146	735	3,173	3,908
	4	10/27	12,624	5,102	17,726	597	2,456	3,053
	5	12/1	12,848	7,274	20,122	636	3,422	4,058
Total			**136,707**	**69576**	**206,283**	**9,531**	**30,107**	**39,638**

Table 2. Numbers of the parasitoid (*P. Lounsburyi*) adults released in California during 2013 -2015

Year	Date	Number released	Release site	Habitat	County
2013	22 Aug.	315♀, 100♂	Cañada College	Ornamental trees	San Mateo
	20 Sept.	60♀, 15♂	Avila Beach 1	Ornamental trees	San Luis Obispo
		60♀, 15♂	Avila Beach 2	Ornamental trees	San Luis Obispo
		25♀, 10♂	David Farm 1	Ornamental trees	San Luis Obispo
		100♀, 43♂	David Farm 2	Ornamental trees	San Luis Obispo
		245♀, 113♂	San Anselmo	Ornamental trees	Marin
	18 Oct.	120♀, 30♂	David Farm 1	Ornamental trees	San Luis Obispo
		143♀, 43♂	David Farm 2	Ornamental trees	San Luis Obispo
	20 Oct.	242♀, 50♂	San Anselmo	Ornamental trees	Marin
	14 Nov.	140♀, 20♂	Avila Beach 2	Ornamental trees	San Luis Obispo
		100♀, 15♂	David Farm 1	Ornamental trees	San Luis Obispo

Year	Date	Number released	Release site	Habitat	County
		60♀, 15♂	David Farm 3	Ornamental trees	San Luis Obispo
		25♀, 10♂	Cal Poly 2	Ornamental trees	San Luis Obispo
		20♀, 10♂	Cal Poly 3	Ornamental trees	San Luis Obispo
	11 Dec.	120♀, 35♂	Avila Beach 2	Ornamental trees	San Luis Obispo
		280♀, 75♂	David Farm 1	Ornamental trees	San Luis Obispo
		350♀, 304♂	David Farm 2	Ornamental trees	San Luis Obispo
		350♀, 300♂	David Farm 3	Ornamental trees	San Luis Obispo
2014	12 Aug.	900♀, 544♂	San Anselmo	Ornamental trees	Marin
		945♀, 116♂	San Diego	Ornamental trees	San Diego
	8 Sept.	616♀, 75♂	Rossi Estate	Commercial grove	Sonoma
		703♀, 78♂	Stone Edge Estate	Commercial grove	Sonoma
	7 Oct.	741♀, 55♂	Kamen Estate	Commercial grove	Sonoma
		138♀, 10♂	Coturri Estate	Commercial grove	Sonoma
		417♀, 30♂	Moon Mountain	Commercial grove	Sonoma
		700♀, 130♂	Davis Sci. Center	Commercial olives	Yolo
	11 Nov.	550♀, 50♂	San Anselmo	Ornamental trees	Marin
		1,135♀, 255♂	Davis Sci. Center	Commercial olives	Yolo
	6 Dec.	700♀, 100♂	389 4th St. East	Ornamental trees	Sonoma
		1,249♀, 208♂	Napa City	Ornamental trees	Napa
		250♀, 50♂	Albany Village	Ornamental trees	Alameda
		400♀, 100♂	College of Marin	Ornamental trees	Marin
2015	4 Aug.	460♀ 52♂	Rincon Vista	Abandoned olives	Ventura
		500♀ 87♂	Olivewood Gard.	Ornamental trees	San Diego
		431♀ 43♂	Temecula Olives	Organic olives	Riverside
	1 Sept.	500♀ 58♂	389 4th St. East	Ornamental trees	Sonoma
		300♀ 54♂	College of Marin	Ornamental trees	Marin
		230♀ 35♂	Woodland market	Ornamental trees	Marin
		500♀ 50♂	458 Ingalls St.	Ornamental trees	Santa Cruz
		830♀ 110♂	Stubbs Ranch	Commercial olives	Marin
	28 Sept.	300♀ 30♂	2216 Las Amigas	Commercial olives	Napa
		500♀ 50♂	389 4th St. East	Ornamental trees	Sonoma
		500♀ 50♂	Berkeley campus	Ornamental trees	Alameda
		300♀ 60♂	Davis Sci. Center	Commercial olives	Yolo
		890♀ 100♂	Atascadero	Ornamental trees	San Luis Obispo
	27 Oct.	726♀ 67♂	Cliff Family Farm	Commercial olives	Napa
		500♀ 13♂	Stubbs Ranch	Commercial olives	Marin
		500♀ 13♂	Davis Sci. Center	Commercial olives	Yolo
	1 Dec.	250♀ 30♂	Summit Lake 1	Commercial olives	Napa
		550♀ 60♂	Summit Lake 2	Commercial olives	Napa
		250♀ 30♂	Gott's Property	Ornamental trees	Napa
		550♀ 60♂	Charter Oak Ave.	Ornamental trees	Napa
		550♀ 60♂	Franciscan Estate	Ornamental trees	Napa
		574♀ 70♂	E. Spain St.	Ornamental trees	Sonoma

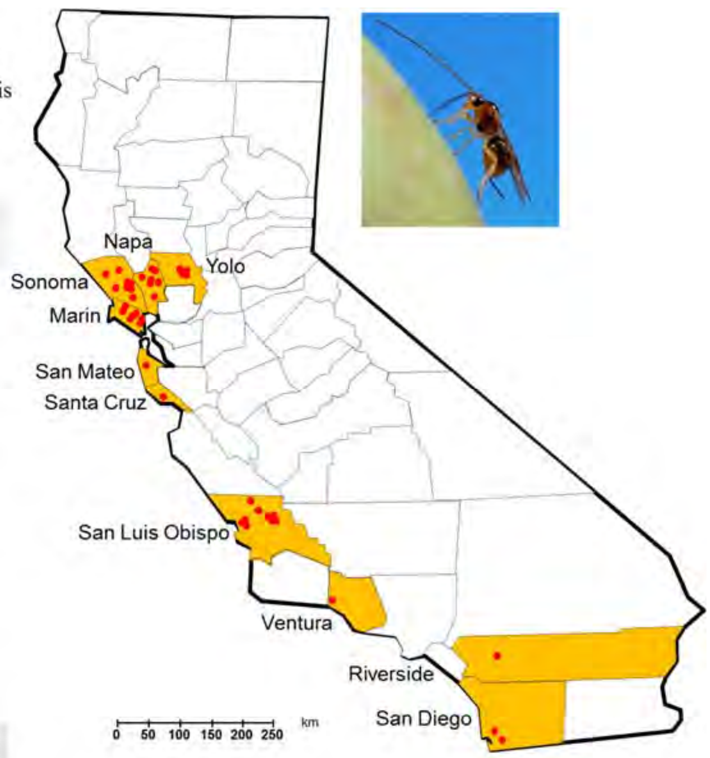
(3) Monitoring the establishment, dispersal and parasitism: Extensive surveys of infested olives were conducted in previously released sites prior to each year's release and after each new release. Surveying began in July when infested fruit became available in California. Prior to the 2013 release, pre-release samplings were conducted at two previous release sites in San Luis Obispo and San Mateo. *P. lounsburyi* was recovered at the California Polytechnic State University (Cal Poly) site 1, on August 8, 2013 in San Luis Obispo and at the Cañada Community College campus in San Mateo. This marked the two earliest established sites.

Following the 2013 release, the parasitoid was also recovered from two other sites located approximately 1,500 and 1,700 m away from the Cal Poly 1 site in San Luis Obispo, and at several sites close (< 1 miles) to the Cañada Community College campus site in San Mateo. These results showed that this parasitoid had dispersed from these two original release sites.

Figure 1. Numbers of adult female *P. lounsburyi* released in different sites and counties from 2013 to 2015. Red dots indicate release sites in each county.

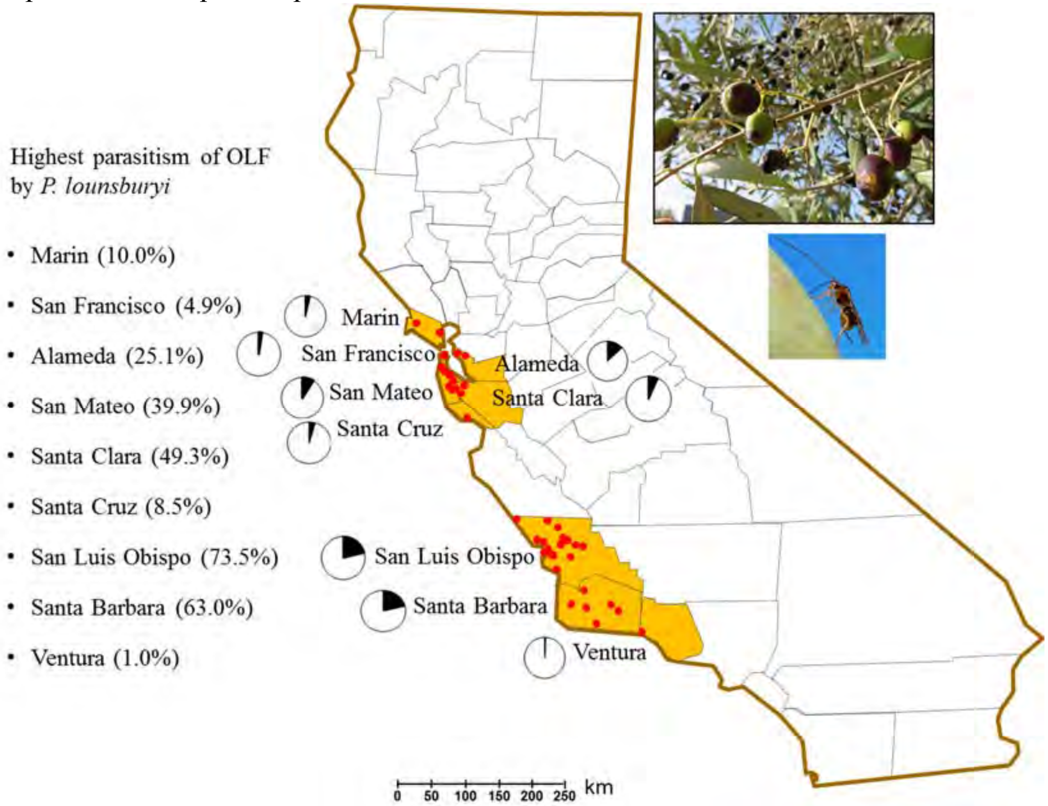
Number of adult female *P. lounsburyi* released in different counties during this project (2013-2016)

County	Number (sites)
Yolo	2635 (4)
Napa	4425 (7)
Sonoma	4858 (7)
Marin	3952 (7)
San Mateo	315 (1)
Santa Cruz	500 (1)
San Luis Obispo	3008 (9)
Ventura	460 (1)
Riverside	431 (1)
San Diego	1445 (2)
Total	**22809**



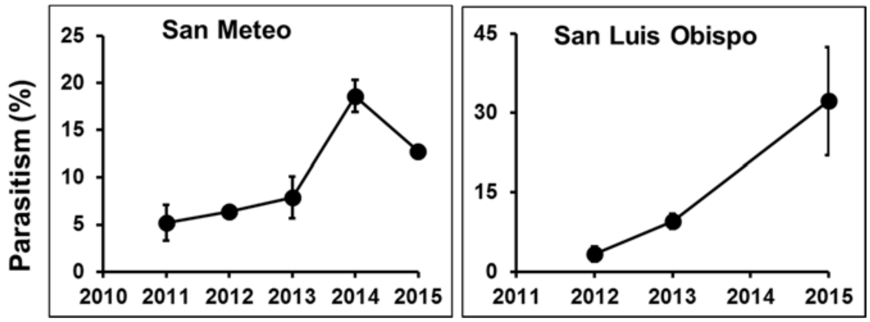
In 2014, *P. lounsburyi* was first recovered from San Anselmo, in Marin County in August before additional releases were made in 2014 and after parasitoids were first released at this location in August 2013. This marked a third location where the parasitoid had successfully overwintered and recovered the following fruiting season. *P. lounsburyi* was continually monitored at the one previously established site in San Mateo (due to low number of fruit in San Luis Obispo, this site was not sampled). Parasitism by *P. lounsburyi* significantly increased over the 2014 fruiting season, reaching a peak of 40% by end of season, and then dropped in early spring as host infested fruit dropped from trees and dried up.

Figure 2. Highest and mean parasitism of OLF by *P. lounsburyi* in different counties (based on 2015 data). Red dots indicate the release sites and dark area inside each circle represents mean percent parasitism.



In 2015, a total of 95 sites in 14 counties were surveyed and over 60,000 fruit was collected and processed in the laboratory. The project team continually recovered this parasitoid in the three early release sites in San Luis Obispo, San Mateo and Marin counties, and made the first ever recovery of this parasitoid in Alameda, San Francisco, Santa Clara, Santa Cruz, Santa Barbara and Ventura counties. It was found in all 15 sampled sites in San Luis Obispo area, 23 out of 25 randomly sampled sites from San Francisco to Santa Clara area and 30 out of 31 randomly sites in Ventura, Santa Barbara and San Luis Obispo counties. The high parasitism of OLF by *P. lounsburyi* was up to 39.9% in San Mateo, 49.3% in Santa Clara, 63.0% in Santa Barbara and 73.5% in San Luis Obispo (Figure 2). Parasitism of OLF larvae by *P. lounsburyi* increased over the years at both early release sites in San Mateo or San Luis Obispo (Figure 3). This marked a continuous, persisting population of this parasitoid following the previous releases in these earliest locations. These results demonstrated that this parasitoid had also permanently established, expanded, and had the potential to impact the population dynamics of the OLF in the coastal regions. However, *P. lounsburyi* had not been recovered in Sonoma, Napa, Yolo, Riverside and San Diego counties. The lack of recovery at these locations may have been due to either low numbers of released parasitoids or small pre and post sample sizes.

Figure 3. Mean (± SE) parasitism of OLF larvae by *P. lounsburyi* in two early release sites



All funds from this project were used to solely enhance the competitiveness of Californian table and oil olives. The accounting department also assisted in ensuring that all receipts and documents were recorded according to the project's budget narrative.

This project represented a true collaboration between various research agencies and the public sector. The Project Director (UC Berkeley) coordinated the Quarantine activities and field release and monitoring in California. The Research Specialist (UC Berkeley) conducted most of the research and report writing; several technicians at the project's laboratory assisted with the field surveys and releases; the co-PI with the California Department of Food and Agriculture helped to coordinate shipments of parasitoids from the USDA EBCL in Montferrier, France and also conducted release efforts in Marin and Yolo counties. A cooperator with Cañada Community College helped to coordinate release and recovery efforts near Santa Cruz and San Mateo, they also had a class of 20-30 students help with the release and recovery efforts. The Quarantine Manager handled shipments of the parasitoids that had arrived from France and helped move the imported material through Quarantine at UC Berkeley.

Field releases were accomplished only with the cooperation of individual olive farmers and landscape managers that allowed releases of parasitoids on their property and accepted a no-spray policy in order for the pest and natural enemy populations to be studied. These included many University of California Cooperative Extension (UCCE) farm advisors (eg., the area IPM Advisor and Acting Director, UC Statewide IPM Program; Farm Advisors in Napa, Ventura, and Santa Barbara), commercial olive growers (e.g., Enterprise Vineyards, Sonoma; Mesa Vineyard, San Luis Obispo; Temecula Olive Oil, Riverside), and numerous olive growers (San Diego, San Luis Obispo, Napa and Ventura counties).

Outreach activities:
The Project Director gave numerous talks to olive growers throughout the duration of the project. During the state-wide surveys and releases of the parasitoids, the project team also reached out to the UCCE farmer advisors (e.g., UC Statewide IPM Program, Napa, Ventura and Santa Barbara advisors), commercial olive growers (e.g., Enterprise Vineyards, Sonoma; Mesa Vineyard, San Luis Obispo; Temecula Olive Oil, Riverside), as well as individual olive growers in San Diego, San Luis Obispo, Napa and Ventura, and used these opportunities to disseminate information and research results from this project.

Goals and Outcomes Achieved

As described previously, the project team conducted wide release and extensive monitoring of the released parasitoid and quantified field establishment and dispersal patterns, seasonal population dynamics as well as the impact of the parasitoid in released areas. The collected field data was then analyzed to determine factors that could have had an affect on the establishment of the parasitoid (e.g., landscape, climate, olive varieties). This information will be useful for developing optimal release strategies (e.g., numbers of parasitoids released, seasonal release periods) for future release of *P. lounsburyi* or other parasitoids.

The short term goal accomplished by the project team was to establish *P. lounsburyi* as widely as possible in all major olive growing regions in California in a relatively short period of time. Currently, the parasitoid has permanently established in most released sites along the coastal regions from Ventura County to Marin County.

P. lounsburyi was not recovered in interior (e.g., Butte, Solano and Yolo), northern (Sonoma and Napa), and southern (e.g., Riverside and San Diego) olive growing regions. The lack of recovery in these regions may have been due to the lack of samples or due to the small number of wasps previously released. The project team continued to monitor the establishment and spread of this parasitoid and conducted more releases in late 2016 in attempt to further expand the range of the parasitoid.

The long term goal was to establish specialized parasitoids in a majority of olive growing regions in California. It was suspected that the lack of recovery of *P. lounsburyi* in some previously released regions may have been due to the fact that the tropical African parasitoid, *P. lounsburyi* appeared not to diapause during the winter. *P. lounsburyi* established only in the weather-mild olive growing regions in California. In order to achieve the long term goal of reducing the overall need to treat for OLF the project team would recommend the introduction of a more cold tolerant parasitoid such as the temperate *Psyttalia ponerophaga* (*P. ponerophaga*) from Pakistan. This parasitoid appeared to diapause at low temperatures such as those found in the states interior. This characteristic may make *P. ponerophaga* more capable of surviving the winter especially in colder olive growing regions and would be an important addition to the long term management of OLF.

All of the stated activities were accomplished within the program period.

At the beginning of the project, the parasitoid *P. lounsburyi* was found permanently established only in two counties. Through the course of the project, the parasitoid was found permanently established in at least 10 coastal counties and parasitism of OLF by the parasitoid increased steadily. Thus, *P. lounsburyi* was successfully disseminated throughout California.

After a three-year effort, both the geographical range of this parasitoid and the parasitism of OLF by the parasitoid had increased. It is expected the parasitoid will continue to play a key role in controlling this pest fly in its established regions.

Beneficiaries

California coastal olive oil producers were the primary beneficiaries. Interior Valley table and oil olive growers also benefited, but primarily through the increase knowledge of OLF biology. Landscape systems (home-owners, commercial properties, etc.) with olive trees also benefited.

There were approximately 27,000 acres of olives grown in California. In 2014-2015 fiscal year there was approximately $72,904,000 in revenue from olive orchards. In 2015, 4.0 million gallons of California extra virgin olive oil was produced. With continued work, achievement of the long term goals would reduce the need to treat for OLF, especially in coastal areas. This outcome would greatly reduce pesticide use and its impacts.

Lessons Learned

P. lounsburyi permanently established in most released sites along the coastal regions from Ventura County to Marin County. The *P. lounsburyi* continued to expand and increase its impact on OLF population dynamics. This successful experience will help in future releases of other biological control agents of OLF or other pests. However, *P. lounsburyi* has not yet been recovered in interior (e.g., Butte, Solano and Yolo) and southern (e.g., Riverside and San Diego) olive growing regions. This suggested a need for the introduction of a more cold tolerant parasitoid.

An original petition to remove *P. ponerophaga* from quarantine was submitted to USDA APHIS in 2005 (USDA APHIS PPQ 526). It was recommended that release of *P. ponerophaga* be approved after: 1) submission of a more detailed petition that included a comprehensive post-release monitoring plan; and 2) deposition of voucher specimens of the released population of *P. ponerophaga* in the national entomological collections in North America (including Canada and Mexico). In 2009, the project team resubmitted the revised North American Plant Protection Organization (NAPPO) Petition and Draft Environmental Assessment. The Committee recommended to (1) provide more information regarding the agent and the agents' host use in its native range in Pakistan; (2) discuss the establishment potential of the agent in California, with a concern that it may not diapause and be difficult to survive the seasons when host availability is likely scarce; (3) describe specific post-release monitoring plan; and (4) if possible, add more non-target test results. To date, the project team had conducted (1) more biological studies on this parasitoid's temperature range, especially its tolerance to low temperature; (2) field survey and laboratory tests of the parasitoid's host use in Pakistan; and (3) more non-target test in California. These new results showed that *P. ponerophaga* was more cold-tolerant than other released OLF parasitoids and appeared to diapause at low temperatures. All surveys in Pakistan showed that this parasitoid used only OLF as a host and did not attack other common tephritid species there. A revised petition for the release of *P. ponerophaga* was submitted in order to achieve the projects long term goal of establishing specialized parasitoids in the majority of California's olive growing regions.

The costs and difficulties in rearing the parasitoid *P. lounsburyi* limited the numbers that could be released. Five shipments of wasps were received during each fruit season, once per month from August to December. The project team discovered that release in southern California should be started in July when OLF fruit have begun to mature and become infested by OLF. The team also realized that the release in December was a little too late as the parasitoids would not be very active when field temperatures dropped below 10-15°C. It is recommended that future releases in southern California begin in July and end in November.

All goals and outcome measures of the project were considered to have been achieved.

Additional Information

Publications:

Benelli G, Daane K M, Canale A, Niu CY, Messing RH, Vargas RI. 2014. Sexual communication and related behaviors in Tephritidae – current knowledge and potential applications for integrated pest management. J. Pest Sci. 87: 449-457.
Daane KM, Wang XG, Nieto DJ, Pickett CH, Hoelmer KA, Blanchet A, Johnson MW. 2015. Classical biological control of olive fruit fly in California, USA: release and recovery of introduced parasitoids. BioControl 60:317-330.

Bon M-C, Hoelmer KA, Pickett CH, Kirk AA, He Y, Mahmood R, Daane KM. 2016. Populations of *Bactrocera oleae* (Diptera: Tephritidae) and its parasitoids in Himalayan Asia. Ann. Entomol. Soc. Am. 114:81-91.
Wang XG, Daane KM, Nieto DJ, Pickett CH *et al*. Establishment and spread of an introduced parasitoid for the control of olive fruit fly in California (in preparation).

Presentations at national and international conferences:
Daane KM. Olive fruit fly and Marshall Johnson: Controlling ancient pests in modern times. ESA's 61st Annual Meeting, Austin, TX, November 4-9, 2013.

Daane KM, Wang XG, Nieto DJ, Pickett CH, Hoelmer KA, Johnson MW. Field release and establishment of introduced olive fruit fly parasitoids in California and predication of geographical range of the parasitoids. ESA's 62nd Annual Meeting, Portland, OR, November 16-19, 2014.

La Spina M, Daane KM, Blanchet A, Hoelmer K, Pickett C, Williams L. Improvement of mass-rearing procedures for an olive fruit fly parasitoid – duration of exposure to hosts affects production of *Psyttalia lounsburyi*. 4th International Entomophagous Insects Conference, Málaga, Spain, October 4-9, 2015.

La Spina M, Daane KM, Wang XG, Kirk A, Blanchet A, Hoelmer KA, Pickett CH, Williams L. Recent developments in the classical biological control program for olive fruit fly in California. 9th Conference of Spanish Society of Applied Entomology, València, Spain, October 19-23, 2015.

Wang XG, Daane KM, Nieto DJ, Pickett CH, Blachet A, La Spina M, Williams L, Smith L, Biondi A, Hoelmer KA, Johnson MW. Establishment and spread of an introduced parasitoid for the control of olive fruit fly in California. ESA Pacific Brach Annual Meeting, Honolulu, HI, April 3-6, 2016 (invited talk for the symposium “Achievements in Recent Biological Control”).

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 57	**Project Title:** Mechanisms, Distribution, and Invasion Potential of Glyphosate-Resistant Junglerice and other Summer Grass Weeds in California Tree and Vine Cropping Systems	
Grant Recipient: The Regents of the University of California, Davis	**Grant Agreement No.:** SCB13057	**Date Submitted:** December 2016
Recipient Contact: Brad Hanson	**Telephone:** (530) 752-8115	**Email:** bhanson@ucdavis.edu

Project Summary

This project was designed to address California specialty crop tree and vine industry concerns about rapidly evolving weed management issues related to known or suspected glyphosate-resistant (GR) summer grass weeds. The research team, which included University faculty, a Cooperative Extension Specialist, University of California Cooperative Extension (UCCE) Farm Advisors, and supporting scientists, was well-equipped to address fundamental and applied questions related to understanding and managing herbicide-resistant weeds. This project largely focused on GR junglerice (*Echinocloa colona*) although many aspects are also applicable to other summer grass weeds. The research team used multiple scientific approaches ranging from the lab to the field to develop new information on the distribution, biology, physiology, mechanisms of resistance, and invasion potential of emerging GR summer grass weeds. The overarching goal of this project was to develop knowledge that could lead practical weed management practices that enhance the productivity and sustainability of California specialty crop orchard and vineyard cropping systems.

Management of herbicide-resistant weeds, especially GR biotypes, has been the most important, and the most rapidly changing, weed control issue affecting California orchard and vineyard specialty cropping systems over the past decade. While GR winter-annual weeds, including ryegrass (*Lolium multiflorum*), horseweed (*Conyza canadensis*) and hairy fleabane (*Conyza bonariensis*), are widespread in and around perennial crops, summer-annual grasses, such as junglerice, have recently emerged as the newest challenge facing orchard and vineyard specialty crop producers. Winter-annual weeds differ, substantially, from summer species with respect to growth and phenology patterns, and as a consequence, must be managed using substantially different control strategies. Hence the need to broaden understanding of how environmental and crop production practices specifically affect summer-germinating weeds.

The principal goal of this project was to develop an understanding of GR grass weed biology, phenology, and physiology. This knowledge and associated technology transfer efforts by the collaborators, support scientists, and several student trainees are contributing to the development of more effective, economical and environmentally sustainable weed management practices for orchards and vineyards, which, in turn, will improve the competitiveness of perennial specialty crops in California. Although this research focused, primarily, on the distribution, mechanisms of resistance, and invasion potential of GR junglerice in California tree and vine crops, several other summer grasses (goosegrass, fingergrass, witchgrass, sprangletop, barnyardgrass), also suspected to be GR, were addressed by some aspects of the research and extension objectives.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project. This research project was developed in response to tree nut and grape industry concerns about the rapidly growing problems with GR weeds in orchards, vineyards and other specialty cropping systems in California.

Project Approach

Multiple approaches were to be used to address the objectives of this project including: landscape-scale sampling to identify the distribution of resistance; field, greenhouse, and growth chamber evaluations to characterize growth and development; physiological and analytical laboratory and population genetics to describe the mechanism(s) of resistance.

The following are brief summaries of the activities and tasks performed; more details and data are available in Attachment 1.

1. Collect seed for screening to determine the distribution of GR junglerice in the Central Valley

   - As part of a separate weed screening project, 13 sampling regions were identified in the Central Valley for a stratified random weed survey (Moretti et al. 2016). These 13 regions encompassed a 720 km north-south area of inland California. In each region, 16 sampling sites were identified and visited by research personnel. Over two growing seasons, a total of 410 orchard and vineyard sites were visited and weed species presence documented and mature seed collected if possible. Seed from 28 junglerice populations was collected for resistance screening.

   - Populations were screened using whole plant dose-response experiments in the greenhouse. This work clearly confirmed GR junglerice in multiple locations around the Central Valley with resistance levels ranging from about 1.5 to 4x. This was later confirmed in greenhouse lines subjected to more whole plant dose-responses as well as *in vivo* shikimate assays to specifically measure glyphosate inhibition of the EPSPS enzyme.

2. Evaluate coexistence of GR junglerice and barnyardgrass in California orchards

   - Barnyardgrass presence in commercial orchards was documented as part of the junglerice screening. It was noted that junglerice was much more prevalent than barnyardgrass, although there were a few orchards where they coexisted, particularly in the Sacramento Valley. While barnyardgrass has been, historically, a significant weed for growers in California, junglerice has become a much larger concern over the past five to ten years.

3. Evaluate the risk of GR trait moving from junglerice to barnyardgrass using uni-direction forced outcrossing studies

   - The project team attempted to evaluate sexual crossing of junglerice and barnyardgrass in the greenhouse with little success in either direction (junglerice as male or female parent). Similarly, the team briefly attempted to cross junglerice with other weedy Echinochloa species common in the Sacramento Valley but also were not successful.

   - This approach did not include forcing crosses through emasculation and hand pollination, so lack of crossing does not preclude the possibility that outcrossing can happen. However, it suggests that it is not highly likely. Depending on future research directions, this question may be addressed further; the possibility of glyphosate resistance moving from *E. colona* to other weedy *Echinocloa* species or from herbicide resistant *Echinocloa* species of rice crops into orchards still presents a real risk to weed management.

- Because several target site mutations were identified and also uncovered evidence of a non-target site mechanism of resistance in junglerice, research was refocused to address intraspecific gene flow. Since junglerice is a tetraploid, it is very possible that multiple resistance alleles could accumulate in an individual and this may account for some of the variability in the level of glyphosate resistance observed in this species in various experimental and commercial settings.

4. Evaluate glyphosate uptake and translocation in GR and glyphosate-susceptible (GS) junglerice using 14C-labeled herbicide

   - The work to determine the fate of glyphosate in treated junglerice seedlings was not fully completed during the project period. Work conducted thus far indicates that there is no difference between GR and GS plants in the amount or rate of glyphosate absorption. The radioactive plant samples for the translocation work are currently in storage awaiting final processing. This part of the project was delayed by a maintenance issue with a critical piece of equipment, a reagent backorder, and a backlog of samples from other projects. This work is still progressing and will continue beyond this performance period in conjunction with a new research project.

5. Evaluate GR junglerice populations for target site (EPSPS enzyme) gene mutations known to confer glyphosate resistance

   - Whole plant response to glyphosate was evaluated in a screening of the initial 28 junglerice accessions, as well as several subsequently added populations, and was confirmed with later screenings of F2 and F3 junglerice lines. From these lines, several junglerice lines were subjected to partial sequencing of the genetic coding region for the EPSPS enzyme that is the target site for glyphosate. There are several single amino acid substitutions in this coding region for this enzyme that can result in target site resistance.

   - The normal, wildtype plants have a proline at position 106. This work identified three different mutations at position 106 resulting in some GR populations with a serine, a leucine, or a threonine. This confirms target site mediated resistance in California junglerice. However, there appears to be at least one GR population that does not have a target site mutation which raises the possibility of a non-target site mechanism also in this species.

6. Assess glyphosate metabolism in GR junglerice

   - The techniques for treating summer grass weeds with 14-C glyphosate, extracting the tissue, and monitoring for glyphosate and metabolites using HPLC coupled radiation detection has been optimized. However, progress was delayed by an instrument malfunction that has since been repaired. The metabolism work on jungle rice and two other grass species of orchards will continue in conjunction with an ongoing project.

7. Assess plasticity and phenotypic variability of GR junglerice from different regions of California in common garden experiments.

   - The work evaluating the plasticity and phenotypic variability was completed as planned. Studies were conducted in the field to evaluate junglerice response to various levels of shading at field locations in both Davis and Fresno.

   - Interestingly, there was an interaction among biotypes and shade response; some biotypes were morphologically similar under all environments while others presented vastly different architecture depending on the level of shade. This response was most notable in regards to degree of prostrateness or erectness, but also to some degree in total biomass prosecution and reproductive potential.

   - The phenological development of GR and GS junglerice was monitored to determine the effects of establishment date on the development and reproductive capacity of plants emerging early-to-late in the growing season. These experiments were conducted in 2016 and data are currently being collected and analyzed.

8. Determine effects of environmental factors on GR junglerice germination, growth, and response to glyphosate

   - Several data sets were developed to describe the growth rates and phenotypic response of GR and GS junglerice populations to different environmental factors. A series of experiments were conducted in growth chambers to compare germination rates, vegetative productivity, and reproductive output in response to a series of temperatures. This work generally showed similar temperature preferences for all of the junglerice populations tested regardless of their known response to glyphosate.

   - Representative GR and GS populations were subjected to salinity and osmotic stress at germination and salt stress was also imposed on whole plants in greenhouse studies. This work suggested that the GR population tested is slightly more robust than the GS population under challenging environmental conditions. However, due to the limited number of populations in this study, cautious interpretation is needed.

   - A study on the relative competitive ability of GR and GS junglerice was conducted using a replacement series experiment. This work did not show any clear differences in competitive ability of the two biotypes in the absence of glyphosate.

   - A laboratory experiment was conducted to compare nitrogen uptake by a GR and GS junglerice. This work did not find any differences in nitrogen uptake or nitrogen use efficiency that appeared to be biologically relevant.

   - The results from the aforementioned studies have suggested that the presence of the GR trait does not affect junglerice growth and development under a wide range of conditions. This is an important piece of information: while the GR trait may not be associated with elevated tolerances to abiotic stresses, neither does it confer any fitness penalty. In the absence of glyphosate, GR and GS biotypes appear to be equally suited to grow and develop in perennial cropping systems.

- Two studies were conducted to evaluate potential interactions between environment and herbicidal efficacy. In the first study, junglerice plants were treated with sethoxydim, glufosinate, or glyphosate and grown under conditions of shade or sun and various levels of moisture stress. In a second study, GR and GS plants were treated with glyphosate and subject to three different temperature regimes. These trials both indicated interesting and potentially meaningful interactions between environmental conditions and herbicide efficacy – even for the GR biotypes.

9. Evaluate susceptibility of GR junglerice to alternate Mode of Action (MOA) herbicides in field and greenhouse (GH) experiments

   - Over three growing seasons, members of the research team conducted several field research and demonstration trials to evaluate alternative herbicide strategies for management of junglerice in commercial vineyards and orchards in the Central Valley. These provided important information and context for the laboratory and greenhouse work and also formed the backbone of the extension programming aspects of the project. Additionally, greenhouse research was conducted to formally evaluate the performance of known GR and GS junglerice populations to other herbicides with other modes of action.

   - In general, this research did not find any evidence of cross-resistance among GR junglerice to other herbicide chemistries that control the GS populations. Additionally, the field work and extension programs strongly suggested that growers consider utilization of preemergence herbicide programs rather than rely solely on POST programs for management of summer grasses. In particular, a sequential approach to use of split or late applications of dinitroanaline herbicides was proposed as a management tactic to increase efficacy on summer annual grasses without significant increase in herbicide use.

10. Evaluate susceptibility of other summer annual grass weeds to glyphosate and alternate herbicide MOA in field and GH experiments

    - Over three growing seasons, several field research and demonstration trials were conducted in commercial orchards and vineyards infested with other summer grass weeds. Grass weeds evaluated in some of these trials included threespike goosegrass, Mexican sprangletop, feather fingergrass, and witchgrass. This work primarily supported the extension programming aspects of the project and, in some cases, suggested areas of future research for the collaborators

11. Disseminate biology and control information to California specialty crop stakeholders

    - Most of the project collaborators on this project have extension responsibilities and interests. Over the course of the project, project staff routinely participated in extension meetings and shared results via presentations, online outreach activities, and individual consultations with growers, pest control advisors, and others involved in specialty crop weed management via UCCE. Collectively, the investigators and members of their research programs delivered project-related information in at least 60 presentations, online articles, or grower-oriented media during the project period (see Attachment 1 for a partial listing).

12. Project reporting: Prepare final reports for the SCBGP; prepare journal manuscripts and extension materials

- The annual and final reports for the SCBGP were organized by the principal investigator with input on specific research and extension efforts from all collaborators. Because the majority of this research was just completed mid-2016 and some will continue after the project, no journal articles have been submitted at this time. It is anticipated at least three journal manuscripts will be submitted in January 2017. Extension materials in the form of PowerPoint presentations, online articles, and newsletter articles (see Attachment 1 for a list of extension presentations).

The benefits of the applied aspects of the research and the extension efforts apply specifically to orchard and vineyard perennial specialty crops in California, namely tree nuts, tree fruit and grapes. Some of the more fundamental aspects of the research such as molecular genetics of the GR junglerice biotypes are broadly applicable to the weed rather than to the cropping system. However, weed populations tested were specifically collected from orchard and vineyard production systems that are heavily reliant on glyphosate (including almond, walnut, pistachio and grape) but also benefit other specialty orchard crops (such as olive, prune and pomegranate, among others) that also depend on glyphosate for postemergence weed control which maintains the specialty crop focus. Importantly, all risk assessments and alternative control strategies developed apply solely to specialty crops and are not directly applicable to annual cropping systems or other non-specialty crops in California because of differences in growing seasons, tillage operations, cultural control methods and herbicide availability.

The project team members have collaborated for several years on herbicide resistant weed research. As in previous work, the team contributed to various research and extension objectives in their areas of expertise. In this project, UC Davis was the lead institution with the principal investigator responsible for project coordination and reporting.

Goals and Outcomes Achieved

The activities in each of the major performance areas were previously summarized in the Project Approach section of this report (and also in Attachment 1) but are briefly described here as well.

- Junglerice populations collected from multiple tree and vine cropping systems in the Central Valley were surveyed and screened for resistance.
- The coexistence of junglerice and barnyardgrass in California orchards and vineyards was evaluated.
- The risk of GR trait movement from junglerice to barnyardgrass was explored but not pursued in depth based on the results of preliminary studies. This effort was refocused on intraspecific gene flow within junglerice populations after multiple mechanisms of resistance were identified and noted the variability in level of resistance among populations which suggested possible accumulation of multiple resistance mechanisms in this polyploidy species.
- Glyphosate absorption was evaluated using radiolabeled herbicide in several GR and GS junglerice populations and no differences were observed. The glyphosate translocation work was not completed during the performance period due to an equipment malfunction; however, this work will be continued and completed in the next few months.
- Several gene mutations leading to single amino acid substitutions in the gene coding for the EPSPS enzyme were identified. A Pro106Thr, Pro106Ser, and Pro106Leu were identified. Additionally, evidence of a non-target site resistance mechanism was also uncovered and being explored in ongoing research.
- Glyphosate metabolism work is complete and does not appear to be a contributing factor to

glyphosate resistance in junglerice from California. The data is currently being finalized and will be included in the principal investigator's (PI) journal manuscript early 2017, and posted on the UC Weed Science report database: http://ucanr.edu/sites/UCWeedReports/Weed_Science_Database/
- Common garden experiments were conducted to evaluate the effects of different levels of shade on junglerice grown in the San Joaquin and Sacramento Valleys.
- The plasticity and phenotypic variability of GR and GS junglerice was evaluated in multiple experiments during this project period. Research addressed the effects of temperature, salinity, and osmotic stress on junglerice seed germination. Whole plant research included evaluations of the effects of salinity, shade, temperature, nitrogen, and planting date on junglerice growth and phenology.
- The susceptibility of GR and GS junglerice to preemergence and other postemergence herbicide modes of action was evaluated and demonstrated in greenhouse trials at CSU Fresno and UC Davis, as well as in commercial orchards and vineyards throughout the Central Valley by UC Davis and UCCE collaborators.
- Several greenhouse and field studies included evaluations of other summer annual grasses including sprangletop, feather fingergrass, threespike goosegrass, and witchgrass. However, the more detailed genetic, physiology, and phenology research focused on junglerice due to the economic importance and rapid spread of this species during the project period.
- Information on the biology and control of junglerice and other summer grass weeds of orchard and vineyard cropping systems was disseminated to California specialty crop stakeholders through the extension programs of the project collaborators.

Most of the outcomes of this project are relatively long term in nature. A much greater depth of understanding has been developed of the biology and resistance mechanisms of GR junglerice. Alternative control strategies have also been evaluated and demonstrated that orchard and vineyard managers can use to manage current problems with GR junglerice and reduce selection of additional GR weed biotypes. Many of the impacts of this research cannot be measured in the short term because changes in an evolutionary process are only observed over generations.

The project staff largely accomplished the goals of this project. Project staff worked both together and separately to address basic and applied questions related to the distribution, genetics, physiology, phenology, and management of GR junglerice in orchard and vineyard production systems of California. Objectives related to gene flow from junglerice to barnyardgrass were not fully explored or in depth studies conducted on the genetics and physiology of the other summer grass species. However, the preliminary and exploratory studies conducted in these areas provide good context relative to the detailed junglerice research and also provide a useful starting points for future studies.

With this research project staff determined that: 1) GR junglerice is common in many areas of the Central Valley, 2) it co-occurs with other *Echinocloa* species and other weedy, summer grasses, 3) there are at least three target site mutations and probably a non-target site mechanism of resistance in the species, 4) differences in glyphosate absorption does not appear to be related to resistance in this species, 5) the species is broadly adapted to the environmental stresses found in orchard systems, 6) the species is plastic in phenology but there does not appear to be a competitive difference among populations that is specifically related to glyphosate resistance, 7) there does not appear to be any evidence of cross resistance to other herbicide modes of action conferred by glyphosate resistance in this species, and 8) there are alternative management strategies that growers can implement to reduce problems with GR junglerice will likely involve more complicated management and higher costs.

During the course of this project, project staff identified three new target site mutations conferring resistance to glyphosate in California populations of junglerice. The germination, growth and development of this species was characterized under a wide range of environmental conditions and found that it was adapted to a diversity of habitats. Through information dissemination efforts, orchard and vineyard manager awareness was increased of this weed and demonstrated alternative management strategies. Because of the research team's statewide extension programs that address weed problems in nearly all the tree and vine commodities in California, these efforts have the potential to impact growers, commodities, and pest control advisors who collectively manage weeds on nearly two million acres of irrigated California specialty crops.

Beneficiaries

The research information developed is applicable to all of the orchard and vineyard projection systems of California's Central Valley that utilize herbicides for weed control. The extension programs of project collaborators routinely presented information on management of GR weeds to audiences of fruit and nut tree and grapevine commodity groups and weed management professionals from around California (see a partial list of extension outreach presentations elsewhere in this report).

Commodity groups that benefit from this work include: tree nuts (almond, walnut, pistachio, pecan), stone fruits (apricot, nectarine, plum, prune, cherry, peach), grape (wine, table, raisin), as well as crops such as apple, pear, avocado, fig, kiwi, olive, and pomegranate. Conventional growers in all of those crops rely primarily or, in some cases exclusively, on glyphosate for postemergence weed management.

In broad terms, the tree and vine acreage that currently utilizes glyphosate and where junglerice and other summer grasses are present or could become problematic is approximately two million acres. Since this research addressed current issues with GR weeds and also had an educational focus aimed and preventing future problems with resistant weeds, the economic impact of this research cannot be directly calculated. However, growers routinely indicate that weed management is one of the largest economic costs and management concerns in most tree and vine crops.

Lessons Learned

Although the project largely proceeded as planned in most of the experimental objectives, two important lessons were noted.

First, in hindsight, the project had some misalignment between the very specific research proposed on the primary species of interest, junglerice, and the broad array of other summer annual grasses. The broad category of summer annual grasses are much more easily evaluated in field trials and extension programming than in the more detailed laboratory work where species-specific differences were more challenging. Because of this, less specific physiology and gene flow work on barnyardgrass and the other species should have been proposed and simply included them in the broader management and education objectives.

The second challenge was related to the proposed budget and spending. The notification of funding and the beginning of the project performance period were relatively close together. A large portion of the budget was research staff salaries but, in several cases, those staff members were either hired specifically for this project and were not available to start immediately. This resulted in slower than projected spending during the first year of the project and that carried through the remainder of the project period.

No significant unexpected outcomes or results were noted during the implementation of this project.

Project staff did not fully explore the objectives related to gene flow from junglerice to barnyardgrass or conduct in depth studies on the genetics and physiology of the other summer grass species. However, the preliminary and exploratory studies conducted in these areas provide good context relative to the detailed junglerice research and also provide a useful starting point for future research. The goals related to evaluating glyphosate translocation within GR and GS junglerice were not fully achieved due to an equipment malfunction, but this will continue as part of a related graduate student project and is expected to be achieved after this project performance period ends.

Additional Information

Please refer to Attachment 1:

1. List of project-related presentations, publications, and outreach efforts during the project period (all project collaborators).
2. Junglerice sampling and initial greenhouse screening information (UC Davis).
3. Genetic and enzyme assays on GR and GS jungerice (UC Davis).
4. Junglerice phenology and productivity in response to shade in common garden experiments (UC Davis and CSU Frenso).
5. Junglerice germination and growth in response to temperature (UC Davis).
6. Comparisions of GR and GS junglerice response to temperature, salinity, nitrogen uptake, and osmotic stress (CSU Fresno).
7. Effects of shade or moisture conditions on herbicide on junglerice (CSU Fresno).
8. Herbicide performance evaluations and demonstration in commercial orchards and vineyards (UC Davis and UCCE).

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 58	**Project Title:** Evaluation of Multiple Disinfection Methods to Mitigate the Risk of Produce Contamination by Irrigation Water	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13058	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

In the United States annually, contaminated produce is estimated to cause over 1.1 million illnesses, 7,125 hospitalizations, and 134 deaths, with associated costs of $1.4 billion. This data speaks to the staggering impact of foodborne pathogen contamination on produce and the resulting impact to public health. Produce continues to be linked to foodborne outbreaks since many fruits and vegetables are consumed raw without a processing step that could inactivate microorganisms, if present. Currently, the safety of produce relies on the implementation of Good Agricultural Practices (GAPs) to prevent microbial contamination during growing, harvesting, and processing. However, effective mitigation strategies for foodborne pathogens on fresh fruits and vegetables are still lacking. Over a 15-year period beginning in 1990, produce was linked to 713 outbreaks and 34,049 cases of foodborne illnesses. Most recently in the U.S., outbreaks related to *Escherichia coli (E. Coli)* O157:H7, O145, and O26, *Salmonella* serovars, and *Listeria monocytogenes* have been linked to baby spinach, Romaine lettuce, peppers, cantaloupe, mangoes, and sprouts.

One approach to reduce the risk of produce contamination is to use effective mitigation strategies in irrigation water application systems. This research evaluated disinfection systems in real-world scenarios to provide insight to inactivation of pathogens and indicator organisms in irrigation water as well as risk reduction with respect to pathogen transfer.

The Food Safety Modernization Act (FSMA) of 2011 emphasized prevention of foodborne illnesses rather than responding to outbreaks. In response to FSMA, the U.S. Food and Drug Administration (FDA) recently finalized 21 CFR Part 112: Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption (i.e., the Produce Safety Rule). Because irrigation water is a likely point of pathogen contamination during fruit and vegetable production, the Produce Safety Rule calls for in-depth initial water quality surveys, which will be amended with annual surveys for generic *E. coli* in any surface-source agricultural water that will contact the edible portion of the plant during growing, unless a water treatment method is used. The testing expenses will greatly impact U.S. fruit and vegetable growers since many utilize surface water as an irrigation source or in agricultural protective sprays, and, more importantly, quantifying generic *E. coli* does not always indicate a food safety risk.

This project focused on identifying effective mitigation strategies, specifically various in-line water disinfection treatments, which growers could utilize in irrigation water application systems to reduce the risk of produce contamination. It is important for growers to understand the benefits of these mitigation strategies in addition to their limitations.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

Project Approach

The field work for this project was conducted at the University of Tennessee Plateau Research and Education Center (Crossville, TN). Laboratory work was conducted at the Food Science Lab and the Biosystems Engineering Water Quality Lab at the University of Tennessee, Institute of Agriculture, in Knoxville, TN.

Project Experimental Design, Preparation of Plots, and Plant Tissue Sampling
2014 Strawberry Trial: Four separate irrigation blocks were established—ultraviolet (UV) light, chlorine, peroxyacetic acid (PAA), and a non-disinfected control. Each block consisted of eight raised-bed plots: four of the plots were covered in plastic mulch (plasticulture) and four were bare soil. These eight plots were further divided between overhead irrigation and drip irrigation. All plots were installed with both overhead irrigation (for frost protection) and drip irrigation (for fertigation). A typical plot was 1 m (3 ft) wide by 6 m (20 ft) long. A "blank" row with a tarpaulin curtain was placed between irrigation blocks to minimize water drift between treatments. The water source was pond-1, a cattle-watering pond with high concentrations of generic *E. coli* and Shiga toxin–producing *E. coli* (STEC).

2014 Tomato, 2015 Strawberry, and 2015 Cabbage Trials: Because of the extreme environmental contamination found during the 2014 Strawberry trial, the team decided to move the research plots 850 m (2,800 ft) further away from the beef herd. The same four irrigation blocks (UV, chlorine, PAA and non-disinfected control plots) were re-established with both overhead and drip irrigation. In addition, a municipal water irrigation block was created to help minimize potential contaminant sources and serve as a negative control. The municipal block only had drip irrigation, and the water was supplied in a trailer-mounted 950-L (250-gallon) tank. Pond-2, which is contaminated with STEC, served as the water source for the remainder of this project. Cattle did not have direct access to pond-2, but were in the same drainage area. Tomatoes and cabbage are generally not overhead irrigated, thus overhead irrigation plots were not used during these trials. Initially the 2015 strawberry crop was terminated June 5, and cantaloupes were seeded back into the same plots on June 10. This location received 7.7 inches of rain in June and 11.75 inches of rain in July; in total, this was 11 inches over average. By early August, crop failure was obvious and the project team decided to switch to cabbage as a late-season model crop. The cabbage was transplanted into newly formed beds on August 21, and harvested in November 3, 2015.

Plant Tissue Sampling: Ripe strawberries (cv. Chandler) and tomatoes (cv. Florida 47) were picked from each plant using sterile gloves and placed into sterile Whirl-Pak bags. Strawberries undergoing the same experimental treatment were placed into the same bag; undamaged, marketable strawberries were chosen for sampling. Tomatoes undergoing the same experimental treatment were placed into the same bag; undamaged tomatoes larger than 3.5 cm in diameter were chosen for sampling. For cabbages, nine cabbage (cv. Grand Vantage) heads per plot were sampled. Outer leaves were removed to reveal the inner head, from which two exterior leaves were removed.

Design of Water Treatment Systems
A general purpose centrifugal pump was used to move pond water from the contaminated ponds (pond-1 and pond-2) to the irrigation plots. A sand filter (150-mesh equivalent) was located adjacent to the disinfection system and provided filtered water to the irrigation systems. After filtration, the water was divided across the four treatments.

UV Disinfection: A Sterilight Silver model SSM-37 (Viqua, Guelph, Ontario, Canada) closed-vessel UV light module was incorporated into the hydraulic network system serving the UV block. This device was operated at a UV dosage of approximately 35,000 $\mu W \cdot s/cm^2$ during frost protection and 47,000 $\mu W \cdot s/cm^2$ during drip irrigation. This configuration was used in both year one and year two.

Chlorine: For year one, calcium hypochlorite ($Ca(ClO)_2$) was the chlorine source. Chlorine was metered into the irrigation system using a diaphragm injection pump. Stock concentrates were produced using 454-g (1-lb) packs of 68% calcium hypochlorite (i.e., swimming pool shock) to get a stock solution of 12% available chlorine. At this concentration not all of the inert ingredients within the packs are soluble and thus form a significant precipitant; the precipitant was removed to prevent clogging of the metering pumps. A 12% concentration was chosen because the Peroxyacetic Acid (PAA) solution was also 12%, which allowed both metering pumps to be operated at the same setting. The concentrate was injected at a rate that created irrigation water with 20 ppm available chlorine. The hydraulic network was constructed to provide at least 2 minutes of water-chlorine contact time before water was applied to the crop. Chlorine concentrations were monitored with test strips (pHydrion, Micro Essential Laboratory, Brooklyn, NY).

During year two, chlorine dioxide was the chlorine source. A stock concentrate of 2% chlorine dioxide (ClO_2) was produced by dissolving a proprietary powdered-mixture containing sodium chlorite (ICA TriNova, Newnan, GA). This mixture was injected into the irrigation stream to achieve a final ClO_2 concentration of 10 ppm. ClO_2 concentrations were monitored with test strips (Insta-Test ClO_2, LaMotte Co., Chestertown, MD).

PAA: During year one, a 12% commercially-prepared PAA concentrate (SaniDate 12, BioSafe Systems, East Hartford, CT) was used as the PAA source. During year two, this concentrate was diluted by 50%, and the injection rate was doubled. For each year, the final PAA concentration in the irrigation water was 20 ppm, with a 2-minute contact prior to exiting the system. PAA concentrations were monitored with test strips (Insta-Test PAA, LaMotte Co.).

Irrigation Water Sample Collection and Analysis

Irrigation was scheduled on the basis of 50 mm (2 in) of water per week. Nutrients were applied by fertigation and followed the recommendations in the 2013 Southeastern U.S. Vegetable Crop Handbook. Once per week during irrigation/fertigation, three sets of water samples were taken from each treatment plus the source water. Following the protocols in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, 2015), the following water quality parameters were determined: turbidity, total dissolved solids, total nitrogen, non-purgeable organic carbon, and pH. Total coliforms and generic *E. coli* were enumerated by the Quanti-Tray/2000 procedure (IDEXX Laboratories Inc., Westbrook, ME). STEC was enumerated using membrane filtration onto CHROMagar STEC (CHROMagar, Paris, France).

Objective 1– Evaluation of Irrigation Water Treatment Systems

Inactivation of indicator organisms (*E. coli* and fecal coliforms) and STEC was determined from a surface-water irrigation source after treatment by sand filtration followed by: 1) UV light dosage, 2) ClO_2 dosage, 3) PAA dosage, or 4) no further treatment (control).

Ultraviolet Light: The results of using the UV treatment are shown in Tables 1, 2, 3 and 4 (see Attachment). A particular advantage of using UV light is that a module can be installed on the irrigation pipeline to treat all the water. However, this is also a disadvantage because the pathogen kill-zone is limited to the volume within the module – there is no downstream residual treatment. UV systems are designated by water flow rate and UV intensity. For point-of-use drinking water treatment, the U.S. Environmental Protection Agency (EPA) recommends a UV dosage of 40,000 $\mu W \cdot s/cm^2$. This value has a two-fold safety factor. Further, a certified UV system must be able to provide this exposure when about 50% of the transmitted radiation is blocked by a dirty quartz sleeve or by turbid water. Because the UV module has a fixed volume, as the flow rate changes, so does the UV dosage. As such, the user must size the UV device based on the greatest flow rate expected to be treated. As mentioned, UV is very sensitive to turbidity. This project was able to successfully remove pathogens from surface water with turbidities as high as 35 NTUs (nephelometric turbidity units). A notable difference in UV disinfection success was observed between Table 1 and Tables 3, 5 and 7. While UV provided successful treatment in all cases, when the source water was switched to pond-2 (less turbidity, see Table 5), pathogen reduction was more complete. Based on these findings, it is recommended that a UV device should be selected that can provide a minimum dosage 40,000 $\mu W \cdot s/cm^2$ at the required flow rate, and that the maximum turbidity should be limited to approximately 30 NTUs. The UV module should be placed for easy maintenance and include an intensity monitor to let the operator know when the UV transmission cannot provide the required dosage.

Calcium Hypochlorite: Overall, calcium hypochlorite performed very well. As shown in Tables 1 and 2, this product significantly inactivated generic *E. coli* and STEC organisms as compared with the non-treated control. Generic *E. coli* and STEC were not detected in 2014 strawberry and tomato crops irrigated with water treated with calcium hypochlorite. For this evaluation, the target available chlorine concentration was 20 ppm to ensure the satisfaction of the chlorine demand created by the organic matter in pond-1 and the short contact time; this dosage was higher than needed. It is recommended that producers have an injection system that can provide 10 to 20 ppm of available chlorine, and then the dosage can be lowered until 3 to 5 ppm chlorine residual remains in the water that is applied to plant surfaces.

Chlorine Dioxide: Chlorine dioxide was the chlorine source during 2015 and was injected at a rate to produce a 10 ppm concentration in the irrigation water. As shown in Tables 3 and 4, this product performed similarly to calcium hypochlorite and inactivated STEC below detection limits. Generic *E. coli* was detected twice, but populations were at or below 11 MPN/100 ml. Some plant damage on the chlorine dioxide plots was attributed to the sodium content of the disinfectant solution. This product must be manufactured on site; however, there are now vendors that will provide the chlorine dioxide precursors in smaller packets (as opposed to a shipping container) that produce final product volumes that are reasonable for producers to use for disinfection. It is recommended that producers have the capacity to inject chlorine dioxide at a rate that can produce a 5 to 10 ppm chlorine concentration in the irrigation water.

Peroxyacetic Acid: PAA performed very well as a disinfectant of raw surface water, even with a short contact time. For reasons not completely explained in the research literature, PAA seems to have a slightly greater affinity for oxidizing microbes than for the dissolved organic matter, which reduces the potential for dissolved organic matter to interfere with disinfection. PAA also readily decomposes to carbon dioxide and water in the environment. This product is commercially available in several concentrations. It is somewhat difficult to compare the various PAA formulations: this product is a mixture of peracetic acid, hydrogen peroxide, acetic acid and water. Peracetic acid is the primary active ingredient; however, hydrogen peroxide and acetic acid also have disinfectant properties. The solution used for this project was 12% peracetic acid, 18.5% hydrogen peroxide, and 20% acetic acid.

The PAA disinfectant performance was very good, but care must be taken when using this product. Initially, the 12% concentrate was used as the stock solution. However, the concentration produced sufficient volatilization that the metering pumps would frequently vapor-lock, allowing large water volumes to pass without treatment. As shown in Table 1, when injection was properly controlled, the compound performed moderately well. Tables 2, 3 and 4 show the improvement with PAA performance achieved with changes in management. This problem was alleviated by diluting this concentrate by 50% (thus doubling the injection rate), and by replacing the diaphragm metering pump with a peristaltic metering pump. A second potential issue with using PAA is the change in water pH; after treatment, the irrigation water dropped from approximately 6.8 to approximately 4.5. The pH change has the potential to acidify the soil and change the availability of nutrients. The issue of pH change needs further research to determine whether this concern is warranted.

Objective 2 – Transfer of Organisms onto Produce
The original intent of this objective was to evaluate the movement of pathogens from the irrigation water onto the model crops, with the anticipation that the plots irrigated with treated water would demonstrate less contamination than the non-treated control plots. To minimize cross-contamination, the plots were separated by curtains and there were blank rows between treatments to increase the separation. As seen in Table 7, STEC contamination was fairly well-distributed across all treatments in the 2014 strawberry trial (24–40%). The untreated control had slightly more contaminated samples (40%) than the treated irrigation blocks, but the result was not significant ($p > 0.05$). These plots were located 100 m (300 ft) downwind of a pasture containing beef cattle (stocking density approximately 1 cow per acre). It was assumed that other environmental pressures (insects, small mammals, birds, bioaerosols) played a significant role in crop contamination, such that any irrigation treatment effects were eliminated. No conclusions could be drawn from this trial. The research plots were reestablished 850 m (2,800 ft) away from this pasture, but still downwind for subsequent trials.

Tomatoes were transplanted into the new plots. The tomato trial resulted in only one positive sample, isolated from the control plot, but there was no significant difference found between treatment blocks (Table 8; $p > 0.05$). This crop was only drip irrigated, and the results indicate that drip irrigating tomatoes is a good agricultural practice. Strawberries were transplanted the fall of 2014 and grown out in 2015; as shown in Table 9, the 2015 strawberries were as contaminated as the 2014 crop. This crop did not receive frost protection, thus the drip irrigated plots were not overhead frost protected, and still there was equal contamination across all treatments (43–32%). The project team attempted to find more information about the contaminant sources beyond the irrigation water. Isolates collected from plant samples were submitted for molecular genetic analysis to provide more information as to the pathogen reservoir. As shown in Table 10, there was minimum contamination (4–7%) in cabbage, but it was found among all treatments, with the exception of municipal water. These plots received only drip irrigation, but were significantly closer to the soil than the tomato crop.

On the basis of the above results, no specific conclusions about pathogen transfer from irrigation water could be made. Other environmental factors are apparently a greater cause of contamination than the irrigation water. While the specific vectors are unknown at this time, it appears that their effect overwhelmed any potential treatment effect provided by disinfecting the irrigation water.

In June 2015, the PI presented a poster on the project's interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

The crops grown for this project are listed on the United States Department of Agriculture, Agricultural Marketing Service's list of specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and the University of Tennessee, Institute of Agriculture. CPS managed the project and the University of Tennessee performed the work.

Goals and Outcomes Achieved

Activities that were completed included (1) determining the inactivation of indicator organisms (*E. coli* and fecal coliforms) and STEC from a surface-water irrigation source after treatment by sand filtration followed by three disinfection methods, and (2) evaluating the transfer of STEC and indicator organisms from the irrigation water to model crops with the three mitigation strategies as compared to no treatment, utilizing overhead and drip irrigation delivery.

Some modifications to the project were approved, and these included using tomatoes and cabbage (instead of cantaloupes) as the late season crops, using calcium hypochlorite as the chlorine source in year one, and adding an additional irrigation water treatment (municipal water as a negative control).

As a background to the field activities, during the summer of 2013, funding from the U.S. FDA Western Center for Food Safety (secured by one Co-PI) was used to establish the strawberry plots that served as the model crop for frost protection and for irrigation. This crop overwintered well and began new growth in late March 2014. One night in April was the only frost protection event required that season; this night had greater than 12 hours of below freezing temperatures, with a low temperature of −3°C (27°F). For the remainder of the growing season, liquid nutrients were applied once per week, providing the equivalent of one-half inch of water. Supplemental water was added to maintain a weekly water application of approximately two inches. A routine was established with one-half of the ripe berries harvested on Monday mornings, overhead irrigation provided on Monday afternoons, and the remaining ripe berries harvested on Tuesday mornings. This was an attempt to provide before and after information about pathogen transfer. The third portion of the weekly harvest was on Thursdays. The last harvest was in late May 2014.

It was determined that 30% of the strawberry samples from the 2014 trial were contaminated with STEC independent of irrigation treatment (Table 7; $p > 0.05$). The team anticipated that other routes of contamination resulted in similar contamination levels amongst all produce although significantly lower populations of STEC were present in treated water (UV, PAA, chlorine) used for irrigation and frost protection than the untreated positive control (Table 1; $p < 0.05$). In retrospect, while the cattle were 100 m (300 ft) from the plots, it seems that the plots were too close to the STEC source. Flies, bioaerosols, and other vectors could have transferred pathogens to the research plots. In the hope of controlling the natural contaminant sources, this field location was abandoned and the experiment was relocated further away from the cattle, and a negative control (municipal water) irrigation block was added as a treatment. With the plots reestablished, a fall tomato crop was transplanted on August 14, 2014. Each treatment had four plots for a total of 20 plots. These plots were drip irrigated only – no overhead irrigation. After an early frost, green tomatoes were harvested on October 6, 2014.

On September 18, 2014, 1,600 strawberry plugs were transplanted across 40 plots adjacent to the tomato plots. There were 8 plots per treatment and five treatments – chlorine dioxide, PAA, UV, municipal water (negative control), and untreated surface water (positive control). During January 2015, row covers were applied to the strawberry plots. During the spring of 2015, the strawberry crop was cultivated and harvested; there was no need to frost protect this season. Irrigation water (both overhead and drip) samples were collected throughout the growing season. Once ripening began, the plots were harvested using the following routine. On Mondays, half the ripe berries were gathered from all plots during the mornings. During those same afternoons, half of the plots received overhead irrigation and half of the plots received drip irrigation. On the next mornings (Tuesdays), the remaining ripe berries were picked. On Thursdays, a complete picking was conducted to prevent overripe berries from causing spoilage. The strawberry crop was terminated June 5, and cantaloupes were seeded back into the same plots on June 10. This location received 7.7 inches of rain in June and 11.75 inches of rain in July. In total, this was 11 inches over average. By August 8, 2015, crop failure was obvious and the project team decided to switch to cabbage as a late-season model crop. The cabbage was transplanted into newly formed beds on August 21 and harvested on November 3, 2015.

The project was carried out as per the work plan, and direct enumeration of STEC and indicator organisms of treated irrigation water was determined and compared with untreated water. The target criteria—to achieve specific log reductions of indicator organisms and no recoverable STEC per liter of irrigation water or on produce—were not as expected. As the project went forward it became obvious that there were other pathogen sources beyond the irrigation water; however, developing an understanding of other pathogen sources was not our original objective. This project was not able to clearly demonstrate pathogen-free crops when using treated irrigation water because of these additional pathogen sources. Any potential treatment effect provided by disinfecting the irrigation water was overwhelmed by these other (unknown) sources.

The water treatment data gathered were based on surface water samples taken before and after treatment with the selected disinfectants. The baseline data for *E. coli* and STEC in water are shown in Tables 1–4 as “before treatment.” Reductions in pathogen concentration are shown for each of the treatment technologies.

For the irrigation water measurements during the various crop trials, calcium hypochlorite (at 12% available chlorine) significantly inactivated generic *E. coli* and STEC organisms in the irrigation pond water as compared with the non-treated control. Chlorine dioxide (10 ppm) performed similarly to calcium hypochlorite and inactivated STEC below detection limits; generic *E. coli* was detected twice, but populations were at or below 11 MPN/100 ml. While the UV light provided successful water treatment in all cases, pathogen reduction was more complete for pond-2 source water (less turbidity) than pond-1 source water. Peroxyacetic acid (20 ppm) performed very well as a disinfectant of raw surface water, even with a short contact time, but care must be taken with injection control and changes in water pH when using this product.

The project was not able to demonstrate the elimination of STEC on strawberry and cabbage crop trials that used treated irrigation water. The likely reason was that additional pathogen sources aside from the irrigation water were not accounted for in the development of the project.

The project demonstrated that the tested water disinfection treatments are promising mitigation strategies that can be applied by produce growers to reduce contamination risk to their crops. Overall, all disinfection treatments performed significantly ($p < 0.05$) better than the untreated positive control in reducing the populations of STEC in water sourced from the contaminated irrigation ponds, and water from all treatments was similar to municipal water (Table 6). These treatments should especially be considered when irrigation water will contact the edible portion of the crop.

Beneficiaries

The primary beneficiaries of this project are specialty crop producers who use ponds as their source of irrigation water. The desire to produce safe fruits and vegetables goes beyond the requirements of FSMA. Producers need guidance on how to mitigate the risks associated with using surface water for irrigation. This project demonstrated that contaminated surface water can be treated with traditional water disinfection methods under less than ideal circumstances. All producers who grow crops that will likely be consumed raw or with minimal processing can benefit from this project.

The potential economic impact of this project is the development of mitigation methods that can reduce the potential for pathogens to be transferred from surface water to fresh fruits and vegetables. When consumers have confidence in the safety of fresh produce then the whole produce industry benefits from increased sales, and the consumer benefits from the consumption of fresh (not processed) food.

According to the most recent (2012) Census of Agriculture there are 42,729 farms that grow specialty crops (including tomatoes, leafy greens, and melons) in California, representing $23.9 billion in sales in the state (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp). More specifically, the beneficiaries of this project in California may include the 250 growers of fresh-market tomatoes.

Dr. Buchanan (PI), University of Tennessee, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously in a poster session at the 2015 CPS Produce Research Symposium in Atlanta, GA (with approximately 245 attendees). The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results also will be made available online as follows:

1. Final reports submitted to CPS (after the June 2016 symposium) will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the “2015 CPS Symposium Summary: Key Learnings and What They Mean for You” on the CPS website at the following link:

http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf.

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

Overall, all disinfection treatments performed better than the untreated positive control and were found to be similar to municipal water, which demonstrates that these disinfection methods are promising mitigation strategies that can be applied by growers to reduce risk. The water treatments should especially be considered when water will contact the edible portion of the crop.

Based on the project results, the investigators cannot draw specific conclusions about pathogen transfer from irrigation water. Other environmental factors were apparently a greater cause of contamination than the irrigation water. While the specific vectors are unknown at this time, it appears that their effect overwhelmed any potential treatment effect provided by disinfecting the irrigation water.

The project team learned that it is important to consider irrigation system start-up when evaluating the efficacy of water treatment. At start-up, the pipelines are not under pressure and the pump will transfer water at a greater rate than during steady-state conditions. As discussed in this document, disinfectant injection rates and UV dosages have been based on steady-state conditions. Either the start-up water can be diverted until the water flow rate reaches steady-state, or additional disinfection capacity can be added to account for the increased flow rate. Also, when fertigation is used, then the fertigation system needs to be disinfected. Water used to dissolve the nutrients must be from a sanitary source and the injection equipment must be sanitized before use. An alternative is to place the fertigation system before the disinfection system.

The project team clearly showed that STEC contamination does not only come from concentrated feedlots, as a STEC source in this study was a pasture-fed herd that had a stocking density of approximately one cow per acre. Therefore it is important for a grower to determine if they are downwind or downstream of cattle herds in any field study evaluating produce contamination.

The unexpected outcome of this project was the inability to clearly show the reduction of pathogens on crops that used treated irrigation water. The likely reason was that additional pathogen sources aside from the irrigation water were not accounted for in the development of the project.

As mentioned above, the project team suggests that other researchers doing field studies of produce contamination clearly determine if fields are downwind or down stream of cattle herds. STEC contamination does not only come from concentrated feedlots, and a STEC source can be a pasture-fed herd with a stocking density of approximately one cow per acre.

The project team suggests taking swabs of leaves and other vegetation before establishing research plots, as the team was quite surprised (after the fact) to find STEC on tree leaves and grasses well away from the beef pasture.

Additional Information

See Attachment for Tables 1–10.

Presentations:

Buchanan, J. R. 2016. Beyond chlorination: Other ways to keep your irrigation water safe. Pick TN Conference, Knoxville, TN, February 11-13.

Critzer, F. J. 2016. Produce Safety: Don't kill your customer. Pick TN Conference, Knoxville, TN, February 11-13.

Wszelaki, A. L., F. J. Critzer, J. R. Buchanan, and D. Lockwood. 2016. Western region fruit, vegetable, and food safety update. Tennessee Extension Agent In-Service, Lexington, TN, January 26-27.

Wszelaki, A. L., F. J. Critzer, J. R. Buchanan, and D. Lockwood. 2016. Central region fruit, vegetable, and food safety update. Tennessee Extension Agent In-Service, Murfreesboro, TN, February 2-3.

Buchanan, J. R., F. Critzer, A. Wszelaki and D. Lockwood. 2015. Evaluation of multiple disinfection methods to mitigate the risk of produce contamination by irrigation water - progress report [poster]. Center for Produce Safety Symposium, Atlanta, Georgia, June 24.

Gorman, S., L. Gann, A. L. Wszelaki, F. Critzer, and J. R. Buchanan. 2015. Disinfection methods to mitigate food safety risks associated with contaminated irrigation water on drip-irrigated tomatoes. [abstract] Journal of Food Protection, Supplement A, 78:280, Portland, OR, July 25-28.

Buchanan, J. R., F. Critzer, A. L. Wszelaki, and D. W. Lockwood. 2014. Irrigation water disinfection strategies. Center for Produce Safety Symposium, Long Beach, CA, June 24.

Buchanan, J. R. and A. L. Wszelaki. 2014. Mitigation of agricultural water. Plateau Research and Education Center, Steak and Potatoes Field Day, Crossville, TN, August 6.

Buchanan, J. R. and F. J. Critzer. 2013. New applications for old tools: Strategies for mitigating risks in agricultural irrigation. Steak & Potatoes Field Day, Plateau Research and Education Center, Crossville, TN, August 8.

USDA Project No.: 59	Project Title: Assessing Postharvest Food Safety Risks and Identifying Mitigation Strategies for Foodborne Pathogens in Pistachios	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13059	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

In the past decade, outbreaks of salmonellosis and *Escherichia coli* (*E. coli*) O157:H7 gastroenteritis associated with consumption of a range of tree nuts, including pistachios, have been documented. Until recently, very little was known about the ecology of foodborne pathogens (*Salmonella*, (*E. coli*) O157:H7, and *Listeria monocytogenes* (*L. monocytogenes*)) in pistachio production and processing environments. This impeded the development of targeted pistachios-specific food safety programs. This project addressed the critical need for further information on identification of points during postharvest handling of pistachios where foodborne pathogens may be reduced, controlled or amplified.

The Preventative Controls for Human Food rule, finalized in August 2015, was implemented beginning in the fall 2016 to 2018. This rule mandated a formal hazard analysis and an introduction of practices that would control hazards that were identified. The hazard analysis and preventive controls must be supported with robust scientific data. Characterization of the heat resistance of foodborne pathogens and a potential surrogate organism in inoculated pistachios was needed to provide the scientific foundation for thermal process validation (one type of preventive control) used in the pistachio industry.

This project built on three previously funded Specialty Crop Block Grant Program (SCBGP) projects: 2009 SCBGP Project 54: *Assessing Postharvest Risks for Salmonella in Pistachios*, 2011 SCBGP Project 65: *Sources and Mechanisms of Transfer of Salmonella in the Production and Postharvest Tree Nut Environment*, and 2011 SCBGP Project 66: *Distribution of Salmonella in Pistachios and Development of Effective Sampling Strategies*. The previous research most relevant to this project demonstrated that there were differences in the prevalence and levels of *Salmonella* between floater and sinker pistachios. The current study sought to identify potential causes of the higher floater prevalence with the goal of determining appropriate mitigation practices.

Project Approach

In 2014, methods for determining bacterial heat sensitivity in oil, hot water, and in a dry oven were evaluated for in-shell pistachios, kernels, and the shell. Significant differences in the reduction of the potential surrogate organism, *Enterococcus faecium* NRRL B-2354 (*E. faecium*), were noted among all three forms of pistachios. Reductions on the shell alone were orders of magnitude greater than either the in-shell pistachio or kernel. These differences were more evident in hot oil and hot water than in a dry oven.

Unusual weather led to a very short 2014 pistachio harvest. The number of collaborating pistachio processors was increased from one to four to ensure that adequate samples could be collected.

Growth curves were generated for a cocktail of *Salmonella* strains inoculated onto both "first shake" and "second shake" in-hull pistachios and "first shake" floaters and sinkers under postharvest conditions determined in previous studies.

Floater and sinker streams were characterized visually to determine the amount of adhering hull, foreign material and other defects. Proportions were determined by weight and documented with photos.

The Principal Investigator (PI) attended the June 2015 Center for Produce Safety (CPS) Symposium in Buckhead, GA and gave an oral presentation "Assessing Postharvest Food Safety Risks and Identifying Mitigation Strategies for Foodborne Pathogens in Pistachios".

On August 5, 2015 a meeting was held in Fresno, California at the office of the Administrative Committee for Pistachios. The PI and three laboratory staff from the Regents of the University of California, Davis (UC Davis) were present. The head of the Administrative Committee for Pistachios was in attendance, as were representatives from four pistachio processors. Results from the 2014 harvest were discussed, as were plans for the 2015 harvest. Industry members provided input and recommitted to assisting with sample collection during the 2015 harvest. Data pertaining to the use of *E. faecium* as a surrogate organism for *Salmonella* in pistachios was also discussed.

At the recommendation of the pistachio processors the 2015 data collection focused on Objectives 1a (evaluate growth or survival of foodborne pathogens on in-hull pistachios after harvest including the impact of pathogen type, temperature of exposure, harvest container (bins or trailers), time of harvest (first or second shake), and post huller stream (floaters and sinkers)) and 1b (evaluate growth or survival of foodborne pathogens on pre-dryer hulled pistachios including impact of pathogen type and post float tank stream (floater vs sinker)). The existing data on the reduction of *Salmonella*/*E. faecium* during drying, Objective 1c (evaluate the reduction of foodborne pathogens during drying under a range of drying times, temperatures and target moisture levels used by the pistachio industry) was considered sufficient to accomplish Objective 1d (develop a quantitative risk model to assess the parameters between the point where pistachios are shaken from the tree to the point that dehydration in the silo is complete).

The 2015 pistachio harvest lasted five weeks beginning August 31, 2015. Each week, through the week of September 28, 2015, pistachios were recovered from one or more of the project collaborators and the growth curves of inoculated pathogens was measured for: (a) a cocktail of *Salmonella* on early season (first shake) floater and sinker pistachios; (b) a cocktail of *Salmonella* on mid-season floater pistachios collected from three different hullers; (c) a cocktail of *Salmonella* on late season (second shake) floater and sinker pistachios; (d) a cocktail of *Salmonella* on separate components of late season floater pistachios; and (e) separate cocktails of *Salmonella* or *E. coli* O157:H7 or *L. monocytogenes* on mid-season floater pistachios.

Data collection was carried out for comparison of thermal tolerance of *Salmonella* and *E. faecium* as well as *E. coli* O157:H7 and *L. monocytogenes* (Objective 2). Specifically, the survival of *E. faecium*, *Salmonella* Enteritidis phage type (PT) 30 (control), and several *E. coli* O157:H7 strains inoculated onto in-shell pistachios on exposure to hot oil (dry heat), hot water (moist heat), and a hot oven was compared. Also, the survival of *E. faecium*, *Salmonella* Enteritidis PT 30, several *L. monocytogenes* strains inoculated onto in-shell pistachios on exposure to hot oil (dry heat), hot water (moist heat), and a hot oven were compared. Various survivor curves were generated, including: (a) a survivor curve over time of exposure to hot oil and hot water for *E. faecium*, and three strains of *Salmonella* inoculated onto in-shell pistachios; (b) a survivor curve over time of exposure to hot oil and hot water for *Salmonella* Enteritidis PT 30 (control) and the more heat resistant *E. coli* O157:H7 and *L. monocytogenes* strains; and (c) a survivor curve over time of exposure to hot oil for *Salmonella* Enteritidis PT 30 and *E. faecium* on kernels stabilized at low and high moistures and for in-shell pistachios stabilized at high moisture.

The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels; increasing pistachio moisture significantly increased reduction of *Salmonella* during thermal treatments. The data suggested that *E. faecium* NRRL 2354 was an appropriate surrogate organism for *Salmonella* on pistachios; the majority of current California pistachio processes have already used this organism to validate their processes, and thus, this was a particularly important finding.

California pistachios are a specialty crop and the research targeted this crop specifically. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

Collaborating industry partners were critical for access to facilities and for providing raw materials. The data described here were presented to the pistachio industry (coordinated by the Administrative Committee for Pistachios) on a regular basis, and feedback from pistachio processors lead to modifications in data collection and analysis that significantly increased the impact of the data collected. Processors were very open and willing to provide information on how their operations worked and provided valuable feedback on the study design and to key variables in the quantitative model. The team's documentation of "early" and "mid" season pistachios during and separation of float stream components in the generation of foodborne pathogen growth curves was added as a direct result of discussions with industry representatives.

Goals and Outcomes Achieved

The project aims were: to understand the relative risks associated with *Salmonella, E. coli* O157:H7 and *L. monocytogenes* in pistachios; to elucidate the mechanisms by which floater pistachios were contaminated to a greater extent than in-shell pistachios; to develop a quantitative model that would assess parameters that influence growth or survival of foodborne pathogens between the point where pistachios were shaken from the tree to the time that dehydration in the silo was complete; and to determine the impact of pistachio moisture and nut form (kernel or in-shell) on the heat sensitivity of *Salmonella*, *E. coli* O157:H7, *L. monocytogenes*, and *E. faecium* inoculated pistachios.

The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. Increasing pistachio moisture significantly increased the reduction of *Salmonella* during thermal treatments. The data suggested that *E. faecium* NRRL 2354 was an appropriate surrogate organism for *Salmonella* on pistachios; the majority of current California pistachio processes have already used this organism to validate their processes, and thus, this was a particularly important finding.

There was no significant difference in the growth of *Salmonella* on first or second shake in-hull pistachios; in either case there was no significant growth of *Salmonella* in the first three hours of incubation. There was a shorter lag time, growth of *Salmonella* was more rapid, and final populations were higher on floater pistachios compared with sinker pistachios. A quantitative model was developed to predict levels of *Salmonella* in floaters and sinkers from the time of shaking the trees to completion of drying. The model was based on data derived from this study as well as input from industry collaborators. The model predicted significantly greater levels of *Salmonella* in floaters than in sinkers, and the model sensitivity analysis suggested that delays in drying of hulled pistachios significantly influenced this outcome.

The outcome measures were not long term. Accomplishments very closely matched the goals of the project.

The project met the goal outlined in the initial grant proposal to compare the thermal tolerance of *Salmonella* to *E. coli* O157:H7, *L. monocytogenes*, and a surrogate (*E. faecium*) on pistachios. Over 1,000 samples were processed over the 2014 and 2015 harvests to generate 15 separate growth curves that were used in a quantitative model developed in this study. Over 1,500 samples were processed in screening pathogens for heat resistance and for generating survivor curves for pathogens and a surrogate organism inoculated onto pistachios. The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. In addition, *E. faecium* NRRL 2354 was shown to be an appropriate surrogate organism for *Salmonella* on pistachios. These data can be used by the pistachio industry to support practices that reduce potential levels of *Salmonella* in pistachios during harvest and to reliably reduce pathogens during thermal treatments.

The data generated in this study supported that the appropriate target pathogen for pistachios was *Salmonella* and provided solid evidence that thermal processes validated for this organism would reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. The data also supported the use of *E. faecium* NRRL 2354 as a surrogate organism for *Salmonella* on pistachios. A model developed with industry input and data generated in this study predicted that delays between hulling and drying pistachios could significantly impact levels of *Salmonella* in sinker and, especially, in floater pistachios. The model predicted significantly greater levels of *Salmonella* in floaters than in sinkers, and the model sensitivity analysis suggested that delays in drying of hulled pistachios significantly influenced this outcome.

Beneficiaries

The primary beneficiaries of the results of this study were the pistachio processors and users of pistachio nuts, with growers as indirect beneficiaries.

There were more than 950 pistachio growers farming over 300,000 acres (bearing and nonbearing) in California. There were 24 pistachio processors in the United States, with the seven largest processors located in California, accounting for over 97% of the total volume produced. The total crop size increased from 1.5 million pounds in 1976 to an average of nearly 500 million pounds per year over the 2010–2015 crop years, with a value of over $1 billion annually. A large portion (60%) of the crop was exported, primarily to China and Europe.

The PI, with the UC Davis, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results were disseminated at industry meetings, and streamed through social media sources. Results are also available online as follows:

1. Final reports submitted to CPS were posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php\
2. CPS works with the scientists to publish results in scientific journals. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

In a previously funded SCBGP study, one of the unexpected findings was that, in some years, higher levels of *Salmonella* were found in floater pistachios. In the current study the project team sought to identify potential causes of the higher floater prevalence. Floaters were shown to better support the growth of *Salmonella* than sinkers, in part due to the adherence of hull material to a significant portion of the floater stream. A quantitative model of *Salmonella* growth between shaking the trees and drying of the hulled pistachios predicted significantly greater levels of *Salmonella* on floaters than sinkers.

There were no truly unexpected outcomes or results. However, the data generated by this study provided the pistachio industry with significant actionable data that could be used to support food safety programs.

The goals and outcome measures were achieved.

Initially, the project had proposed to set up a temporary laboratory on site at one of the processing facilities in the Visalia, California area. However, because of the unexpectedly short 2014 harvest and the need to source pistachios from more than one facility, it was more efficient to collect samples and bring them back to the laboratory in Davis, California for processing.

Additional Information

Presentation:
Harris, L.J. "Assessing postharvest food safety risks and identifying mitigation strategies for foodborne pathogens in pistachios," Center for Produce Safety Produce Research Symposium, Buckhead, GA; 23 June 2015.

Publications:

Moussavi, M., V. Lieberman, C. Theofel, and L.J. Harris. Behavior of foodborne pathogens in harvested pistachios. Target: Journal of Food Protection.

Barouei, J., M. Moussavi, C. Theofel, and L.J. Harris. Model to predict levels of Salmonella in postharvest pistachio streams. Target: Microbial Risk Analysis.

Moussavi, M., C. Theofel, and L. J. Harris. Reduction of foodborne pathogens and the surrogate *Enterococcus faecium* NRRL 2354 on inoculated pistachios exposed to hot oil and hot water. Target: Food Control.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 60	**Project Title:** Effect of Physicochemical and Biological Parameters on Survival, Persistence and Transmission of Norovirus in Water and on Produce	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13060	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

Key knowledge on the factors that enhance or reduce norovirus survival in water and on produce is lacking. Collectively, there is strong evidence that human noroviruses (HuNoVs) can survive for prolonged periods of time (weeks to months) on produce as well as in water that can itself contaminate the produce. Human NoVs are responsible for a significant number of foodborne diarrheal cases each year, causing greater than 58% of California 9 million total cases (1). These viruses are estimated to cause nearly 15,000 hospitalizations and 150 deaths each year in the United States as a result of food and waterborne transmission alone (1, 2). Produce has been widely implicated in HuNoV outbreaks, particularly leafy greens (3–5) and soft red fruits (6–9). While some produce outbreaks have resulted from handler contamination at the food preparation level, HuNoVs have been detected on market-ready produce and shown to be infectious (10–12). Human NoVs can persist on strawberries and raspberries at common storage conditions well past the shelf-life of the fruits (13). Overall, HuNoVs are estimated to account for 40% of produce-related outbreaks (14).

Contamination of produce commonly occurs through the application of contaminated irrigation waters (6, 15, 16), and HuNoVs have been detected in water used for irrigation (17, 18). Contamination of ground and surface waters with enteric pathogens is a major problem in the U.S. and can occur in several ways, including discharge of treated and untreated wastewater, illegal dumping of human excrements (feces or vomit), and unintentional discharges due to urban, rural and agricultural run-off (19–21). Documented gastroenteritis outbreaks linked to contaminated surface and groundwater confirm the public health risk caused by the presence of enteric viruses in the environment (22). Moreover, once in the environment these viruses are able to persist for long periods of time. Human NoVs are stable in groundwater, river water, mineral water, and tap water for months (23–25). Remarkably, a recent study demonstrated that a HuNoV can persist in groundwater for years (23).

Noroviruses (NoV) are extremely hardy and resistant to desiccation, low pH, and common disinfectants, including dilute chlorine bleach (26–29). Relatively few environmental conditions (e.g., temperature, relative humidity) have been evaluated for their impact on NoV survival (26, 30, 31), and discrepancies between in vitro and epidemiological data suggest additional factors are also involved. Specifically, while laboratory experiments have demonstrated that high relative humidity and high temperatures lead to viral degradation (26, 30, 31), this is in stark contrast to epidemiological studies that reveal HuNoV disease is virtually endemic in tropical regions where humidity and temperatures are continually elevated (32, 33). Based on these conflicting observations, project staff predict that other as-yet undefined factors contribute to both the environmental stability of NoVs and their transmission to a host. These knowledge gaps prevent food safety experts from adequately addressing issues critical to development of virus removal/inactivation methods.

Such critical issues include (i) the ability to remove or inactivate virus below the threshold level of infectivity considering the extremely low infectious dose of NoVs; (ii) the relationship between NoVs and other environmental microorganisms; and (iii) the impact of environmental factors on the transmission of NoVs to a host. The effects of the food matrix and naturally occurring microorganisms on NoV transmission to a host are largely unknown.

Microbial risk analysis has indicated that even low levels of viral contamination in irrigation waters can result in a significant level of risk to consumers (34), but factors that contribute to virus survival on produce and ultimately transmission to a host are almost completely uncharacterized. While methods to reduce virus levels on contaminated produce have been discovered (35), the incidence of diarrheal disease upon consumption of virally contaminated produce is on the rise (36). Therefore, understanding agricultural and environmental properties that influence virus stability is necessary in order to prevent viral transmission and thus protect public health.

In this study, project staff investigated the ecology of virus, water and virus, produce interactions. These data are necessary to develop rational and effective strategies to prevent viral contamination of produce. Specifically, project staff proposed that NoV interaction with bacteria in the environment enhances persistence of NoVs in water and on produce, leading to enhanced transmission to a host. Biological parameters, such as enteric bacterial concentration, have been suggested to contribute to viral persistence but have not been investigated in detail (18). Moreover, bacteria have been shown to enhance infectivity of another enteric virus in vitro and in vivo and so may also aid in their persistence and stability (38). Also, conflicting data have shown that *P. aeruginosa* can negatively impact the viability of some viruses, presumably due to the secretion of specific bacterial enzymes (37), but this theory has not been investigated in detail or in relation to enteric viruses. A full investigation into the role of naturally occurring bacteria in the survival and transmission of noroviruses is necessary.

These studies provide foundational knowledge for the understanding of NoV ecology and its poly-microbial interaction with bacteria in irrigation waters and on tomatoes. This understanding provides the basis for development of pre and/or post-harvest intervention and/or mitigation efforts aimed directly at a common entry point into the food supply for many viral pathogens. The gathered data will be broadly applicable to a variety of foodborne viruses and so the information gained will help prevent the spread of other pathogens and reduce the overall burden of disease.

The epidemiology of global HuNoV outbreaks since 2002 is indicative of epochal evolution, typified by short bursts of high outbreak activity correlating with the emergence of a new pandemic strain interspersed with quiescent periods lasting 1–3 years (39, 40). In March 2012, the latest pandemic HuNoV strain, called GII.4 Sydney, was identified and has rapidly spread across the globe (41–43). To date, there has been a 58% increase in HuNoV outbreak activity in the United States since GII.4 Sydney emerged (41).

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The impact of ammonium, phosphate and solar radiation (in the form of ultraviolet [UV] light) on the survival of norovirus were assessed during this project. Specifically, murine norovirus (MuNoV) was incubated at various temperatures (4, 22, 37 and 65°C) in a range of chemical (ammonium chloride or sodium phosphate) concentrations. These mixtures were sampled periodically over the course of 45–60 days and viral loads quantified using both Real Time Polymerase Chain Reaction (qRT-PCR) and 50% Tissue Culture Infectious Dose ($TCID_{50}$) assays. For UV light treatment, two concentrations of MuNoV (10^4 and 10^7 $TCID_{50}$/ml) were exposed to a range of UV doses. Two independent methods of analysis were used to discriminate between total viral RNA present (which is currently the only technique available for detection of HuNoVs and actual infectious virus).

Experiments evaluating the effect of UV light demonstrated that doses of 100,000 µJ/cm2 and higher completely inactivated MuNoV, while a dose as low as 10,000 µJ/cm2 did not reduce the levels of infectious virus compared to untreated samples. Results from initial experiments determining virus survival at the various temperatures revealed (as expected) that virus survival in the untreated control samples was increasingly stable with decreasing temperature. At 65°C, viral titers decreased rapidly and were undetectable by 3 days post infection (dpi). Surprisingly, at 37°C the virus remained detectable until 10 dpi, but concentrations did steadily decline over time, as expected. MuNoV was the most stable at 22 and 4°C, surviving past 10 and 60 days, respectively. Based on these control studies, 4°C provides and optimal condition for evaluating the ability of the aforementioned compounds to decrease viral stability, while 37 and 22°C provide an environment in which stability enhancement of MuNoV by these compounds can be assessed.

When evaluating the impact of chemical compounds at 4°C, higher concentrations (800 mg/ml) of ammonium chloride (NH_4Cl) resulted in a significant ($p < 0.05$) loss of infectious MuNoV after three days of incubation compared with untreated controls. By 7 dpi, both lower (80 mg/ml) and higher doses of the compound resulted in significantly ($p < 0.01$) lower concentrations of MuNoV and this trend continued out through 42 dpi. Exposure of MuNoV to sodium phosphate ($NaPO_4$) did not result in significant reductions in viral titers compared with untreated controls until 7 dpi, at which time the highest concentration of compound (5 mg/ml) resulted in a significant ($p < 0.001$) 1.3-log reduction in infectious viral particles. By 10 dpi, even low amounts (1 mg/ml) of $NaPO_4$ were able to significantly ($p < 0.001$) reduce viral titers, and this trend continued through 42 days for both compound concentrations.

Unlike the significant affects reported above, ammonium chloride had no effect on MuNoV concentrations at 22 or 37°C compared with untreated controls throughout the time when detectable virus was present. However, sodium phosphate negatively impacted survival of MuNoV at 22°C. By 3 dpi, the highest concentration of $NaPO_4$ had significantly ($p < 0.001$) lowered MuNoV concentrations compared with the untreated control; by 7 dpi, both concentrations of the compound resulted in significant ($p < 0.001$) virus reductions. At 37°C, $NaPO_4$ had little impact on virus survival through 3 dpi. By 7 dpi, the virus concentrations have decreased in all samples, but the virus concentration in both phosphate-treated samples were significantly ($p < 0.05$ and $p < 0.01$ for 1 and 5 mg/ml, respectively) higher compared with the untreated control. These results were complicated somewhat by the slightly lower input in the control samples; however, even taking this into consideration, the higher viral loads in the sample containing 5 mg/ml of $NaPO_4$ are still significant ($p < 0.05$). None of the treatments impacted virus survival positively or negatively at 65°C (data not shown).

This project also evaluated the survival of MuNoV on the surface of tomatoes. Green tomatoes were acquired from local growers immediately after harvest, prior to waxing. Tomato surfaces were spotted 10 times with 10-µl aliquots of MuNoV at a concentration of either 10^4 or 10^7 $TCID_{50}$/ml. The spots were allowed to dry and tomatoes were incubated for 24, 48 or 72 h. After incubation the tomatoes were manually scrubbed in sterile bags containing 50 ml of phosphate buffered saline (PBS), and the concentration of virus in the wash was determined using qRT-PCR and $TCID_{50}$. These studies demonstrated the ability of MuNoV to remain stable and infectious on the surface of the tomato even after 72 hours of incubation, regardless of input concentration. Decreases in concentration were observed over time, but are consistent with the effect of room temperature incubation on viral stability. Interestingly, the concentration of virus removed from the tomatoes at every time point was similar to the amount applied to the tomatoes suggesting this virus does not form a strong attachment to the surface of tomatoes and can therefore be easily removed even after prolonged incubation. A second interesting observation revealed during data analysis of these samples was the comparison of infectious virus concentrations as determined by $TCID_{50}$ and viral concentrations as determined by qRT-PCR. For high amounts of virus, there was no difference in viral titer between these two types of analysis; however, for lower viral concentrations, the amount of virus determined by qPCR was always higher than the amount of infectious virus present.

Virus from chemical/UV treatments and tomato washes were used to infect mice in order to assess the ability of the virus to transmit to its natural host after exposure to the various conditions. C57BL/6 mice (n=3 for each strain/time point/condition) were infected orally with a maximum volume of virus containing sample from these conditions. After 24 hours, the mice were euthanized and pertinent organs (specifically, the distal ileum [small intestine], colon [large intestine] and mesenteric lymph nodes) in which MuNoV replicated were harvested. The tissues were homogenized and viral titers determined using plaque assay. Infection studies using UV-treated virus mirrored results from tissue culture infection where the highest levels of virus replication in the host occurred with samples that were untreated, and viral concentrations in the tissues were only slightly less in samples where virus had been treated with 10,000 µJ/cm2 prior to infection. These reductions in tissue titers are likely due to the slightly lower amount of infectious virus present after UV treatment. As with tissue culture, samples treated with 100,000 or 250,000 µJ/cm2 were not infectious to the host. Therefore, exposure to low amounts of UV light did not significantly reduce the transmissibility of the virus, however high doses of UV light did completely inactivate the virus and hinder transmission. For samples that were exposed to either ammonium chloride or sodium phosphate, a reduction in the ability of the virus to transmit to the host was observed after only three days of incubation prior to infection. However, this result was observed under all conditions, including the untreated virus samples, suggesting that the incubation alone, and exposure to the compounds, was responsible for the decreased ability of the virus to transmit. Infections in mice were also performed using the washes from tomato attachment studies described above. There was no detectable virus in the harvested tissues one day post infection, indicating that infection by the virus did not occur.

In addition to assessing the ability of physical and chemical factors to impact norovirus survival, the ability of bacteria and their secreted products to impact MuNoV survival were also assessed. For these experiments, high doses (10^7 $TCID_{50}$/ml) of MuNoV were incubated with either Psuedomonas aeruginosa (Pa), Escherichia coli (EC), Enterobacter cloacaie (ENT) or Citrobacter fruendii (Cf) or the cell free supernatants of these bacteria for 10 days, and the concentration of the virus monitored over time using RT-qPCR and $TCID_{50}$ assays. Results showed that MuNoV binds to bacteria at a high rate at various temperatures. At 4, 22 and 37°C, greater than 95% of the virus bound to bacteria. This attachment hindered the ability to analyze virus stability using tissue culture assays, but given the strong correlation demonstrated between tissue culture and molecular detection, qPCR was used for assessing the impact of bacteria on MuNoV survival. Results showed that incubation with live bacteria stabilized MuNoV during room temperature incubation. However, the degree of stabilization was dependent on virus concentration. High virus inoculums demonstrated significant decline over the 10-day incubation while low virus inoculums were much more stable. This pattern was seen for all three bacteria (*E. coli*, *C. fruendii*, and *P. aeruginosa*), and while there was variability among the bacterial concentrations (low concentrations appeared to stabilize better than high concentrations for some samples) that were tested, those differences were not significantly different. These findings are particularly exciting in light of the known instability of MuNoV at room temperature. Room temperature incubation of MuNoV has been repeatedly demonstrated to be detrimental to virus stability leading to a total loss of detectable bacteria by 7–10 days. In addition, considering that environmental concentrations of both virus and bacteria are most similar to the lower concentrations used in these studies, these data may point to a strategy employed by the noroviruses to aid in their stability when outside the natural host.

The project staff also evaluated samples where MuNoV was incubated with the cell free supernatant (CFS) of the bacteria. Results from these studies demonstrated that both high and low concentrations of the virus can be stabilized by the factors secreted from Pseudomonas aeruginosa. When compared to incubation with the live bacterium, it appears stability is better when only the secreted factors are present.

In June 2015, the principal investigator (PI) gave an oral presentation on the project's interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

The CPS staff was in constant communication with the industry and the scientists working on this project and ensured that only California specialty crop commodities benefited from this project.

The project partners were CPS and the University of Florida. CPS managed the project and the project team at the University of Florida performed the research studies.

Goals and Outcomes Achieved

For this project, MuNoV was exposed to physical (temperature and UV light), chemical (ammonium chloride and sodium phosphate) and biological (live bacteria and their cell free supernatants) parameters over extended periods of time (10–60 days). The virus levels in samples were then quantified using tissue culture and molecular detection assays and these quantities compared to virus levels in untreated samples. In addition, MuNoV was also applied to green, unwashed tomatoes and incubated for up to 72 hours. The tomatoes were then washed and the virus quantified, as mentioned above, to determine virus survival on this type of produce. Finally, virus exposed to physical, chemical or biological conditions or virus removed from tomatoes was inoculated into mice (the natural host) and the level of infection measured in order to assess the ability of the aforementioned conditions to impact transmission of this pathogen from food/water to the host.

Survival of MuNoV in response to physical stressors (i.e., temperature and UV light) was evaluated. Survival of MuNoV in chemically adjusted waters at 4, 22, 37 and 65°C using high and low doses of chemical compounds also was determined. Viral attachment and persistence on tomatoes were evaluated. The transmission of virus exposed to physical or chemical treatments to natural murine host was evaluated—infections from ammonium chloride–treated samples and UV-treated samples were completed, and plaque assay analysis for UV-treated samples was completed. The transmission of virus exposed to tomato surface to natural murine host was determined. The effect of tomato matrix on MuNoV infection of the host was assessed; however, the tomato matrix was found to be detrimental to cell culture assays and thus unusable for determining viral concentrations necessary to cause infection. The effect of bacteria on viral persistence was assessed. Also, the effects of bacterial secreted factors on virus survival were evaluated through molecular detection. The effect of bacteria on viral attachment and persistence on tomatoes was evaluated; however, due to high levels of virus survival on tomatoes without bacteria, project staff could not determine if the presence of bacteria enhanced MuNoV survival on produce. Finally, the effect of biological parameters on MuNoV infection of a host was determined, but high levels of MuNoV attachment to live bacteria significantly reduced their concentrations so that virus levels in filtered inoculum were too low to cause host infection.

Two publications from the research results of this project are in progress and will be submitted at the end of 2016. The first, entitled "The effect of physical and chemical factor on norovirus survival" is under revision for subsequent re-submission. The second publication, "Bacterial enhancement of norovirus survival in vitro" is in preparation for first submission to the journal Applied and Environmental Microbiology.

The success of this project was to be determined by the identification of one or more factors that unequivocally impact norovirus survival in water and on tomatoes or disease in a host, and this outcome was achieved. Results from this project demonstrated that temperature (≥65°C), UV light (≥100,000 µJ/cm2), and ammonium chloride (only at 4°C) significantly reduce the viability of MuNoV over time. Sodium phosphate can also negatively impact virus survival at conditions (4 and 22°C) where MuNoV can persist for extended periods of time; however, this compound may also provide a protective effect at higher concentrations under conditions (37°C) that are normally detrimental to the virus. This project also demonstrated that the presence of bacteria provides protection and thus aids in survival of MuNoV.

Beneficiaries

The most near-term beneficiaries of this research are produce growers who can implement the knowledge gained from these studies, particularly those who have control over their irrigation water supplies. This research also directly benefits research scientists and industry personnel involved in development of pathogen mitigation strategies. Furthermore, groups involved with the development of Good Agricultural Practices (GAPs) as they relate to reducing or preventing contamination by viral pathogens will benefit from a better understanding of chemical and biological factors that enhance virus survival. Results from this project will also benefit those involved in developing effective risk management techniques for noroviruses in foods and water, as the extensive comparison of infectious virus versus genome levels under a variety of conditions now provides a solid understanding of the relationship between molecular detection of viral genome and infectivity/disease potential of retained virus.

Produce growers are beneficiaries from this project. According to the most recent (2012) Census of Agriculture, there are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp).

A PI from the University of Florida presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, Washington, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, Georgia, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results were disseminated at industry meetings, and streamed through social media sources. Results are available online as follows:

Final reports submitted to CPS (after the June 2016 symposium) are posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php

CPS will work with the scientists to publish results in scientific journals. Publication dates will occur after the project is completed. Abstracts and awards can be found on the CPS website.

The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "CPS 2016 Research Symposium Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/365/CPS%202016%20Key%20Learnings.pdf.

Lessons Learned

This project confirmed that noroviruses are extremely stable and that factors that contribute to their stability can be multi-faceted. Only UV light and very high temperatures (65°C) were able to quickly eliminate infectious virus particles. All other treatments resulted in slower declines in virus stability. However, the decline in infectious virus can be accelerated by the addition of high concentrations of ammonium chloride or potassium phosphate. Thus, the addition of these compounds to irrigation water systems may prove useful in controlling and lowering norovirus in water when contamination events occur. Sodium phosphate also demonstrated a slight protective effect for MuNoV under certain conditions, but bacteria provided the biggest stabilizing force of all the conditions tested. Furthermore, it seems the presence of the bacteria themselves is not necessarily required for enhancing viral stability; enhanced viral stability can be achieved through products secreted by the bacterium. These observations may help explain the stability of norovirus in water sources and particularly in wastewater treatment systems. During this project period the team learned a great deal regarding the difficulty in working with poly-microbial systems and the challenges that arise when trying to analyze experiments and data. These complications extended to evaluating transmission of this virus which also proved to be difficult. However, through these challenges much was learned and techniques were modified or developed to aid follow-up studies.

Several unexpected results were obtained from this project. The first unexpected outcome encountered was the ability of sodium phosphate to stabilize MuNoV at 37°C when all other chemical and physical conditions reduced virus survival. A second unexpected outcome was the inability of MuNoV, which had been previously incubated on tomatoes, to infect its natural murine host. Infectious virus titers in the wash were determined by tissue culture analysis, and, while low, were within the range normally able to cause disease in mice. It is apparent that under these conditions, the ability to infect under tissue culture conditions does not correlate 100% to infectivity in a host. This phenomenon is not usually encountered in the research team's lab; therefore, it is possible that exposure to the tomato surface in some way inactivates the virus and prevents transmission to the host. The hypothesis is still untested, but remains an exciting possibility.

A third unexpected outcome was the high level of norovirus attachment to the bacteria. It is known that noroviruses interact with bacteria; however, under the conditions tested, approximately 90% of the virus attached to bacteria, regardless of bacterial concentration (which ranged from 10^3 CFU/ml to 10^7 CFU/ml) or if the bacterium was gram-positive or gram-negative. This association with bacteria may provide a means of protection for the virus in the environment. Unfortunately, this attachment prevented the performance of experiments as they were originally designed; however, we were able to find a method by which bacteria could be removed from the mixture while the majority of the norovirus remained. Samples that have undergone this treatment are in the process of being analyzed by the team to determine if bacteria (or the factors they secrete) stabilize norovirus in water.

An outcome not achieved was evaluating the impact of bacteria on norovirus transmission. Through trying to perform these studies, project staff learned that large numbers of MuNoV attach to bacteria, which eliminated filtration as a method for removing bacteria from mixtures prior to infection in mice. It was found that chloroform treatment of virus: bacteria mixtures was able to completely remove bacteria while resulting in only a nominal loss in virus. The discovery of this technique will allow for a more in-depth analysis of the results generated from this project thus far and will also aid in future studies aimed at determining the mechanism behind bacterial enhancement of MuNoV survival.

Additional Information

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com (e.g., http://pma.com/content/articles/2016/09/2016-cps-research-key-learning)
Western Growers Association: http://www.wga.com/ (e.g., http://www.wga.com/magazine/2012/03/08/2016-cps-symposium-highlights)

References cited:

1. Scharff RL. Economic Burden from Health Losses Due to Foodborne Illness in the United States. Journal of Food Protection. 2012 Jan 1;75(1):123–31.
2. Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson M-A, Roy SL, et al. Foodborne Illness Acquired in the United States—Major Pathogens. Emerging Infectious Diseases. 2011 Jan;17:7–15.
3. Ethelberg S, Lisby M, Bottiger B, Schultz AC, Villif A, Jensen T, et al. Outbreaks of gastroenteritis linked to lettuce, Denmark, January 2010. Euro Surveillance: Bulletin Européen Sur Les Maladies Transmissibles = European Communicable Disease Bulletin [Internet]. 2010 Feb [cited 2012 Jan 17];15(6). Available from: http://www.ncbi.nlm.nih.gov/pubmed/20158982
4. Makary P, Maunula L, Niskanen T, Kuusi M, Virtanen M, Pajunen S, et al. Multiple Norovirus Outbreaks Among Workplace Canteen Users in Finland, July 2006. Epidemiology and Infection. 2009;137:402–7.
5. Wadl M, Scherer K, Nielsen S, Diedrich S, Ellerbroek L, Frank C, et al. Food-borne norovirus-outbreak at a military base, Germany, 2009. BMC Infectious Diseases. 2010;10:30.
6. Falkenhorst G, Krusell L, Lisby M, Madsen SB, Böttiger B, Mølbak K. Imported frozen raspberries cause a series of norovirus outbreaks in Denmark, 2005. Euro Surveillance: Bulletin Européen Sur Les Maladies Transmissibles = European Communicable Disease Bulletin. 2005 Sep;10(9):E050922.2.

7. Le Guyader FS, Mittelholzer C, Haugarreau L, Hedlund K-O, Alsterlund R, Pommepuy M, et al. Detection of noroviruses in raspberries associated with a gastroenteritis outbreak. International Journal of Food Microbiology. 2004 Dec;97(2):179–86.
8. Maunula L, Roivainen M, Keränen M, Mäkela S, Söderberg K, Summa M, et al. Detection of human norovirus from frozen raspberries in a cluster of gastroenteritis outbreaks. Euro Surveillance: Bulletin Européen Sur Les Maladies Transmissibles = European Communicable Disease Bulletin [Internet]. 2009;14(49). Available from: http://www.ncbi.nlm.nih.gov/pubmed/20003905
9. Sarvikivi E, Roivainen M, Maunula L, Niskanen T, Korhonen T, Lappalainen M, et al. Multiple Norovirus Outbreaks Linked to Imported Frozen Raspberries. Epidemiology and Infection. 2012;140:260–7.
10. Kukkula M, Maunula L, Silvennoinen E, von Bonsdorff C-H. Outbreak of Viral Gastroenteritis Due to Drinking Water Contaminated by Norwalk-like Viruses. Journal of Infectious Diseases. 1999 Dec;180(6):1771 –1776.
11. Mattison K, Harlow J, Morton V, Cook A, Pollari F, Bidawid S, et al. Enteric Viruses in Ready-to-Eat Packaged Leafy Greens. Emerging Infectious Diseases. 2010;16(11):1815–7.
12. Baert L, Mattison K, Loisy-Hamon F, Harlow J, Martyres A, Lebeau B, et al. Review: norovirus prevalence in Belgian, Canadian and French fresh produce: a threat to human health? International Journal of Food Microbiology. 2011;151(3):261–9.
13. Verhaelen K, Bouwknegt M, Rutjes SA, de Roda Husman AM. Persistence of human norovirus in reconstituted pesticides — Pesticide application as a possible source of viruses in fresh produce chains. International Journal of Food Microbiology. 2013 Jan;160(3):323–8.
14. Doyle MP, Erickson MC. Summer meeting 2007 the problems with fresh produce: an overview. Journal of Applied Microbiology. 2008 Aug;105(2):317–30.
15. Steele M, Odumeru J. Irrigation water as source of foodborne pathogens on fruit and vegetables. Journal of Food Protection. 2004;67(12):2839–49.
16. Mathijs E, Stals A, Baert L, Botteldoorn N, Denayer S, Mauroy A, et al. A review of known and hypothetical transmission routes for noroviruses. Food and Environmental Virology. 2012;4:131–52.
17. Cheong S, Lee C, Song SW, Choi WC, Lee CH, Kim S-J. Enteric Viruses in Raw Vegetables and Groundwater Used for Irrigation in South Korea. Applied and Environmental Microbiology 2009;75(24):7745 –7751.
18. Espinosa AC, Arias CF, Sánchez-Colón S, Mazari-Hiriart M. Comparative study of enteric viruses, coliphages and indicator bacteria for evaluating water quality in a tropical high-altitude system. Environmental Health. 2009;8(1):49.
19. Richards GP. Enteric virus contamination of foods through industrial practices: a primer on intervention strategies. Journal of Industrial Microbiology & Biotechnology. 2001 Aug;27:117–25.
20. di Caracalla VT. For further information on the joint FAO/WHO activities on microbiological risk assessment, please contact. Available from: ftp://ftp.fao.org/docrep.../fao/011/i0452e/i0452e00.pdf
21. FAO/WHO. Microbiological hazards in fresh leafy vegetables and herbs: Meeting Report. 2008;151.
22. Koh S-J, Cho HG, Choi BY. An outbreak of gastroenteritis caused by norovirus-contaminated groundwater at a waterpark in Korea. Journal of Korean Medical Science. 2011;26(1):28–32.
23. Seitz SR, Leon JS, Schwab KJ, Lyon GM, Dowd M, McDaniels M, et al. Norovirus infectivity in humans and persistence in water. Applied and Environmental Microbiology. 2011;77(19):6884 –88.

24. Charles KJ, Shore J, Sellwood J, Laverick M, Hart A, Pedley S. Assessment of the stability of human viruses and coliphage in groundwater by PCR and infectivity methods. Journal of Applied Microbiology. 2009;106(6):1827–37.
25. Ngazoa SE, Fliss I, Jean J. Quantitative study of persistence of human norovirus genome in water using TaqMan real-time RT-PCR. Journal of Applied Microbiology. 2008;104:707–15.
26. Cannon JL, Papafragkou E, Park GW, Osborne J, Jaykus L-A, Vinjé J. Surrogates for the Study of Norovirus Stability and Inactivation in the Environment: A Comparison of Murine Norovirus and Feline Calicivirus. Journal of Food Protection. 2006;69(11):2761–5.
27. Lamhoujeb S, Fliss I, Ngazoa SE, Jean J. Evaluation of the Persistence of Infectious Human Noroviruses on Food Surfaces by Using Real-Time Nucleic Acid Sequence-Based Amplification. Applied and Environmental Microbiology. 2008 Jun;74(11):3349 –3355.
28. Doultree JC, Druce JD, Birch CJ, Bowden DS, Marshall JA. Inactivation of feline calicivirus, a Norwalk virus surrogate. The Journal of Hospital Infection. 1999 Jan;41(1):51–7.
29. Appleton H. Control of food-borne viruses. Br. Med. Bull. 2000;56:172–83.
30. Fallahi S, Mattison K. Evaluation of Murine Norovirus Persistence in Environments Relevant to Food Production and Processing. Journal of Food Protection. 2011;74(11):1847–51.
31. Girard M, Ngazoa S, Mattison K, Jean J. Attachment of noroviruses to stainless steel and their inactivation, using household disinfectants. Journal of Food Protection. 2010;73(2):400–4.
32. Yori PP, Schwab KJ, Gilman RH, Nappier S, Portocarrero D, Velasquez BS, et al. Norovirus highly prevalent cause of endemic acute diarrhea in children in the Peruvian Amazon. The Pediatric Infectious Disease Journal. 2009;28(9):844–7.
33. Viau EJ, Lee D, Boehm AB. Swimmer Risk of Gastrointestinal Illness from Exposure to Tropical Coastal Waters Impacted by Terrestrial Dry-Weather Runoff. Environmental Science & Technology. 2011 Sep;45(17):7158–65.
34. Petterson SR, Teun P, Ashbolt NJ. Modelling virus inactivation on salad crops using microbial count data. Risk Analysis. 2001;21:1097–108.
35. Su X, D'Souza DH. Inactivation of human norovirus surrogates by benzalkonium chloride, potassium peroxymonosulfate, tannic acid, and gallic acid. Foodborne Pathogens and Disease. 2012;9(9):829–34.
36. Sivapalasingam S, Friedman CR, Cohen L, Tauxe RV. Fresh produce: a growing cause of outbreaks of foodborne illness in the United States, 1973 through 1997. Journal of Food Protection. 2004;67:2342–53.
37. Nasser AM, Glozman R, Nitzan Y. Contribution of microbial activity to virus reduction in saturated soil. Water Research. 2002;36(10):2589–95.
38. Kuss SK, Best GT, Etheredge CA, Pruijssers AJ, Frierson JM, Hooper LV, et al. Intestinal Microbiota Promote Enteric Virus Replication and Systemic Pathogenesis. Science. 2011;334(6053):249–52.
39. Lindesmith LC, Donaldson EF, LoBue AD, Cannon JL, Zheng D-P, Vinje J, et al. Mechanisms of GII.4 Norovirus Persistence in Human Populations. PLoS Med. 2008 Feb 12;5(2):e31.
40. Lindesmith LC, Beltramello M, Donaldson EF, Corti D, Swanstrom J, Debbink K, et al. Immunogenetic Mechanisms Driving Norovirus GII.4 Antigenic Variation. PLoS Pathog. 2012 May;8(5):e1002705.
41. Barclay L, Wikswo ME, Gregoricus N, Vinje J, Lopman B, Parashar UD, et al. Notes from the Field: Emergence of New Norovirus Strain GII.4 Sydney — United States, 2012. MMWR. Morbidity and Mortality Weekly Report. 2013 Jan 25;62(03):55.

42. Norovirus GII.4 Sydney breaks loose in United States [Internet]. Allvoices. 2013 [cited 2013 Feb 5]. Available from: http://www.allvoices.com/contributed-news/13894300-norovirus-gii4-sydney-breaks-loose-in-united-states.
43. New strain of stomach bug sweeping the U.S. [Internet]. CBS News. 2013 [cited 2013 Feb 5]. Available from: http://www.cbsnews.com/8301-204_162-57565694/cdc-says-new-norovirus-strain-caused-140-outbreaks-since-september/.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 61	**Project Title:** Remediation and Recovery Measures to Expedite Plant or Replant of Vegetables Following Soil Contamination by Salmonella Enterica	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13061	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary
Pathogen testing programs conducted on diverse raw and minimally-processed specialty crops, especially since 2007, have demonstrated that contamination capable or known to have reached market channels is present on fruits and vegetables intended for fresh consumption. Although the frequency and prevalence appears to be very low, these industry intercepts within pre-harvest and post-harvest monitoring programs have resulted in substantial losses to individual growers and handlers. Destruction of multiple fields per year, occasionally hundreds of acres, is damaging economically but also may negate initiatives of sustainability for the operation. While the decision to destroy a field or produce lot in cold storage is the responsible action when pathogens are detected, prevention of recurrence of contamination in rotational or replanted vegetable crops, originating from the prior contamination event, is an important component of a farm safety plan. Prior to developing the concept for this project, the research team demonstrated persistence of Salmonella in soil-crop residues following incorporation of more than 100 days. Transfer from soil to baby spinach seeded to the experimental crop, after this fallow interval, resulted in approximately 50% detection of the specific applied Salmonella on spinach leaves at the 2–3 and 5–6 leaf stages, simulating typical commercial harvest maturity. Additionally, in response to dual requests by growers, the analysis of widespread contamination of leafy greens by Salmonella led to the conclusion that inadequately managed composts containing poultry manure and litter were likely responsible. Whether on crop residue, from an irrigation source, the result of flooding, contaminated manure/compost or other acute contamination incident, persistent populations of human pathogens in soil can have devastating impacts for a grower or regionally. This project was initiated to develop practices and supporting data that would apply to remediation and recovery of soil contaminated by Salmonella following intentional application of chicken manure/litter or compost during pre-plant and pre-harvest fertility management of vegetable crops. Low-residue, short-cycle cover crops and solarization were identified as two practical and potentially economical techniques to return farm soil to replant safety in intervals of shorter duration than current industry standards.

The repeated loss of high value specialty crops, such as baby greens and related tender salad greens and leafy culinary herbs (cilantro, basil, parsley), due to replanting into production blocks impacted by various sources of known or suspected contamination has been very damaging to individual growers and the industry at large. Several major incidents of contamination or presumptive contamination preceded this project definition, and the identification of practical remediation to widespread contamination events, specifically contaminated compost, was the motivation for the timing of the initial proposal. A goal of this project has been to provide data in support of options, available to all scales of farming, to modify existing and future guidance and industry standards for produce safety. In addition, this project has potential benefits to improving

sustainability performance because the primary remediation being explored incorporates cover crops to eliminate repeated crop destruction and improve soil health and microbial community diversity.

Although this project did not build on a previously funded Specialty Crop Block Grant Program project, the soil and plant microbiological and molecular detection techniques to accomplish this study were all based on previous Center for Produce Safety (CPS) funded studies related to soil survival of Salmonella and contaminated crop residues.

Project Approach

A series of replicated experimental trials were conducted, from microcosm to field-level trials, in consecutive seasons to address the work plan objectives related to determining whether a low-residue cover crop will enhance die-off of *Salmonella enterica* in contaminated soils. Three cover crops, selected for their known release of antibacterial compounds during decomposition of residues in soil, were tested in 2 microcosm, 2 mesocosm, and 3 field trials during the two-year grant period. Efficacy of treatments was attempted by following Salmonella survival in fallow soil or after incorporation of cover crops grown for approximately 30–40 days. In general, the experimental implementation followed the work plan as described and approved with minor deviations due to fluctuating personnel availability and seasonal weather. Although population differences were not statistically different among the cover crops and trials, buckwheat was observed to have potential as a low-residue remediation treatment. In Year 2, additional cover crop entries, including broccoli, triticale, Sudan grass, barley, purple vetch, and common vetch, were added to the work plan. 'Greenbelt' broccoli emerged as a potential residue for growers, resulting in more rapid quantitative die-off (4 log in 28 days) and qualitative die-off (~33% positive soil enrichments vs. 100% for controls and most other treatments) than other treatments or controls. After each cycle of post–cover crop survival studies, once Salmonella populations dropped below quantitative and qualitative detection limits, a replant crop of baby spinach and red chard was seeded to each plot. No recontamination of the subsequent crop was detected at harvest in any of the three trials.

Due to the comparable die-off in fallow controls, at the University of California, Davis (UCD) field trials, a specific outcome and guidance regarding cover crops and remediation of Salmonella-contaminated soils was not possible. While definitely encouraging, similar studies in diverse soils and climates would be needed to develop a set of Best Practice standards for industry.

Solarization was evaluated as a method to accelerate die-off of Salmonella introduced to soil via chicken manure and litter. Solarization trials were performed in each year of the award by covering replicated plots with 4- or 6-mil polymer sheets, and temperature dataloggers were placed central to each plot to record diurnal temperature flux. In addition, a microcosm assessment of die-off under different soil temperatures was conducted as an add-on to the work plan. In these studies the time to lethality (no recovered Salmonella in three attempts) was determined for exposures to 29, 37, 48, and 55°C for 0, 2, 4, 18, 24, and 48 h as well as 4, 13, and 21 days. It was determined that 99.99% kill was achieved at 4, 96, 312, and 504 h, at 55, 48, 37, and 29°C, respectively. In the field trials, a 99.99% quantitative reduction was achieved in 14 days for controls and solarized plots, but control plots remained 100% positive by qualitative detection throughout the 55-day experiment whereas solarized plots were observed to have 33 and 0% detectable at 14 and 39 days, respectively. Where economical and in compatible climates with high solar radiation intensity, solarization is a viable remediation option.

One of the unexpected developments which impacted the research in Year 2 was the heavy damage to the polymer tarps on the solarization trials by multiple dozens of American crows. There was minimal interest by the bird populations in Year 1 but, having learned that chicken manure pellets were good food, they poked through the plastic, which impacted heat retention, and the research team had to recover all plots with new tarps.

The principal investigator (PI) presented interim research results at the 2015 CPS Research Symposium in Atlanta, Georgia. The participants (approximately 245) included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies.

The scope of the project and all activities were conducted in a manner to directly benefit leafy greens and other specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and the UCD. CPS managed the project and UCD performed and coordinated the research studies. This project was substantially and significantly accomplished by the dedicated effort of the Staff Research Associate, who was assigned a major role with PI to manage, supervise, and implement all aspects of the work plan from the outset and, especially, once it became clear that a qualified and suitable Postdoctoral researcher could not be hired. The Assistant Specialist was instrumental in conducting the molecular detections. In addition, the Facility Manager contributed throughout the award period in coordination of undergraduate lab assistants, research farm personnel, attempts to secure a source(s) of naturally contaminated chicken manure /litter, and budget oversight and management.

Goals and Outcomes Achieved

Throughout the award period the activities followed the linear experimental steps of inoculum production–inoculum incorporation–soil testing for initial survival-seeding of cover crops OR placement of solarization tarps–growth of cover crops OR time points for solarization treatment–interval soil sampling for survival of Salmonella–cutting of cover crops OR removal of solarization tarps–incorporation of cover crop residues–timeline interval soil sampling for Salmonella–re-planting baby spinach and red chard crops–growth of replanted economic crops–testing for Salmonella contamination at harvest. Measurable data outcomes (log CFU/g; presence/absence) were based on this system and followed Salmonella survival or die-off over time in relation to treatments.

Outcome measures were not long term.

A comparison of actual accomplishments with the goals established are as follows:
(1) Cover crop remediation was completed in full. (2) Solarization remediation was completed in full. (3) Analysis of cover crop residues and microbial community impacts: Due to the lack of significant differences among cover crop treatments in the UCD field trials in two years, the compositional analysis of antimicrobial compounds from cover crops and impacts on the soil microbiota were deferred. In the absence of treatment effects, these were not likely to be productive to explore mechanisms for optimization. However, all retained frozen soil samples have been extracted for analysis and these objectives, though delayed by lack of technical staff, are in progress and the data will be added to journal manuscripts. (4) Similarly, the final stage of

detection, post-enrichment, of Listeria in soil following cover cropping was deferred as being of limited priority due to the primary outcomes of die-off in fallow controls, in the main cover crop field trials.

Baseline data supporting the potential for short-cycle cover cropping to accelerate die-off, and achieve safe replanting of high-value baby greens, are exemplified by a 17% positive rate for Salmonella detection with buckwheat compared with 100% in controls in a high organic matter soil, and a 33% positive rate for Salmonella detection with broccoli residues compared with 100% in controls in a silty clay loam soil. Baseline data supporting the efficacy of solarization as a Salmonella remediation practice are exemplified by a 4-day kill-time in soils able to reach a sustained 48°C temperature, in model studies, and <39 days in field trials under soil temperature conditions reaching at least 6 h of >40°C. In both cases, the target to achieve functional and practical remediation to allow safe replanting in less than 60 days—the current industry standard—was accomplished.

Application of either cover cropping or solarization, to prevent contamination or re-contamination of a commercial salad greens field, and subsequent destruction following detection of soil-borne pathogens, would conservatively save the grower $5,000 per acre and prevent serious product availability shortfalls for the processor.

Beneficiaries

The primary and immediate beneficiaries are growers, handlers, and processors of leafy greens. The potential for the project accomplishments and outcomes to be translatable to other crops and all scales of specialty crop production is very high.

The California Agricultural Statistics Review for 2014–15 underscores the high diversity and value of specialty crops and most are potential beneficiaries of this research. Handlers enrolled in the Leafy Greens Marketing Agreement, alone, number more than 75 companies with a farm-gate value of over $2 billion. Only a small subset of farms impacted by soil contamination would benefit in any given year, but a substantial loss of leafy greens from more than 200 acres, implicating contaminated compost, is the basis for on-going litigation in the state.

The principle investigator from the UCD, presented final research results in June 2016 at the seventh annual CPS Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results will also be made available online as follows:

1. Final reports submitted to CPS will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.

3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf.

Lessons Learned

Coordination and communication remains an essential and challenging component to any research project but is especially acute in any work plan with a heavy open-field research activity. The team had many successes and some failures in executing project timelines and accomplishments, which were co-dependent on the participation and professionalism of others.

To minimize frustration, only propose research projects that have a very strong and linear experimental path and a low potential to require deviation between initial proposal, eventual award, and ultimate project execution timeline.

The team did not fully anticipate the high rate of die-off of the available and only permitted attenuated Salmonella isolate in the UCD trials. This did not meet the research team's expectations and limited the conclusions relative to treatment success and recommendations.

When and where possible, be cautious in depending on others financially bound or not to your project. Limit your vulnerability to project management barriers over which you have no leverage to control.

Additional Information

The following websites provide additional resources on the final reports and symposium proceedings:

- Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
- Produce Marketing Association: http://pma.com
- Western Growers Association: http://www.wga.com/

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 62	**Project Title:** Food Safety Risks at the Fresh Produce-Animal Interface: Identifying Pathogen Sources and their Movement on Diversified Farms	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13062	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

The primary goal of this project was to determine the potential transmission of *Salmonella*, Shiga toxin–producing *Escherichia coli* (STEC) O157:H7, and non-O157:H7 STEC from animal operations that are in close proximity to vegetable production systems on (1) an experimental research station and (2) commercial diversified farming operations in North Carolina and Tennessee. The interface of food animals and fresh produce in agricultural production is an area in need of research that addresses transfer, persistence, and the overall risk factors potentially influencing pathogen transmission to fresh produce through water, air, and soil or basic cultivation practices. The overall goal of the project was to identify those risk factors that, when managed properly, could reduce the risk of contamination. The research team first performed control open-field studies within an agriculture research station and studied the impact of multiple farm variables, including buffer zone distances, temporal factors, air, and insects, on transmission of the above pathogens from dairy and poultry operations to an array of vegetable crops grown under the diversified farming system model. The information gathered throughout the control study was concomitantly used to design and implement studies in small to medium-sized commercial diversified farms in the two states. The aim under the second objective was to identify whether some of the observations determined during the control study, including source of the pathogen, movement and persistence, could explain the key parameters influencing produce contamination, narrow the "how-to" information gap, and help the produce industry to strategize control measures to improve food safety on their farms.

It is clear that the emergence and growth of the "Eat Local" movement has contributed directly to the growth of diversified sustainable farms that promote rearing livestock and growing fresh produce within the same agricultural system. This project was aimed at determining indicator and pathogenic bacterial transmission at the interface between food animal production and fresh produce on these farming systems. Further, the diversity within commercial sustainable farming systems poses a big challenge to the proposed buffer zone distance and to the potential mitigation practices that could provide practical evidence of reducing produce contamination from nearby animal operations across growing seasons. With the signing into law of the Food Safety Modernization Act (FSMA) and the implementation of the Produce Rule, this project began to address one of the major concerns within the rules, which is proximity, and the intrusion of domestic animals and transfer of pathogens to crops from these activities.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

To achieve the goals of objective 1, a control study was conducted on diversified farming operations that were established at two locations, one located next to a dairy unit holding 150 animals and another located next to a layer-hen house. At both locations, plots were placed at 32 ft, 200 ft, and 400 ft downwind from each animal operation. The selected land had not been used for dairy and poultry farming practices for a period of 3 and 10 years, respectively, and both locations were covered with native grasses before the experimental plots were established. Before, during, and after each growing season, vegetables were managed under organic practices except for fertilizer applications or the control of pigweed (which is a major problem in different regions in North Carolina). No manure was applied to any of the plots during the duration of the project. Between growing seasons, cover crops appropriate to the region and season were planted to maintain the field under a green cover. Soil, water, air, produce, and dairy and poultry manure samples were collected and analyzed for the presence of indicator microorganisms, including generic *E. coli,* coliforms, *Enterococci*, and *Salmonella* and STEC pathogens based on the animal production system. Overall, over 2,500 samples were collected from the selected locations, and the transfer of STEC pathogens was established within both animal-produce interfaces. *Salmonella* was not recovered from 99% of the samples, except for two poultry manure samples. This manure was collected within the layer-hen house manure and was never in contact with the diversified plots. Despite being able to collect over 2.1×10^6 L of air over the entire growing season, no pathogens were recovered from this intensive sampling. Water used mainly for drip irrigation met the adopted water quality standards by the Produce Rule by two-fold, and STEC or *Salmonella* were not recovered from these samples. Soil and produce samples consistently were positive for STEC within the 400-ft buffer zone distance. For soil samples the presence of STEC varied with distance, with a greater number of positive samples collected at 32 ft from each animal operation than collected at distances of 200 and 400 ft. This same trend was not observed with produce samples, in which distribution of STEC was random and present in samples collected at 32, 200, and 400 ft from each animal operation. *Salmonella* was not recovered from soil or produce samples. Although no pathogens were detected in the air samples, air remains the most likely route of contamination since no manure from any of these sources was applied to the fields for over 3 to 10 years.

The focus was on pathogen transfer from animal operations to diversified vegetable farming practices; however, the project findings are not limited to the sustainable agriculture environment since other cropping systems, including standard organic production, conventional farming practices, and biodynamic approaches, also pose the risk of pathogen transfer when in close proximity to animal operations. Under these scenarios and within the studied system, the size of animal operation, proximity to produce fields, and cultural practices seem to impact pathogen transfer to produce, and these parameters are irrespective of farming approaches. Consequently, whether farmers are dealing with fruits, vegetables, tree nuts, horticulture, nursery crops, or others included within the definition of specialty crops, the team's findings and potential approaches to reduce pathogen transfer could benefit all.

To achieve the goals of objective 2, the team collected farm samples, including produce, animal, and environmental, from selected commercial sustainable farms in North Carolina (n=2) and Tennessee (n=5). *Salmonella* and STEC isolated from samples were characterized at phenotypic and genotypic levels. There were clear distinctions between the outcomes based on geographic locations of these farms in the two different states. *Salmonella* was isolated from multiple samples originating from commercial sustainable farms only in Tennessee and not in North Carolina. None of the fresh produce samples from the farms in either of the two states tested positive for *Salmonella*. In Tennessee, STEC was isolated from fresh produce and animal and environmental sources as well as flies, while in North Carolina only the fecal and soil samples tested positive. Based on the outcomes of the 2-year sampling period in which animal feces, soil, air, and fresh produce samples were collected at varying distances from the animal source (~32–400 ft), the team concluded that a 400-feet distance between the animal source and the produce field as mandated by the California Leafy Green Products Handler Marketing Agreement (LGMA) rules may not be appropriate and that this buffer zone distance requirement needs to be reviewed and extended.

The principal investigator (PI) presented interim research results at the 2015 Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia, in June.

The scope of the project focused on specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and North Carolina State University (NCSU). CPS managed the project and the NCSU coordinated and performed the research studies. The PI led the overall coordination of the project and worked closely with the NCSU Co-PI 1 in ensuring completion of the proposal objectives in the project time frame. The PI led the efforts listed under objective 2 while the University of Tennessee Co-PI led the efforts under objective 2 in Tennessee. The NCSU Co-PI 1 led the control studies at the research station and provided protocols to analyze all the collected samples in both states following the same experimental procedures. The NCSU Co-PI 1 also assisted in the establishing the sampling schemes at the commercial diversified farms. The other NCSU Co-PIs assisted in recruiting sustainable farms in North Carolina and in sample collection, and also played a key role in the extension efforts of this team working on disseminating the information to the participating farmers in our study and across the state at growers meetings.

Goals and Outcomes Achieved

The transmission of pathogenic microorganisms (*Salmonella,* STEC O157:H7 and non-O157:H7 STEC) from animal production systems to fresh produce was characterized on an agriculture research station farm and commercial diversified farms. The movement of pathogenic organisms from the animal reservoirs and potential environmental sources into fresh produce fields was quantified based on distance from animal operations. A total of three vegetable growing seasons were implemented at each location. During each growing season soil, air, water, produce and manure samples were collected at each location and the presence of indicator and pathogen microorganisms was assessed on all samples. Farm samples including produce, animal and environmental, were collected from two commercial sustainable farms in North Carolina and five in Tennessee. Sampling was conducted multiple times on these farms over the 2-year period to fulfil the sampling requirements proposed in the study. Overall the results of this study suggest that a 400-feet buffer zone distance between animal operations and produce fields is not sufficient to prevent transfer of pathogenic microorganisms from the animal source to contaminate produce.

For the control study at the agriculture research station, all field experimental procedures have been completed and data have been analyzed. The team is finalizing the next generation sequencing analysis of soil, air, water, and produce samples collected at each location. The difficulty in recruiting commercial diversified farms for conducting the experiments in objective 2 was a major hurdle for the project team. To meet the project requirements in terms of samples collected, the team completed multiple sampling rounds on the farms. The molecular characterization of pathogenic organisms collected as part of the research conducted on the selected commercial diversified farms is complete. Overall, the team met the outcomes listed under the two objectives and generated useful information that will assist multiple farming systems.

Results for the control study (objective 1) suggest that the proposed 400-feet buffer zone distance between animal operations and produce fields may not be appropriate for preventing movement of pathogens from the animal source and into fresh produce. Further, these results suggest that the proposed buffer zone distance requirement needs to be revised and potentially include other barriers to reduce pathogen transfer. Although air sampling followed continuous and large volume capacities, the team was not able to recover pathogens throughout all sampling events; however, generic *E. coli* and coliforms were recovered on over 40% of the collected samples. Based on the data collected from the air filters, the team was not able to find that air was a potential source of pathogen transmission, despite the ability to consistently recover STEC from the soil and produce samples at different distances from the dairy operations (Figures 1 and 2 – see Attachment).

Baseline data obtained for the commercial diversified farm study (objective 2) are as follows:

North Carolina Year 1 – Over the 2-year study period two farms were sampled repeatedly in North Carolina. The team collected multiple samples comprising produce (n=110), soil (n=122), poultry feces (n=60), water (n=3), and insects (n=11) from Farm 1 that was sampled twice in the Piedmont region of North Carolina. The team recruited a second sustainable farm late in the year (2014) and this farm was sampled only once in December. From Farm 2 the team collected 72 samples, including produce (n=40), soil (n=16), and dairy cattle feces (n=16). Samples were processed individually to isolate *Salmonella* and STEC. Based on the results (Figure 3) it was clear that *Salmonella* contamination of fresh produce was not an issue, as none of the samples tested positive for *Salmonella* over the entire sampling period. However, STEC was isolated from eight fecal (13.3%) and three fly (27%) samples on Farm 1 and from three fecal samples (18.75%) on Farm 2. None of the STEC isolated from Farm 1 or 2 tested positive for *E. coli* O157:H7.

North Carolina Year 2 – The same two North Carolina farms were sampled repeatedly (3 times each) between May–September 2015. From Farm 1 the team collected 181 samples comprising vegetables (n=52), soil (n=71), poultry feces (n=45), insects (n=10), and water (n=3). From Farm 2 the team collected an additional 150 samples comprising vegetables (n=47), soil (n=23), dairy cattle feces (32), insects (n=15), and water (n=1). Samples were processed individually to isolate *Salmonella* and STEC. Any presumptive positive cultures collected from agar plates were prepared and stored until further analysis. No *Salmonella*-positive samples were detected from these two farms in year 2 of sampling. From Farm 1, STEC was isolated from 11 fecal samples (24.4%) and a single soil sample (1.4%). From Farm 2, STEC was isolated from five fecal (15.6%) and two soil (8.7%) samples (Figure 4). None of the confirmed STEC isolates were O157:H7, as determined by PCR testing.

Tennessee Year 1 – A total of 769 samples, including cattle feces (n=7), insects (fly traps; n=153), poultry feces (n=72), poultry litter (54), produce (n=265), soil (n=171), water (n=30), and manure (n=17), were collected from three Tennessee sustainable farms in 2014. Each farm was sampled three times during 2014, and sampling dates and locations were recorded. The team isolated and confirmed 110, 17, and 62 isolates of STEC, *E. coli* O157:H7, and *Salmonella*, respectively. STEC was predominantly isolated from samples originating from Farm 1 (n=43) and Farm 2 (n=60) compared with Farm 3 (n=7) during the year (Figure 5). The number of STEC-positive samples was significantly higher from Farm 2 than from Farm 1 ($P = 0.01$). STEC prevalence in both Farms 1 and 2 was highest among the poultry samples, including fecal and litter.

Fresh produce samples from Farm 1 (1.1%) and Farm 3 (6.5%) tested positive for STEC; the produce samples that tested positive included melons, cucumbers and beans. There was no significant difference between STEC prevalence detected in fly traps ($P = 0.31$) and water source ($P = 0.25$) between Farm 1 and 2. Based on PCR testing, a total of 17 STEC isolates (13.3%) were serotyped O157:H7, which were recovered from multiple sample types, including produce (beans), soil (bean field), poultry litter, and poultry feces, and fly traps (Figure 6). The serotype O157:H7 were predominantly isolated from Farm 1. A total of 40 isolates of *Salmonella* were isolated from the multiple sampling conducted on the three farms. *Salmonella* was isolated predominately from Farm 2 (n=50; 80.6%) followed by Farm 1 (n=11; 17.7%) and Farm 3 (n=1; 1.6%). The sample types that tested positive included poultry feces, poultry litter, soil, and manure; none of the produce samples tested positive (Figure 7). The predominant serotype detected was 4,5,12:i:- (45%), followed by Enteritidis (17.5%) and Schwarzengrund (15%).

Tennessee Year 2 – Two farms were sampled in Tennessee in 2015 and each farm was sampled three times. In total, 298 samples (fecal and litter, produce, soil, water, and flies) were collected from the two farms**.** A total of 91 STEC isolates were obtained from Farm 1 (n=27) and Farm 2 (n=64). All the presumptive STEC and O157:H7 isolates were confirmed by PCR. Serotype O157 was detected from two samples (water and cucumber) from Farm 1 but none from Farm 2. *Salmonella* (n=22) was isolated in Farm 2 from feces (n=8), litter (n=10), and fly-traps (n=4); the predominant serotype detected was Schwarzengrund (59%), followed by Kentucky (13.6%) and Typhimurium (13.6%). The detection of similar serotypes in flies and the poultry litter and fecal samples confirm the role of flies in the persistence of *Salmonella* on chicken farms. Since chickens eat the flies, they may become colonized and shed the pathogen thereby contaminating the litter, which becomes an important source of cross-contamination if directly applied to the fields or if composting does not kill the *Salmonella*.

The transfer of STEC pathogens was established between animal operations located in close proximity to diversified vegetable production systems. The project results strongly suggest that there needs to be a reassessment of the proposed 400-feet minimum buffer zone distance between animal operations and the location of fresh produce fields. Based on the project outcomes, this distance does not seem sufficient to prevent the transmission of pathogens from animal sources to produce. The team suggests conducting quantitative studies at varying buffer zone distances to determine the adequate buffer zones to prevent pathogen transmission and the establishment/assessment of other physical barriers to potentially reduce pathogen transfer.

The size and management of each animal operation seems to impact indicator and pathogen transfer within the diversified systems; operations with enclosed and small animal herds showed lower transfer than open and large animal operations. *Salmonella* was not isolated from any of the fresh produce samples at either the research station or the five commercial diversified farms in the two different states. Soil and insects were found to be positive for STEC, *E. coli* O157:H7, and *Salmonella*, which clearly highlights their potential for pathogen transmission to fresh produce.

Beneficiaries

The primary beneficiaries of the project's accomplishments are specialty crop producers with diversified farming systems or with production areas near/adjacent to livestock. The team disseminated the project findings at the Carolina Farm Stewardship Association (CFSA) Sustainable Agriculture Conference (November, 2015) in a workshop entitled "Food Safety on Livestock and Produce Mixed Production Farms."

The workshop was well attended by ~35 participants representing multiple organic and sustainable production farms in North Carolina, and the team received positive feedback.

Following the outcomes of this study the team also partnered with CFSA to offer a symposium on food safety within sustainable farming practices, held at the 2016 International Association for Food Protection meeting in Saint Louis, MO.

Furthermore, results of this project will benefit the North Carolina Vegetable Growers' Association (NCVGA) and was included in their annual Southeast Vegetable and Fruit Expo in North Myrtle Beach, SC (November 2016).

California growers, handlers, and processors of leafy greens and other specialty crops will benefit from the research findings regarding buffer zone distances with respect to fresh produce production systems.

The annual Southeast Vegetable and Fruit Expo is attended by 400–500 vegetable and fruit growers from North and South Carolina. In 2015, the targeted agent training session was attended by 17 agents and specialists from North and South Carolina.

According to the most recent (2012) Census of Agriculture there are 5,455 farms of produce crops in North Carolina, representing $520 million in sales in the state, and there are 42,729 farms of produce crops in California, representing $23.9 billion in sales in the state: (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/North_Carolina/ and http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp) .

The project PI, NCSU, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results also will be made available online as follows:

1. Final reports submitted to CPS (after the June 2016 symposium) will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link:

http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf .

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

Management practices for each crop will significantly impact mitigation practices to reduce pathogen transfer. Weather conditions had a profound impact on the project team's initial attempts to establish diversified farming systems. No run-off from poultry or dairy operations was observed. The team cannot discard the possibility that previous farm activities could have introduced some of the STEC pathogens recovered from soil and produce.

The team faced two major challenges. The first challenge was an unexpected extended winter season that delayed sampling from October 2014 to March 2015. This was the trend in both the collaborating states (North Carolina and Tennessee) and it affected both objectives 1 and 2. The atypical weather delayed plantings or prevented full-scale sampling for several months. Adverse weather conditions were also present during the week of March 5 through 8 and again from March 27 through 29; in both instances fall crops suffered frost damage and over 50% of the crops were lost. The second challenge was the difficulty to recruit sustainable commercial diversified farms or rather the unwillingness of farm owners to participate in the study. The team discovered that some farm owners didn't know if they have potential contamination issues because they assumed that microbial communities present in their farming systems will mitigate any risk and/or they didn't want to participate because they felt that they are likely exempt from FSMA. However, the team was eventually able to recruit two farms in North Carolina and sampled multiple times on the two farms.

In spite of facing multiple challenges listed above (willingness to participate and adverse weather patterns), the team was able to generate strong preliminary data that will provide a sound foundation for further research on bacterial transmission at the interface between fresh produce and food animal production on diversified farms. The team met the outcomes that were listed under the two objectives and generated useful information that will assist multiple farming systems. Working closely with the county extension officers was also helpful and it did open some doors for the team.

One recommendation for future projects based on what was learned through this study is to include funds to offset financial burdens to grower participants. The team found it extremely valuable to work closely with county based extension staff on identifying and recruiting grower participants. The team recommends continuing the work on sustainable farming systems as these farmers need assistance and guidance from the produce industry to deal with on-farm challenges that may compromise the safety of their product.

Additional Information

See Attachment for Figures 1–7.

Presentations :

Thakur S. (2015). Food safety risks at the Fresh Produce-Animal Interface: Identifying pathogen sources and their movement on diversified farms. CPS Produce Research Symposium, Atlanta, Georgia.

Carter R, Massel M, Gunter C, Thakur S, and Gutierrez-Rodriguez E. (2015). Food safety risks at the Fresh Produce–Animal Interface: Identifying pathogen sources and their movement on diversified farms. International Association for Food Protection Annual Meeting, Portland, Oregon.

Thakur S, Gutierrez E, Gunter C, Chapman B and Hanning I. (2014). Food safety risks at the fresh produce–animal interface: identifying pathogen sources and their movement on diversified farms. CPS Produce Research Symposium, Newport Beach, California.

Workshop: Food Safety on Livestock and Produce Mixed Production Farms. (2015). Carolina Farm Stewardship Association Sustainable Agriculture Conference, Durham, North Carolina.

Symposium: A Real-world Conversation about Food Safety and Microbial Quality of Sustainable Diversified Farming Systems. (2016). [Submitted] International Association for Food Protection Annual Meeting, St. Louis, Missouri, July 31–August 3, 2016.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 63	**Project Title:** Validation of Geospatial Algorithms to Predict the Prevalence and Persistence of Pathogens in Produce Fields to Improve GAPs	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13063	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

The risk of produce contamination can be reduced if contamination is minimized in the production environment, specifically during the growth and harvest stages. On-farm produce safety is complicated by the fact that each farm has a distinct combination of topography, land-use interactions and weather. Combinations of these factors influence the ecology and transmission of pathogens, and subsequently impact the risk of produce contamination. For this project, several extensive field studies were conducted, which identified key factors associated with an increased likelihood of pathogen presence in the produce production environment. Based on these factors, geospatial models were developed to predict on-farm areas that were more or less likely to be reservoirs of *Listeria monocytogenes (L. monocytogenes)*. The overall goal of this research project was to increase the understanding of pathogen transmission in the produce production environment by (a) validating geospatial predictive models for individual produce farms using remotely sensed data in a geographic information system (GIS) platform, and (b) examining the risk of produce contamination during and after precipitation events by quantifying the effect of time after precipitation and amount of precipitation on the frequency of pathogen detection. The validation of the geospatial models is invaluable to the produce industry because it would allow for the development of specific and science-based food safety plans for individual farms by identifying specific or likely hazards (e.g., proximity to domesticated animal operations). Knowledge of such hazards would assist growers in managing contamination risks on their farms by evaluating their current prevention-based programs (e.g., Good Agricultural Practices (GAP)) and implementing new preventive measures.

L. monocytogenes is a key pathogen of importance in the produce industry, and has been associated with multiple produce recalls and foodborne disease outbreaks. Understanding environmental factors associated with an increased *L. monocytogenes* prevalence in the produce pre-harvest environment is therefore critical for the produce industry, consumers, and public health professionals. This project specifically quantified the impact of rain and irrigation on *L. monocytogenes* detection over subsequent 24-h periods (i.e., 24, 48, 72, and 144–192 h post rain events). Furthermore, this project validated a specific tool to predict the likelihood of isolating *L. monocytogenes* from produce-field soils. This project was particularly timely since (a) technological advancements, particularly in GIS and remote sensing, had made it possible to integrate the large amounts of data needed to develop and validate this type of tool, and (b) the release of the Food Safety Modernization Act necessitated the implementation of science-based approaches to pre-harvest produce safety. Overall, this project demonstrated the usefulness of geospatial modeling for limiting produce contamination in the production environment, and provided the produce industry with science-based recommendations to prevent pre-harvest contamination of produce by *L. monocytogenes.*

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

Key activities and tasks that were associated with Objective 1 (implement geospatial algorithms to develop predictive maps identifying environmental reservoirs for *L. monocytogenes* on produce farms) and Objective 2 (independently validate each geospatial algorithm's power to predict areas that have a significantly higher prevalence of *L. monocytogenes*, as compared to areas identified as having significantly lower prevalence of *L. monocytogenes* by the algorithm) of this project included (a) development of predictive risk maps to identify environmental reservoirs (i.e., well defined spatial areas) for *L. monocytogenes* for four produce farms in New York State (NYS); (b) sampling of four NYS produce farms (264 samples/farm) to determine *L. monocytogenes* prevalence in on-farm areas with a low and a high predicted *L. monocytogenes* prevalence; (c) calculation of *L. monocytogenes* prevalence in on-farm areas with a low and a high predicted *L. monocytogenes* prevalence; and (d) validation of the geospatial model used to develop the predictive risk maps using univariate and multivariate logistic regression. Overall, *Listeria* spp. (including *L. monocytogenes*) were isolated from 20% (208/1056) of samples. *L. monocytogenes* was isolated from 12% (128/1,056) of samples. The prevalence of *L. monocytogenes* was greater for all field areas with a high predicted prevalence of *L. monocytogenes* compared with the field areas with a low predicted prevalence. For example, areas with <37.5 m distance from surface water showed a *L. monocytogenes* prevalence of 22%, compared to a prevalence of 10% for areas with >37.5 m distance from surface water.

Key activities and tasks that were associated with Objective 3 (quantify the effect of precipitation on the frequency of *L. monocytogenes* detection in high and low risk areas identified by the geospatial algorithms and the risk of *L. monocytogenes* transfer to produce during or after precipitation events) of this project included: (a) selection of two produce fields with a high and low predicted risk of *L. monocytogenes* isolation; (b) cultivation of spinach plants in 0.2 ha fields divided into twenty-one 13×13 m plots; (c) collection of soil (n=1,092), water (n=52), fecal (n=14) and spinach leaf (n=334) samples 24, 48, 72, and 144–192 h after an irrigation event (i.e., any time irrigation water was applied to the field) or rain event (i.e., >6 mm of rain over a 24-h period); (d) prevalence of *L. monocytogenes* for each field, time period (24, 48, 72, and 144–192 h), event type (rain and irrigation) and sample type (e.g., leaf, soil); (e) development of a statistical model to quantify the impact of rain and irrigation events on *L. monocytogenes* isolation from soil samples; and (f) development of a statistical model to quantify the impact of predicted risk on *L. monocytogenes* isolation from soil samples. The overall prevalence of *L. monocytogenes* was 9% (130/1,492). The prevalence of *L. monocytogenes* was higher in soil samples (8%) than in leaf samples (0.6%). Importantly, the prevalence of *L. monocytogenes* was higher in soil samples collected 24 h after irrigation and rain events (18%) than in soil samples collected 48 h (6%), 72 h (4%) and 144–192 h (1%) after irrigation and rain events.

Key results and recommendations:

- Proximity to surface water and pasture was significantly associated with *L. monocytogenes* isolation from produce production environments. Growers for whom *L. monocytogenes* would be a pathogen of concern may want to carefully manage growing areas in proximity to surface water and pastures. Similarly, processors or growers that conduct traceback investigations (e.g., based on a finished product positive) may want to more heavily focus sampling on field sites in proximity to surface water and pastures when trying to identify pre-harvest *L. monocytogenes* sources.

- The likelihood of isolating *Listeria* spp. and *L. monocytogenes* was greatest during the 24 h immediately following rain or irrigation events. Growers for whom *L. monocytogenes* would be a concern should consider enhanced interventions or management practices when harvesting crops within 24 h of rainfall or irrigation. For example, crops harvested under these conditions could be processed last. Alternatively, and where possible, harvest could be delayed for at least 24 h after rainfall or irrigation.

- Based on the project findings for *L. monocytogenes*, future efforts to explore GIS-based strategies to manage other pathogens (e.g., *Salmonella*) and pathogen sources (e.g., surface water used for irrigation) are warranted.

In June 2015, the Principal Investigator (PI) gave an oral presentation of the interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

This project did not benefit other commodities; all samples tested were collected from active produce farms. The CPS staff was in constant communication with the industry and the scientists working on this project, and was unaware of any commodities that benefited from this project other than specialty crops.

The project PI at Cornell University oversaw and coordinated the project. The Co-PI at North Dakota State University completed Objective 1; the Co-PI at Cornell University helped enroll farms in the project, and communicated findings to CPS and growers. The Industry Collaborator with the National GAPs Program provided logistical support and advice about farm management practices and food safety programs used by commercial growers.

Goals and Outcomes Achieved

Activities associated included (a) implementation of geospatial models to develop predictive risk maps to identify environmental reservoirs for *L. monocytogenes* on NYS produce farms; (b) validation of the geospatial model used to develop the predictive risk maps using univariate and multivariate logistic regression; and (c) quantification of the effects (e.g., amount and timing) of precipitation and irrigation on the frequency of detecting *L. monocytogenes* in NYS produce fields.

Outcome measures set out for the project included the publication of two peer-reviewed manuscripts as well as the citations of said publications. Two manuscripts based on Objective 1 and 2, and Objective 3, respectively, were published in *Applied and Environmental Microbiology* in 2016 and 2015 (see Additional Information for publications). To date, the manuscript based on Objectives 1 and 2 had been cited once, and the manuscript based on Objective 3 had been cited twice. Considering the short time after publication, these citation numbers suggested a high future impact of this work.

The original proposal proposed completion of a study that would (a) accurately predict areas in produce fields with a high or low prevalence of *L. monocytogenes* prevalence, and (b) identify distances and parameter levels that would predict a significantly lower risk of *L. monocytogenes* isolation. Using proximity to water and proximity to pasture, it was possible to accurately identify areas with increased odds of *L. monocytogenes* isolation. Specifically, the odds of isolating *L. monocytogenes* were three times greater in areas that were ≤37.5 m from water than in areas that were >37.5 m from water. Furthermore, the odds of isolating *L. monocytogenes* were 2.9 times greater in areas that were ≤62.5 m from pasture than in areas that were

>62.5 m from pasture. The original proposal also proposed development of a model to predict the effect of precipitation on the detection of *L. monocytogenes* from soil and produce samples. This model was successfully developed; based on the data generated, the model determined that the odds of isolating *L. monocytogenes* from soil samples was twenty-five times greater during the 24 h immediately following a rain or irrigation event compared with time period of 144–192 h after an event.

Key baseline data that was gathered included (a) the on-farm prevalence of *L. monocytogenes* in the soil for five produce farms in NYS (data was collected from four farms as part of Objective 1 and 2, and from a different farm as part of Objective 3); (b) the on-farm prevalence of *L. monocytogenes* in water, feces, and pre-harvest produce for one farm in NYS; (c) the odds of isolating *L. monocytogenes* for areas that were ≤37.5 m from water compared with areas that were >37.5 m from water, and areas that were ≤62.5 m from pasture compared with areas >62.5 m from pasture; and (c) the odds of isolating *L. monocytogenes* 24, 48, and 72 h after a rain or irrigation event compared with144–192 h after an event.

Major successful outcomes for the project included (a) the collection of quantitative data on the prevalence of *L. monocytogenes* in the soil of five produce farms in NYS (data was collected from four farms as part of Objective 1 and 2, and from a different farm as part of Objective 3); (b) the validation of a geospatial model that predicted areas of high and low *L. monocytogenes* prevalence for NYS produce farms; and (c) quantification of the effect of rain on the likelihood of isolating *L. monocytogenes* from on-farm soils. As described above, another major successful outcome for the project was the publication of two peer-reviewed papers.

Beneficiaries

Key beneficiaries of these data were produce growers, the produce industry and other scientists. Specifically, implementation of geospatial predictive models by the produce industry may increase the understanding of risk factors that promote foodborne pathogen prevalence and persistence in produce fields, and will assist growers in focusing their food safety efforts. Geospatial models allow for the development of preventive measures for individual produce farm fields, as they enable growers to proactively assess and address environmental factors that may increase the risk of contamination events on their specific farms. For example, predictive risk maps can identify areas of high predicted pathogen prevalence within specific fields, and enable growers to make more informed decisions about the management of crops in these areas, including targeted pathogen surveillance programs and altered management practices. Specific intervention strategies that the project findings suggested may be effective at reducing pre-harvest contamination risks included (a) waiting 24 h to harvest crops following rain events, (b) not irrigating within 24 h of harvest, (c) altering cropping schemes (e.g., planting high risk crops in low risk fields), and (d) monitoring pathogen levels in irrigation water.

The potential economic impact from this project will come from improved on-farm risk management strategies and a reduction in produce contamination events in the pre-harvest environment. This will reduce costs associated with crop loss (i.e., crops not being harvested because of known contamination), and costs associated with recalls. It will also reduce costs associated with post-harvest contamination, as low-level random contamination of pre-harvest environments could contaminate environments that are downstream in the produce supply chain (e.g., packing houses, processing plants). Another potential impact from this project is the ability to conduct more efficient traceback investigations—the project data can be used to predict field sites that are more likely to yield *L. monocytogenes*–positive samples, therefore potentially reducing the number of samples that need to be collected.

The project PI, Cornell University, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers and shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provided expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results were also made available online as follows:

1. Final reports submitted to CPS posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Abstracts and awards can also be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

Lessons Learned

Key lessons from this project included (a) *L. monocytogenes* contamination on produce farms was dependent on the specific ecological context of a produce farm; (b) geospatial, predictive risk maps can be used to prospectively predict *L. monocytogenes* prevalence for NYS produce production environments, and (c) small changes in management practices may have a significant effect on the risk of *L. monocytogenes* contamination in produce production environments (e.g., waiting 24 h to harvest crops following rain events significantly reduced the likelihood of produce contamination). Since the data showed that geospatial models could accurately predict the likelihood of *L. monocytogenes* isolation from soils collected from produce pre-harvest environments in NYS, further work is warranted to develop similar models for other regions, other pathogen sources (e.g., surface water used for irrigation), and other pathogens (e.g., *Salmonella)*.

One unexpected outcome was that proximity to impervious cover and available soil moisture did not accurately predict the likelihood of isolating *L. monocytogenes* from produce pre-harvest environments. Another unexpected outcome was that the amount of water applied to a field (i.e., as irrigation or rain) was not significantly associated with the likelihood of isolating *L. monocytogenes* from produce pre-harvest environments.

The Work Plan timeline was met and all project outcome measures were achieved.

One especially positive experience was the willingness of growers in NYS to participate in the study. At some point it may be worth investigating why some growers and/or growers in some states are more likely to be willing to participate in field studies like the one conducted here; this may help to further enhance grower participation in other studies.

Additional Information

See Attachment 1 for a map related to the project.

This project resulted in two peer-reviewed publications:

Weller, D., M. Wiedmann and L. K. Strawn. 2015. Spatial and temporal factors associated with *L. monocytogenes* contamination of spinach fields in New York State. *Applied and Environmental Microbiology* 81(17): 6059–6069.

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. Validation of a previously developed geospatial model that predicts *Listeria monocytogenes* prevalence for New York State produce fields. *Applied and Environmental Microbiology* 82(3): 797–807.

The findings of this project were presented on seven separate occasions:

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. *Validation of a previously developed geospatial model that predicts Listeria monocytogenes prevalence for New York State produce fields*. Presented at Cornell Geospatial Forum, October 13, 2015, Ithaca, NY.

Weller, D., L. K. Strawn and M. Wiedmann. 2015. *Microbe detectives: using geographic information systems (GIS) to track and find foodborne pathogens in produce productions systems*. Poster at the Cornell Institute for Food Systems Summit, October 12, 2015, Ithaca, NY.

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. *The use of geographic information systems to predict the risk of Listeria monocytogenes contamination in produce fields*. Presented by Laura Strawn at the International Association for Food Protection Conference, July 16, 2015, Portland, OR.

Weller, D., M. Wiedmann and L. K. Strawn. 2015. *Time since irrigation and rain events is significantly associated with an increased prevalence of Listeria monocytogenes in spinach fields in New York State*. Presented at the International Association for Food Protection Conference, July 16, 2015, Portland, OR.

Weller, D. 2015. *Microbe Hunters: Using geographic information systems to identify risk factors for Listeria monocytogenes contamination in produce production environments*. Presented at the Food Science and Technology Spring Seminar Series, Cornell University, April 21, 2015, Ithaca, NY.

Weller, D., L. K. Strawn and M. Wiedmann. 2014. *Microbe detectives: using geographic information systems (GIS) to track and find foodborne pathogens in produce productions systems*. Poster at the Cornell Institute for Food Systems Summit, December 8, 2014, Ithaca, NY.

Weller, D. 2014. *Integrating geographic information systems and produce safety to develop science-based recommendations for disease prevention*. Presented at the Cornell Geospatial Forum, October 14, 2014, Ithaca, NY.

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 64	**Project Title:** Evaluation of Risk-Based Water Quality Sampling Strategies for the Fresh Produce Industry	
Grant Recipient: The Regents of the University of California, Davis, Center for Produce Safety	**Grant Agreement No.:** SCB13064	**Date Submitted:** December 2016
Recipient Contact: Bonnie Fernandez-Fenaroli	**Telephone:** (530) 554-9761	**Email:** bonnie@centerforproducesafety.org

Project Summary

Irrigation water has been implicated in a number of outbreaks associated with fresh produce. The United States Food and Drug Administration (FDA) recently finalized guidelines for the sampling of irrigation waters for generic *Escherichia coli* (*E. coli*) when used for produce production as an indicator of the potential presence of fecal contamination. These general guidelines are designed to reduce the risk of produce contamination and provide guidance on sampling frequency, location, and source of irrigation water. The guidelines also acknowledge that they may differ depending upon the types of produce, rainfall events, the methods of irrigation, and source water protection. Therefore, proper documentation and quantification of the impact of these environmental factors was needed. This project offers recommendations towards risk-based sampling strategies for irrigation waters that provide the greatest risk reduction to produce.

The project had four major goals: 1) Assess and quantify factors that determine variability of generic (indicator) *E. coli*, pathogenic *E. coli* (Shiga toxin–producing stains: STEC), and *Salmonella* occurrence in irrigation water over time, based on historic data and data collected as part of this study, at specific locations in Arizona and Southern California. These data were then used to assess the impact of risk events, such as rainfall, water quality factors including temperature and turbidity, canal size, and watershed characteristics (potential sources of fecal contamination), on the occurrence of these organisms. 2) Assess the impact of occurrence, duration and intensity of rainfall events on *E. coli*/*Salmonella* in irrigation waters to determine how long after a specific rainfall event the irrigation water quality will be impacted. 3) Use an exposure scenario risk–based model for *E. coli*/*Salmonella* in irrigation waters to quantify the risks of infection with different sampling frequencies of irrigation waters based on environmental factors (e.g., rainfall), irrigation methods, and type of produce. 4) Develop a cell-phone/computer application (app) that can be used for guidance for frequency of sampling after high-risk (rainfall) events.

General guidelines for water quality sampling for indicator bacteria (*E. coli*) and sampling frequency were finalized by the FDA in late 2015, however, it is not apparent if these guidelines are based on site-specific conditions with quantifiable benefits related to risk reduction. This project was of extreme importance as industry will be working over the next 2 to 4 years to establish water quality monitoring programs in response to the FDA regulations.

Previous research conducted by this team supported the development of a Quantitative Microbial Risk Assessment (QMRA) for irrigation water sources, and methods to determine the relative risk of irrigating leafy greens with various water qualities. The previous research was conducted through the 2011 Specialty Crop Block Grant Program (SCBGP) Project 69: *Assessment of Escherichia Coli as an Indicator of Microbial*

Quality of Irrigation Waters Use for Produce. This project built upon that research by looking one step beyond quantifying risk to produce related to irrigation water quality to determine predictive risk factors, both environmental and physical, that impact water quality.

Project Approach

Over the course of this study, three datasets (based on historic data starting in 2001) were gathered from the field by the principal investigator (PI) and Co-PIs and the student research team from irrigation canals at the Yuma and Maricopa, Arizona and Imperial Valley, California. The datasets have measurements of *E. coli* and coliforms counts per 100 milliliters (ml) of irrigation water and the physical characteristics of the irrigation water. Supplemental datasets included pathogen presence information for some sampling locations and represented *Salmonella*, STEC, and enterococci data. Each region's dataset was analyzed separately to arrive at a regional model for prediction of *E. coli* and coliforms. These results allowed the research team to have significantly better ability to apply correlation statistics to the datasets collected and for use in risk model development. Results of note include the following: Correlation between *E. coli* counts and rainfall amounts occurred on the sampling day. A positive correlation between rainfall amounts occurred on day three and day four prior to the sampling day, possibly due to the travel time for water sources as well as the disturbance of canal sediments that could provide adequate environment for bacterial re-suspension and growth. A significant positive correlation was found among coliform counts, air temperature, solar radiation and heat units. A positive correlation was found between coliform counts and electrical conductivity and between coliform counts and irrigation water temperature.

Using transformed data and associated correlations, the research team was then able to build a set of models (equations) that can be used to predict local water quality conditions related to coliform counts or the presence of *E. coli* bacteria based on physical and environmental data. At the onset of this project the research team anticipated the development of only one model to be available to industry; however, it was determined that multiple models could be produced for users based on data input available as well as confidence level needed.

Overall the team developed a total of 13 models that can be used to predict water quality, based on the user data available to be input for calculation. This report presents the three main models that provide the most straightforward interpretation and with the most appropriate confidence level for the user. These models have been named as follows: 1) complete model (includes both physical and environmental variables for risk calculation), 2) physical model (includes only physical parameters in risk calculation), and 3) environmental model (includes only environmental parameters collected from the Arizona Meteorological Network [AZMET] in risk calculation). Following the development of the water quality risk assessment models, the research team worked with an experienced computer modeler to create a user-friendly application or "App" as the interface to help industry better predict risk-based sampling strategies for irrigation water quality.

To track funds supported by the SCBGP, all purchases were provided a code specifically tied to the SCBGP funds. Additionally, before any purchases were approved, the project PI reviewed and gave final authority that the expenditure was valid and was solely used to enhance the competitiveness of specialty crops.

The Center for Produce Safety (CPS) staff were in constant communication with the industry and the scientists working on this project.

This project could not have been completed without significant contributions of the research team and project partners. The CPS managed the project and the University of Arizona performed the research studies. The Co-PIs all played a significant role in historical data collection, data entry, statistical analysis, and model development. An Assistant in extension helped to coordinate sample collection and verification of new data as well as supervision of supporting students and staff. An Assistant Health Educator played a crucial role in the successful App development and worked closely with the computer modeler and the University of Arizona MobileMatters to ensure all tasks were accomplished on time and with industry in mind. In addition, staff at the Western Center for Food Safety in Davis, California played a significant role in communications with the FDA, validation of user App functions, and evaluation of the developed App.

Goals and Outcomes Achieved

Stakeholders were surveyed during multiple events in 2015 and 2016 including at the 2015 CPS Annual Research Symposium, the 2016 Desert Collaborative Field Conference, and two times at the Yuma Safe Produce Council monthly meetings in Yuma, Arizona, where participants were given information about risk-based sampling strategies and were provided with resources to aid in the determination of water quality risk. A total of 120 participants were asked whether, after learning about risk-based sample collection protocols and the risk assessment tool, they would change their current practices and modify their sampling protocols from strategies that were used before attending the presentation/workshop. Responses were overwhelmingly positive, with 67 and 82 percent of respondents indicating that they would be willing to change their current sampling protocol and use the risk assessment tool, respectively, to aid in irrigation water quality assessment.

As of January 2017 the team has determined that there have been 606 active users of the risk assessment tool (App) since online user tracking began in August 2016. This result indicates that industry is using the risk assessment tool for the risk-based sample collection protocol at a level that far surpasses the goal of 5 actual users. Over the past 5 months the team has observed a steady increase in the number of new users as well as the page views indicating time spent within the App. The project staff could not closely follow the original expected measurable outcomes and survey the same 10 growers after each presentation to determine whether 50% of those growers changed their sampling protocols. However, online tracking of users of the developed risk assessment tool (App) for the sampling protocol between August 2016 and January 2017 indicated that there have been 606 active users, which far surpasses the original target of 5 growers changing their sampling protocols.

The overall outcome of the project involved activities to integrate the water quality risk prediction model(s) presented above, into a user friendly App for industry. Working with an external computer modeler and App developer the project PI and supporting research team developed both an online application or “web App” as well as a cell phone–based App that is available for download for both iOS and Android devices.

The developed App, called the AgWater App (Attachment, Figure 1), integrates user information related to location of the water source, any available physical water quality data, locally available environmental data in real-time, as well as historical knowledge of the water quality to predict the likelihood of a water quality exceeding current Leafy Green Marketing Agreements (LGMA) or Food Safety Modernization Act (FSMA) standards. Based on the information available, the App automatically selects the most appropriate model (of the 13 created) to determine the likelihood of coliform or *E. coli* bacteria in the water source. Also, during the development of this App the research team was approached by members of the Western Center for Food

Safety and the FDA to incorporate App user functions to help industry calculate their Microbial Water Quality Profile and Statistical Threshold Value as defined by regulations. Due to the finalization of the FDA FSMA in November of 2015, the research team felt that this was an important component to include in the final developed App.

Future work by project PIs and partners beyond the scope of this project will track the progress of industry to integrate risk related principles into water quality monitoring programs and decision making through both formal and informal interactions, including, but not limited to, workshops, conferences, hands-on guides, surveys and personal communication.

The main goals and research objectives established were achieved by the project PIs and research team at the completion of this project. Ongoing work, beyond the scope of this project, will further integrate research products into industry use.

The research findings from this project are going to provide the produce industry with the best strategies for selecting sampling locations, sample volume, and frequency of testing for generic *E. coli* as an indicator of fecal contamination of irrigation waters. Progress towards achieving expected measurable outcomes included work of the PI and co-PIs to track stakeholder needs and communicate findings during outreach events. These outreach events specifically targeted working directly with the leafy greens specialty crop industry to identify a risk-based sampling protocol in order to minimize risk. No such guideline had existed before. The success of the project was measured by interviewing 10 stakeholders at the end of two years project duration to determine if they would be willing to use the risk assessment tools (App) to aid in water quality determination. In final workshops related to this project, of the 40 or more industry members interviewed and/or surveyed, nearly 90% of respondents indicated that they would be willing to use the AgWater App for one or more functions. Additionally, after the review of the data analytics obtained since August 2016 by tracking usage, project staff determined that to date there have been 606 active users of the risk assessment tool (App) and 520 users of the online calculator. This result far surpasses the original goal of 10 stakeholders and indicates that industry is currently following the recommended guidelines by using the risk assessment tool.

Overall, the major successful outcomes of this project support previous work by the project PIs to determine risk related factors that are likely to influence water quality. More specifically, the results of this project have led the team to make a number of recommendations.

First, the data assessment indicated that water quality is highly dependent on localized environmental conditions, and every effort should be made by industry to better understand their water sources through collection of water quality data and historical analysis. Second, scientific data collected and analyzed by the research team indicated that the four main influential factors in the region evaluated were air temperature, solar radiation, rainfall and electrical conductivity. Surprisingly, the ability of a user to input electrical conductivity into developed models greatly increased risk assessment confidence. This lends itself towards the recommendation to industry to include electrical conductivity in routine water quality monitoring plans to increase the likelihood of predicting coliform bacteria and *E. coli* in water sources. Third, currently there is no "one-size fits all" model to predict water quality; however, the development of multiple models allowed for a wider range of users based on available data and location. The team developed a total of 13 models that can be used to predict water quality, based on the user data available to be input for calculation. The "complete" model developed by the research team, which includes both physical and environmental variables for risk calculation, provides excellent predictions of water quality based on the data available and the region evaluated. Fourth, grower Apps can be useful tools that will allow industry to make more informed decisions about their water sources from both a water use and sampling perspective. And lastly, future work should include testing of additional regional water sources and comparison of water quality data against the developed models (n=13) to validate their use in regions beyond the desert Southwest.

Beneficiaries

The primary beneficiaries of this project included but are not limited to the following: fresh produce industry, food safety professionals, research scientists, U.S. Environmental Protection Agency, California and Arizona LGMAs, United States FDA and the FSMA, Yuma Safe Produce Council, irrigation districts in the Southwest, and commercial testing labs. Of particular interest to the groups mentioned above would be the water quality risk assessment—the AgWater App. This output built on previous research using real time environmental data and applying it to current regulatory guidelines for irrigation waters used for produce. This research built on the expertise in extension and contributed to a growing body of knowledge related to food safety and water quality research. To date, numerous studies have been conducted evaluating the potential for water to act as a source of enteric pathogens during crop production. In past studies funded by CPS and the Arizona Department of Agriculture, the team collected data that demonstrate varying levels of *E. coli* and the common occurrence of the human pathogens (e.g., *Salmonella* spp.) in canal waters used to irrigate fresh produce during canal maintenance events. The team's additional work on developing risk assessment tools and grower Apps shed light on physical and environmental factors that are likely to influence water quality, and was specifically focused on how food safety professionals can assess their operation to determine if and when water quality may be of concern. This work was critically important as it provides tools that stakeholders can use to best assess, and ultimately make food safety decisions in their operations.

Results from this project directly enhance the competitiveness of specialty crops, as this research and its outcomes showcased local stakeholders and their commitment to food safety. More importantly, this work demonstrated the active engagement between Arizona and California growers and the research and extension communities, working together to find tools and solutions to maintain produce safety. The research and extension team was fortunate to partner with stakeholders across Arizona and California who not only saw the benefits of understanding water quality in their region but also fully comprehended the long-term impact it will play on produce productivity and marketability.

According to the most recent (2012) Census of Agriculture there are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/.); in addition, there are 2,716 farms of produce crop growers in Arizona, representing $764 million in sales (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/Arizona/).

Lessons Learned

As a result of the work on this project, the team was approached to participate in broader research and extension projects related to water quality that would directly benefit the local industry and enhance the competitiveness of the leafy green specialty crop industry. This includes support from the CPS, Western Growers, Washington State Tree Fruit Association, U.S. Department of Agriculture, and additional funding from the Arizona Department of Agriculture. The project staff are now able to say that they have a "team" of Arizona researchers and extension specialists working together to solve problems for local industry related to food safety. The SCBGP project has been critical to the success of these efforts.

A positive outcome of this and the past CPS projects was the leveraging of the team's food safety expertise and knowledge in the Yuma and Maricopa regions to acquire additional funding from partners in Arizona and California. The addition of Research Specialist was especially beneficial for the research team as it helped tremendously to determine concerns of the produce industry in the Southwest.

As stated above, the initial intention of the research team was to develop one risk assessment model for industry to use to predict water quality in their region. However, after extensive evaluation of the available data, the team developed a total of 13 models that can be used to predict water quality based on the user data. This allowed for the broadest use of risk assessment information that provides industry with the most straightforward water quality interpretation while maintaining the confidence level needed.

Also, after reviewing the historical data, the research team determined that there wasn't enough pathogen data collected to make accurate correlations and/or much of the data were not quantitative (e.g., *Salmonella* data were presence/absence data only) and thus could not be used in ultimate model development.

At the onset of this project, the project team understood that the research goals and objectives were extremely ambitious to accomplish within a two-year time frame. While the work has been completed and the research team is very confident and proud of the resulting research and extension products, it would have been appropriate to build in some additional support to test the developed industry products at a larger scale after completion of the project.

As the AgWater App is used in the future, it is highly likely that revisions will be needed to strengthen its use and to broaden its application beyond the initial test case of the Southwest. Currently, there is no mechanism to update this application as the grant has now closed. In the future, it would be advisable to have a separate set of limited funds that may be applied for in order to meet the needs of such a project that is separate from its main research call for proposals.

Additional Information

See Attachment for AgWater App.

The following links are for the online calculator and Native/Web App (AgWater). The AgWater App was designed to aid in determining compliance with national FSMA regulations and LGMA recommendations as well as predict the likelihood of microbial contamination based on local environmental conditions.

- Online Calculator: http://agwater.arizona.edu/onlinecalc/
- Native/Web App: http://agwater.arizona.edu/

Presentations – the project PI gave presentations on the project status and research results:

- Oral presentation at the 2015 University of Arizona Desert Collaborative Field Conference, a collaborative effort of University of Arizona Specialists, scientists and local industry; March 31, Yuma, Arizona.

- Poster presentation at the annual Hartnell College Western Food Safety Summit; May 7-8, Salinas, California.
- Invited speaker at local Yuma Safe Produce Council monthly meeting and Water Sampling 101 training; May 20, 2015.
- Oral presentation at the 2015 CPS Produce Research Symposium; June 23, Atlanta, Georgia.
- Oral presentation, along with Assistant Health Educator, at a 2015 industry-testing event with the Yuma Safe Produce Council; November 12, Yuma, Arizona.
- Invited speaker at the Washington State Tree Fruit Association 2015 Annual meeting; December 9, Yakima, Washington.
- Invited speaker at Desert Produce Safety Collaborative 2016 Field Conference; January 12, Yuma, Arizona.
- Hands-on workshop and industry-testing event with Assistant Health Educator at the 2016 Yuma Safe Produce Council; February 3, Yuma, Arizona.
- Oral presentation at the 2016 Southwest Ag Summit; February 26, Yuma, Arizona.

USDA Project No.: 65	Project Title: Farm to Fork Specialty Crop Database Phase 2	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB13065	**Date Submitted:** December 2016
Recipient Contact: Nicole Sturzenberger	**Telephone:** (916) 900-5123	**Email:** nicole.sturzenberger@cdfa.ca.gov

Project Summary

The California Department of Food and Agriculture (CDFA) Office of Farm to Fork sought to create and publish a comprehensive database of specialty crop growers on the Farm to Fork website to be made available to food service institutions, community organizations, and consumers. The increased availability of this data benefits specialty crop growers by providing access to new and non-traditional markets for their produce, increasing their sales potential and enhancing the overall competitiveness of California-grown specialty crops.

Currently, a variety of state agencies, local governments, and community organizations are participating in programs which encourage consumers and large food service institutions to be aware of and purchase from local specialty crop growers in their area. In most cases however, these programs suffer from disjointed coordination and are operating in silos—achieving marginal results in regional food access at the local level. In addition, large food service institutions, consumers and specialty crop growers also face barriers establishing sales relationships. These barriers include: proficient understanding of institutional procedures, local environmental health regulations, price points, transportation logistics, and lack of awareness of specialty crop availability, both geographically and seasonally. Additionally, the U.S. Department of Agriculture's Farm to School census notes that on average, only 30% of California school district food budgets were spent on local food. This figure is only reflective of the 15% of California school districts that had information to respond to the survey. This is indicative of the lack of knowledge and resources available to School Food Authorities and School Food Service Directors about local specialty crops.

The Office of Farm to Fork, working in collaboration with the California Department of Education (CDE), community organizations, and specialty crop growers, developed a comprehensive database to be accessed on the Farm to Fork website. The creation of this database and its publication on the centralized, user-friendly Farm to Fork website with pertinent information (geographic location, types and seasonality of local specialty crops, processing capabilities, GAP/ GHP certifications, and liability insurance) allows specialty crop growers, food service institutions, and public consumers to forge new partnerships. Through these newly established sales relationships, specialty crop growers can now sell directly to food service institutions, and food service institutions (particularly School Food Authorities) can purchase locally-grown, seasonal fruits and vegetables directly from specialty crop growers, with the ultimate effects being increased food access and enhanced competitiveness of California-grown specialty crops.

The Database Phase 2 portion of the overall project was to fine tune the California Farmer Marketplace (CFM). Various feedback features enabled users to contact the CFM by using the "Contact Us" and "Help Us Improve" buttons on the site as well as a "Help Us Improve" popup prompted when users log out. From this feedback the CFM was adjusted to better suit users, solicit new growers outside the pilot counties, as well as answer and address any questions or comments that came through the feedback mechanisms.

There are over 400 specialty crops growing in California and over 4 million school breakfasts, lunches, after school snacks and suppers served in California every school day, as part of the United States Department of Agriculture's (USDA) school meal programs. Connecting specialty crop growers and food service institutions will facilitate the purchase of California specialty crops to be featured in schools. The specialty crop growers, the school food service directors that are trying to get more local, fresh specialty crops in California schools, and the children who consume those local, fresh specialty crops will benefit from this project. Eating locally and including specialty crops into school meals supports the direct connection between the farm and the consumer, and improves product gross margins and farm profitability as well as minimizing operational risk by establishing long-term customer relationships. Making improvements to the CFM enables greater ease of use and increases the likelihood that farmers and School Food Authorities will continue to use the site and recommend it to others, building the user base. Additionally by featuring more specialty crops in school lunches, growers and food service directors can inspire life-long consumers of California specialty crops.

This project builds on 2010 Specialty Crop Block Grant Program (SCBGP) Project 75: *Farm to Fork Website Development – Phase I*, and the 2012 SCBGP Project 70: *Farm to Fork Specialty Crop Database Phase 1*. Project 75 focused on the development of the Farm to Fork Website which created a platform to share innovative information and best practices. Project 70 launched a pilot of a database of specialty crop growers to complement the results of Project 75. This Project further developed and refined the database in response to usability testing as well as specific feedback from users.

Project Approach

The Office of Farm to Fork seeks to facilitate interactions between growers, food service institutions (particularly schools) and community organizations through an easy-to-use database, connecting schools and other consumers directly with local farmers who produce and sell California specialty crops. In Phase 1 of the project, staff worked with key stakeholders to determine the most user-friendly platform for the database as well as information it should contain. Specific surveys of registered users as well as general feedback were used to make improvements to the website. In Phase 2, feedback has continued to be collected from the CFM using the "Contact Us" and "Help Us Improve" buttons on the site as well as a "Help Us Improve" popup prompted when users log out. From this feedback the CFM was adjusted to better suit users. For example, a major feature that has been added is a "Distance from Me" filter. This allows schools and other institutions to search for farmers closest to them, as many organizations specify that foods need to travel a certain distance, i.e. come from less than 100 miles of their facility. This same feature is in the farmer/ producers view, so farmers can reach out to the nearest institutions interested in what they produce. Hyperlinks were also created for the items listed under "Recently Added Commodities" on the CFM homepage. This allows schools to quickly compare seasonal produce, who is offering this particular commodity, their price, distance, etc. Additionally staff added hyperlinks to farmers/producers when a consumer searches by a particular commodity. This way they can directly pull up the description of the farm and see if they would be a good fit or if another farm would work better for their needs. Descriptions for the various features on the CFM were also added for both the producer and consumer view. An example of this is the "inquiries" button for producers. It provides a visually descriptive button of an envelope with a letter in it, with a description along the side stating "View all Inquiries allows you to see past inquiries sent to you from consumers/businesses and the various communications that could have stemmed from that. This feature helps you keep track of who has reached out and contacted you and who you still need to respond to."

The Office of Farm to Fork has publicized the CFM to both consumers as well as specialty crop growers through several key outreach efforts. On March 11, 2016 the CDE sent out an email to all California Child Nutrition Service Directors in the state, reaching approximately 1,000 school districts, informing them of the CFM and the features it includes as well as how to sign up. On March 14, 2016 the Office of Farm to Fork reached out to all of the farmers/producers signed up on the CFM, at the time totaling 48, to let them know of the email CDE sent out, to encourage them to update their current offerings. The CFM was also publicized at various conferences. The CFM was presented in a session given at the SNAP-Ed Conference on January 14, 2016 to a group of 300 people. The CFM was also highlighted at the California Small Farm Conference in Sacramento March 5-8 2016, through a booth as well as an offsite field course. The booth utilized a computer tablet, allowing specialty crop farmers in attendance to sign up for the CFM with staff assistance. The offsite tour had current and aspiring specialty crop farmers in attendance who learned about innovative ways of connecting with traditional markets and institutions, one of which was through the CFM. The CFM was also publicized through a booth at the California Agricultural Day on March 16, 2016 where students from Natomas Unified School District (a current CFM user) promoted seasonal fruits and vegetables through a fresh salsa they had made. On April 19, 2016, the Office of Farm to Fork presented the CFM to attendees at the California WIC Association Conference in San Diego, which had over 900 people in attendance. The CFM was also presented in a keynote address to the Sacramento Regional Farm to School Network meeting on May 18, 2016.

The Office of Farm to Fork secured matching funds to support non-specialty crop commodities listed on the site. Because of minimal data available, the Office of Farm to Fork proposed using a roughly 60/40 split (specialty crop/non-specialty crop) in the initial grant proposal. This "known target threshold" is based on the farm gate value of specialty crops vs. non-specialty crops in California (60% of the state's farm gate sales come from specialty crops as indicated in the CDFA's California Agriculture Statistics Review, 2013, with non-specialty crops making up the remaining 40%). Based on registered site users, specialty crops producers represent 91.2% of users registered as producers (only 5 users out of 57 produce non-specialty crops). Since only 8.8% of producers registered on the CFM offer non-specialty crop products, staff recommend the matching funds reflect this. Therefore staff only requested $3,390.73 in matching funds to cover the portion of the CFM that represents non-specialty crops. This is a more conservative number then by looking at the individual specialty crops listed (42) compared to non-specialty crops (4), which would only represent 8.69% of goods offered on the marketplace. The following specialty crops were listed: Arugula, Basil, Cardoons, Chard, Cucumbers, Eggplant, Plums, Tomatoes, Pumpkins, Jujubes, Eggplant, Onions, Rosemary, Potatoes, Avocados, Lemons, Persimmons, Beets, Carrots, Apples, Bell Peppers, Grapefruit, Grapes, Jicama, Kiwis, Pears, Radishes, Summer Squash, Winter Squash, Turnips, Watermelons, Zucchini, Lettuce, Raisin, Walnuts, Oranges, Olives, Cherries, and Honey. Non-specialty crop commodities include: Eggs, Chicken, Pork and Beef. The Office continuously monitors the site to ensure specialty crops always represent 60 % or more of the items posted.

Project staff have reached out to farmers and school food service professionals to update the site based on their feedback. The contributions from users, farmers and School Food Authorities have been essential to making improvements to the CFM usability. The Office of Farm to Fork also worked with CDE to conduct outreach to school food service directors, which was accomplished on March 11, 2016.

Goals and Outcomes Achieved

The Office of Farm to Fork publicized the CFM to both consumers as well as specialty crop growers through several outreach events. These activities were done in order to achieve the performance goals of a 10% increase in unique page views, having at least 25 school districts in at least 10 different counties signed up on the CFM, and having a 5% increase in average school food budget in registered counties spent on California specialty crops.

A press release publicizing the CFM was issued in July 2015 by the CDFA and was sent to approximately 500 contacts connected to the Office of Farm to Fork, including individuals working in schools, affiliated non-profits, community groups, and supporting governmental organizations. The release was re-publicized by the Almond Board, Imperial News, CDFA Planting Seeds blog, Pacific Coast Farmers Market newsletter, and Ag Alert. The CFM was also publicized through a poster at the Childhood Obesity Conference held June 29-July 4, 2015 in San Diego, California to an audience of over 2,000 individual educators, researchers, and healthcare professionals in attendance. Handouts were distributed at the Sacramento Farm to Fork Festival in September 2015 to event attendees with information describing the CFM. On March 11, 2016 the CDE sent out an email campaign to all California Child Nutrition Service Directors in the state, reaching approximately 1,000 school districts. On March 14, 2016 the CFM reached out to all of the farmers/producers signed up on the CFM, at the time totaling 48, to let them know of the email CDE sent out, to encourage them to update their current offerings. The CFM was publicized at the SNAP-Ed Conference on January 14, 2016 to a group of approximately 300 people. The CFM was highlighted at the California Small Farm Conference in Sacramento March 5-8 2016, through a booth as well as an offsite field course. The booth had a tablet to allow those in attendance to sign up for the CFM on the spot. The offsite tour had current and aspiring specialty crop farmers in attendance who learned about innovative ways of connecting with traditional markets and institutions, one which was through the CFM. The CFM was also publicized through a booth at California Agricultural Day on March 16, 2016 where students from Natomas USD (a current CFM user) promoted seasonal fruits and vegetables through a fresh salsa they had made. On April 19, 2016 the Office of Farm to Fork presented the CFM to attendees at the California WIC Association Conference in San Diego, which had over 900 people in attendance. The CFM was also presented in a keynote address to the Sacramento Regional Farm to School Network meeting on May 18, 2016.

Staff have also continued to engage with the original pilot school districts School Food Authorities who are leaders in the California farm to school movement. Other food service directors looking to incorporate more locally grown food into their cafeteria often consult with them to determine best practices. The increase in CFM signups can also be attributed, in part, to word of mouth marketing by these individuals.

Though staff did not specifically have any long term measures for this grant, they plan on continuing to promote the CFM to schools and farmers and work toward a greater percentage of school food purchases coming from California specialty crop farmers through the CFM.

The overall goal of the project was to increase access to, and awareness of, specialty crops for food service institutions and local community organizations. Benchmark data was set at registering 25 districts in at least 10 different counties by June 2016. Staff have far exceeded that goal and have had 58 school districts signed up in 33 different counties, as well as a handful of charter schools, preschools, Head Start programs, senior resource centers, and colleges. A total of 57 farmers/producers have registered, ranging from small to large and representing a variety of commodities.

Part of bringing awareness to specialty crops is helping to direct producers and buyers to the CFM. One of the outcomes was to have a 10% increase in unique page views from the 2013 monthly average. In the progress reports staff reported that the website analytics were improperly set up for the initial launch of the site so there is no benchmark data captured for the initial launch. The problem was corrected in October 2015, so the Office of Farm to Fork used the November and December views as a benchmark. Comparing the 2015 monthly average of 619 unique page views to the 2016 monthly average of 829 views, shows an increase of 33.9%, exceeding the goal of 10%.

Another outcome of the project was to see a 5% increase in average school food budget spent on California's specialty crop food dollars by the end of Phase 2 using 2013 and 2015 USDA Farm to School Census (USDA F2SC) Data.

According to the 2013 USDA F2SC (school year 2011/2012), of the 625 districts that responded to the census, 353 districts in California (representing 2,626 schools) were participating in Farm to School activities and spent 11.2% of their food dollars locally, excluding local milk purchases. If the 60/40 split of specialty crop/non-specialty crop proposed above was used, that would mean approximately 6.7% of participating schools' total spending was on local specialty crops in 2013.

The 2015 USDA F2SC (school year 2013/2014) indicates that out of the 679 school districts that completed the census, 373 districts in California (representing 5,498 schools) were participating in Farm to School activities and spent approximately 4.9% of their budget on local products, excluding milk. Applying the 60/40 split again indicates that 2.9% of the total budget was spent on specialty crops in 2015. Although this appears to indicate a decrease in local specialty crop spending, the increase from 2,626 to 5,498 of individual schools these districts are serving needs to be considered.

In 2013, the total cost of local food excluding milk spent by districts that completed the census was $30,804,130. Assuming the 60/40 ratio, this would indicate that $18,482,478 of school budget funds were spent on specialty crops. In data collected in 2015 the amount spent on specialty crops had risen to $33,997,616, an 84% increase between the two reports, which indicates a strong trend of improved interest and money spent towards increasing the average school fund budgets spent on California specialty crops.

The five school districts that were signed up on the CFM and reported values on local purchases for the 2013 and 2015 USDA F2SC were consistent with the response of other school districts in the census. There was an overall increase in local purchases, excluding milk, of 1.33% overall. If the one outlier who reported spending 20% of food dollars on local purchases was excluded, in the 2011-2012 school year to just 1.3% in 2013-2014 school year there would be an average of 4.65% increase, translating to a 2.8% increase in local specialty crop purchases. Though staff did not achieve the goal of 5% increase on local specialty crop purchases, the schools spend more money overall on California specialty crops, which shows the positive effectiveness of the CFM. Although the time period of data collected in the two census data sets were prior to the launch of the CFM, staff are confident the tool will allow schools to build on the trend of increasing budgets allocated to local food and alleviating barriers they may face regarding their ability to find growers. The Office of Farm to Fork look forward to the next census cycle in order to evaluate the data and validate the full positive impact of the CFM.

Activities	Performance Indicator	Baseline Data	Actually Accomplished
Track website usage	10% increase in unique page views from 2013 monthly average	619 average views in 2015	33.9% increase in unique page views from 2015 to June 2016
Evaluate database performance	Improvement from 2013 USDA Farm to School Census data—5% increase in average school food budget in the registered counties spent on California's specialty crops	2013 USDA F2SC-10.05% spent on specialty crops* 2015 USDA F2SC-12.84% spent on specialty crops*	Improvement from 2013 USDA F2SC data—2.8% increase in average school food budget in the registered counties spent on California's specialty crops*
Publicize website to consumers, focusing on school food authorities and other institutional consumers	In Phase 2, at least 25 school districts in at least 10 different counties will be registered on the database by the end of June 2016.	8 school districts in 6 different counties were registered by the end of September 2015.	58 school districts in 33 different counties were registered on the database by the end of June 2016.

*Excluding outlier Hueneme Elementary School District, which experienced a nearly 19% change in local purchases, excluding milk, from 2011-2012 school year to 2013-2014 school year. The next largest percent change was 12% at Moorpark Union School District.

Beneficiaries

This project benefits specialty crop growers, food service institutions that handle specialty crops and those that the institutions serve. The CFM facilitated connections between specialty crop growers and food service institutions that will contribute to the long-term sustainability and growth of specialty crop endeavors throughout California. The CFM provides a new market for many specialty crop farmers, more direct purchasing for schools and healthy food for children in California schools.

There are over 400 specialty crops growing in California and over 4 million school breakfasts, lunches, after school snacks and suppers served in California every school day, as part of the USDA's school meal programs. Connecting specialty crop growers and food service institutions will facilitate the purchase of California specialty crops to be featured in schools. The specialty crop growers, the school food service directors that are trying to get more local, fresh specialty crops in California schools, and the children who consume those local, fresh specialty crops will benefit. Eating locally and including specialty crops into school meals supports the direct connection between the farm and the consumer, and improves product gross margins and farm profitability as well as minimizing operational risk by establishing long-term customer relationships. Additionally, by featuring more specialty crops in school lunches, growers and food service directors can inspire life-long consumers of California specialty crops.

Lessons Learned

Targeted marketing and promotion of the CFM was more effective than the email campaign to over 10,000 farmers. It was more impactful to approach parties that were already engaged and/or interested in farm to school activities, as they were more likely to sign up and utilize the CFM as a resource. Staff accomplished this with speaking opportunities, booths at conferences, as well as targeted press releases.

One unexpected outcome was having over twice as many school districts sign up in three times the number of different counties than was the original goal. This shows that there is a strong desire on the side of school districts to have a resource like the CFM to be able to reach out to local farms and reinforces the need for such a site. Another unexpected outcome was not achieving the goal of a 5% increase in average school food budget in the registered counties spent on California's specialty crops. Though staff did see an improvement, the 5% increase was not obtained.

One of the goals that was not achieved was observing an improvement from the 2013 USDA F2SC data. Staff had hoped to see a 5% increase in average school food budget in the registered counties spent on California's specialty crops. Staff observed a 2.8% increase in those schools that were both signed up on the CFM and also responded to all of the relevant questions in the USDA F2SC for both the 2013 and 2015 report. One of the issues was that there were only 5 schools that fit that description, as many schools left large portions of the survey questions blank. With such a small number of schools completing the survey in its entirety, there is uncertainty in the number reported. If staff were to do it again, and if there were the funding, staff would have conducted their own, specific questionnaire to schools to get the exact numbers. This would have required significantly more time and money and would not have been feasible given the scope of this grant.

Additional Information

Website of the CFM: http://cafarmermarketplace.com/.
The blog, Tales from the Field: http://blogs.cdfa.ca.gov/TalesFromTheField/.
Other photographs that might not have been included in blog posts are provided below.

Booth at Small Farm Conference, which provided attendees the opportunity to sign up on the California Farmer Marketplace on the spot.

Students from Natomas Unified School District at Ag Day serving samples of salsa from local produce. CFM adverting was on display in the background, as well as postcard handouts on the table for more information.

California Department of Food & Agriculture
Specialty Crop Block Grant Program
FINAL PERFORMANCE REPORT

USDA Project No.: 66	**Project Title:** Climate-Smart Agriculture for Specialty Crops – Partnership with the Netherlands and Israel	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SC13066	**Date Submitted:** December 2016
Recipient Contact: Josh Eddy	**Telephone:** (916) 654-0462	**Email:** josh.eddy@cdfa.ca.gov

Project Summary

This project was created to help further the application of climate-smart technologies, methodologies, and management practices within the California specialty crop sector. Climate change is a specific issue that impacts agricultural production on a global basis. In California, the impacts correlate with periods of drought, flood, reduced snowpack accumulation, and lessening of natural groundwater recharge.

By leading delegations to the Netherlands and Israel, the California Department of Food and Agriculture (CDFA) provided specialty crop stakeholders the opportunity to develop strategies that enable California farmers to adapt to climate change and reduce greenhouse gas emissions. During the visits, participants were introduced to a variety of technologies and management practices that could be incorporated within California. These practices included, but were not limited to: irrigation technologies; recycled water use for food production, water management techniques, saline agricultural production, substrate production, root breeding technologies, and sustainable greenhouse technology. Each of these focuses can directly improve the production and market competiveness of California's specialty crop sector.

The project was important and timely for several reasons. California continues to suffer from a significant ongoing four-year drought which is impacting growing practices related to specialty crops. The prolonged drought limits surface water availability and is depleting groundwater resources. Climate-smart agricultural technologies and management practices related to irrigation are critical in assisting growers in adapting to changing conditions. Further, reduced natural groundwater recharge, as a part of the ongoing drought, necessitates the need for specialty crop growers to improve on-farm recharge projects maintaining groundwater basin supplies for future use.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

Project Approach

The project consisted of two climate-smart agricultural delegations (Israel and the Netherlands) and associated activities connected to each individual trip.

For the Netherlands, the work plan consisted of three key phases (planning, implementation, and follow-up). During the planning phase, elements of the agricultural trip were designed and participants were selected to maximize the exposure and potential for dissemination of learned practices and technologies to specialty crop stakeholders. Pre-trip meetings were held with delegation members to get feedback on proposed schedule and to outline purpose of the trip as well as objectives and goals.

During the implementation phase, the delegation program was facilitated by the project directors and their collaborators in the Netherlands. As a result of the planning phase the following accomplishments were achieved – number of participants: 13; number of site visits: 8; number of business/government/academic meetings: 11; and number of climate smart technologies/practices observed: 6. As a result of the implementation phase, delegation participants made initial contacts for follow-up with more than 50 individuals connected to climate-smart technologies, policy, research and on-farm practices. The program provided a strong foundation for future collaboration between individuals to assist California specialty crop growers in adapting to a changing climate. A concluding meeting of the project participants was held the last day of the trip to help prioritize future outreach and educational components.

During the follow-up phase several activities were designed to provide further outreach and education on climate-smart agriculture. Among these activities were a climate smart agricultural website and webinar for specialty crop stakeholders. Both activities were conducted in collaboration with partners in the Netherlands and resulted in delays for program implementation. The first climate smart agricultural webinar was hosted in July focusing on saline agriculture – growing specialty crops with saline conditions. The webinar had 100 attendees and is hosted on CDFA's website for additional viewership (https://www.cdfa.ca.gov/climatesmartag/).

For the Israeli program, the work plan was very similar to that of the Netherlands and contained the same three phases (planning, implementation and follow-up). During the planning phase, CDFA worked with the consultants to create an in-country itinerary targeting project objectives. Pre-trip meetings were held with delegation members and contractors to elicit feedback and provide an overview of the program and project goals/objectives.

During the implementation phase, the program was facilitated by the project directors, in partnership with the consultants. As a result of the planning phase, the following accomplishments were achieved: number of participants: 16; number of site visits: 4; number of business/government/academic meetings: 10; and number of climate smart technologies/practices observed: 4. As a result of the implementation phase, delegation participants made initial contacts for follow-up with more than 70 individuals connected to climate-smart technologies, policy, research and on-farm practices. A concluding meeting of the project participants was held the last day of the trip to help prioritize future outreach and educational components.

The follow-up phase of the Israeli program included a climate smart agricultural webinar, hosted in November focusing on recycled water us for specialty crops. The webinar had 82 attendees and is hosted on CDFA's website for additional viewership (https://www.cdfa.ca.gov/climatesmartag/). Further information is still being compiled to assist in climate smart agriculture website development.

The project was focused specifically on specialty crops.

Project partners for this program included:

- CDFA's Office of Climate and Innovation - assisted in program planning, webinar design and development of the Climate Smart Agriculture website (in progress).
- CDFA's Information Technology - assisted with website design and facilitated webinar.

- CDFA's Office of Public Affairs - assisted with program outreach and follow-up, specifically through social media postings, videos and performance measure tracking.
- Consultants - led program development/implementation with the subcontractor; facilitated all in-country logistics for program implementation for the Israeli program.
- The Government of the Netherlands - assisted in program development for the Netherlands trip and facilitated all in-country programing in collaboration with CDFA.

Goals and Outcomes Achieved

Performance goals and measurable outcomes identified in the project focused on the development of a post-mission webinar on climate-smart agriculture and a follow-up survey to gauge the number of growers/producers that gained knowledge about the science-based tools through outreach and education programs.

The first climate smart agricultural webinar was a follow-up to the Netherlands trip and occurred in July 2016. The webinar was on the challenges and opportunities of saline agriculture – a focus on specialty crops. Additional webinars are planned with Netherlands climate partners in 2017.

The second climate smart agricultural webinar was follow-up to the Israeli trip and occurred in November 2016. This webinar focused on the use of recycled water on specialty crop production. Additional webinars are also planned with Israel for 2017.

The project has resulted in an ongoing climate smart agriculture webinar series that links target experts and technologies with delegation participants to provide outreach to California farmers and ranchers. The goal of this project remains to further the application of climate-smart technologies, methodologies and management practices within the California specialty crop sector.

Deliverables (webinars) of the project are both short and long term. The short term deliverable associated with the Netherlands trip were completed in July 2016 within the project time period. The short term deliverable, associated with the Israeli trip, occurred in November 2016.

Additional webinars in 2017 are planned with both Israeli and Netherlands climate exceeding the outlined performance activities of the project.

The measurable defined outcome for this project was to enhance the competitiveness of specialty crops through more sustainable, diverse and resilient specialty crop systems. This was achieved through outreach and educational programing.

Social Media Engagement: 11 blog posts with viewership of more than 4,500; 3 videos with viewership of more than 450.

Webinars: The webinars targeted an audience of 200 individuals. The Netherlands webinar included 100 participants (webinar space limited by technology constraint) and the Israeli webinar included 82 individuals.

As part of the long term deliverables, the project is on course to meet the measurable outcomes identified in the project.

The baseline indicator for this project was an online survey, evaluating progress of those individuals who viewed the webinars.

Survey questions for webinar participants included: 1) Did the program enhance your understanding of climate-smart agriculture practices/technologies associated with specialty crops? 2) Do you see your organization adopting climate –smart agricultural practices/technologies for specialty crops in the next 3-5 years? 3) What value will adopting climate-smart agricultural practices/technologies provide you as a specialty crop grower?

Baseline results of the initial survey fell below a 10 percent participation rate. Among those that participated in the survey, 100 percent of the responses were achieved for questions 1 and 2. Values of adopting climate smart agriculture practices were listed as water conservation/savings and adjusting to salinity levels.

Baseline information will also be collected following subsequent climate smart webinars in 2017.

In quantifiable terms related to project outcomes, more than 5,000 individuals were engaged with climate smart agricultural activities associated with the delegations to Israel and the Netherlands. The outreach and education included not only social media and videos, but a technical webinar on observed technologies and on-farm practices directly related to specialty crops.

In addition, more than 125 farmers, academic and governmental contacts were made as result of the missions. These contacts will further the goals of the project through ongoing collaboration. Combined, the missions included 24 external specialty crop stakeholders representing agricultural organizations, commodity groups, academic organizations and government representatives. The dissemination of information on climate smart practices by these external stakeholders will have strong qualitative benefits to California's specialty crop sector.

Beneficiaries

This project provided 24 California farm organizations, academia and other agricultural stakeholders information on climate-smart agricultural technologies, methodologies and management practices that can then be shared with their specialty crop membership. Information will also be shared on a statewide basis by CDFA through outreach and website availability.

As a result, the beneficiaries of this project are the specialty crop growers in the state, approximately 45,646 farms producing on more than 4,338,625 acres. This project provided information on climate-smart technologies and practices to farm organizations and specialty crop growers allowing for potential on-farm implementation and greenhouse gas reductions. The projects webinar series and website are available online for all stakeholders to access.

Lessons Learned

The Climate Smart Agriculture policy missions and associated webinars provide a strong forum to better understand and disseminate technologies and on-farm practices associated with climate change focusing on specialty crops. In continuing this adaptation of technologies and practices, future emphasis should be placed on establishing demonstration projects with university sponsorship allowing first-hand observations and on-farm testing of applicability.

Among the conclusions for the project is that there are several opportunities for international partnerships in the areas of saline agriculture, root breeding, irrigation technologies/practices, recycled water use for food production, water management, substrate farming and sustainable greenhouse production. The policy missions provided a strong foundation for specialty crop stakeholders to further international collaboration on and dissemination of climate smart technologies and practices within the specialty crop sector.

An unexpected outcome from the project is the continuation of the climate smart agricultural webinar series to be held in collaboration with international partners. Future webinars are planned to include perspectives from Israel, Netherlands, Mexico and Vietnam. Interest among specialty crop stakeholders in regards to climate smart practices that address drought and salinity issues remains very high.

Initial outcome measures were achieved and long term outcomes are also anticipated to meet to projections. These outcomes will help to establish baseline indicators for future work addressing climate smart agricultural practices and technologies.

Additional Information

Information on California's Climate Smart Agriculture webinars is available at:
www.cdfa.ca.gov/climatesmartag

Blog posting from the California Climate Smart Agriculture Policy Missions are available at:
http://plantingseedsblog.cdfa.ca.gov/wordpress/

Attachements:
Itinerary – Climate Smart Agricultural Policy Mission (Netherlands)
Delegation Profile – (Netherlands)
Itinerary – Climate Smart Agricultural Policy Mission (Israel)
Delegation Profile – (Israel)

CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT

USDA Project No.: 67	**Project Title:** Monitoring for Glyphosate in Specialty Crop Produce	
Grant Recipient: California Department of Food and Agriculture	**Grant Agreement No.:** SCB13067	**Date Submitted:** December 2016
Recipient Contact: Tiffany Tu	**Telephone:** (916) 228-6830	**Email:** Tiffany.tu@cdfa.ca.gov

Project Summary

Roundup weed killer (or Glyphosate) is sprayed over millions of acres of food crops and on lawns across the world. Recently, there have been numerous reports that the chemical has been found in the food people consume. A report from the World Health Organization (WHO) referenced many studies suggesting that Glyphosate may cause cancer. These reports have prompted concern among various environmental and consumers protection groups. There has not been any monitoring of this widely used chemical on produce in California. The goal of this project is to demonstrate that California specialty crops conform to EPA established tolerance for Glyphosate. Historical data results clearly demonstrate the safety of California grown produce and this project will enhance the competitiveness of California's specialty crops by evincing that Glyphosate is not present at greater than established tolerance levels. The plan is for the partner, California Department of Pesticide Regulation (CDPR) to collect produce in the channels of trade and deliver them to the California Department of Food and Agriculture (CDFA), Center for Analytical Chemistry (CAC), Pesticide Residue (PR) laboratory for analysis. The project will begin with four commodities (sweet corn, carrots, spinach and green beans) and a total of 300 samples. The number of commodities and samples might increase subsequently.

The PR laboratories monitor for agro-chemicals in specialty crops to ensure their safety and to prevent potential pesticides misuse. The WHO report suggested that Glyphosate may cause cancer which incited concerns among various consumer protection groups. Supplying the lab with new equipment allows the analysis of this important chemical. The project will monitor for and collect data on Glyphosate in produce to show the safety of California grown produce and to protect California consumers. These endeavors enhance the competitiveness of California's specialty crops. Additionally, this is the first large scale project of its kind in California. Data from the project can potentially benefit the risk assessment process of Glyphosate.

This project uses similar instrumentation as the 2012 Specialty Crop Block Grant Program (SCBGP) Project 73: *Improving the Capability of Specialty Crop Pesticide Residue Analysis* in which the Anaheim PR laboratory purchased a Quantiva LCMS system. The PR program was successful in expanding the monitoring capability to screen for 60 more chemicals, many of which are the foreign chemicals being used overseas on specialty crops. The equipment for the current project will not duplicate the efforts of the 2012 SCBGP Project 73, as this equipment will be dedicated solely for the Glyphosate testing because of the different accessories associated with the analysis. This project will complement previous project's effort in screening specialty crop produce for harmful agrochemicals.

Project Approach

To conduct Glyphosate testing on specialty crop produce, the PR laboratory requires a grinder to effectively homogenize fruits and vegetables, a centrifuge to extract the chemical from produce, a pressure manifold for samples clean-up, a tube writer to label test tubes, a Quantiva LiquidChromatograph- Mass Spectrometer

(LCMS) as the primary detection system and laboratory supplies essential to testing. The project officially began in July 2016, before the arrival of the major instrument. It was necessary that the PR staff use equipment from a different program to start the method development and validation. To date, most of the equipment has arrived and is being put to use for the project; the Quantiva LC-MS has been installed and is being validated for use currently. Analysis is still being conducted on the loaned instrument. During a four month period from July to November 2016, a total of 132 samples have been analyzed. Data results show all but one sample tested negative for Glyphosate. One sweet potato sample had a very low incurred level of Glyphosate, a finding of less than 2% of the allowable limit.

The Quantiva LCMS is set up as a dedicated instrument for the Glyphosate analysis on specialty crops only. All laboratory supplies necessary for testing will solely be used for the specialty crops.

This project would not be possible without the partner, CDPR, to collect samples for the PR laboratory. CDPR inspectors collect produce samples from wholesale, retail, farmers market, distribution centers and deliver to the PR laboratory for analysis. At the beginning of the project, a decision was made to monitor for Glyphosate in five commodities: carrots, sweet corn, green beans, sweet potatoes and spinach. As the project progressed, more specialty crop samples were included for analysis such as papaya, apples, asparagus, grapes and broccoli.

Goals and Outcomes Achieved

As soon as the award was announced, PR staff started to order equipment and supplies. Most of the equipment and supplies required for the samples processing such as extraction and clean-up arrived quickly except for the analytical Quantiva LCMS instrument. Because of the timing constraint, the scientist had to start the method development and validation on a loaned instrument. Method validation was completed prior to the start of the project on July 2016. Seven commodities were selected for the validation: carrot, sweet corn, green bean, lettuce, orange, potato, and sweet potato. The minimum detection level (mdl) was set at 10 parts per billion even though the instrument was capable of detecting a much lower level. To date, more than 130 specialty crop produce samples have been analyzed and completed results were released to CDPR for enforcement purposes.

The Glyphosate project got off to a good start. The goal for the first year is to conduct testing on 300 produce samples. The project is on schedule with 132 samples completed. With the current sampling rate, the goal of analyzing 300 samples is easily attainable.

The sampling schedule from CDPR up to the second quarter (half way point) shows a total of 168 samples will have been collected.

PR laboratory staff have completed 132 samples in a period of five months. One hundred thirty-two data points were released to CDPR on a timely manner for enforcement purpose. Only one sample tested positive for Glyphosate and at the level of less than 2% of the allowable limit. These data clearly show the safety of specialty crop produce sold in California.

Beneficiaries

Specialty crops – fruit, dried fruits, vegetables, nuts, and horticulture and nursery crops (including floriculture) – are the mainstay of California agriculture. California is by far the number one US producer of specialty crops both in quantity and in diversity, with a total of over 400 different crops recorded. Many of California's specialty crops (such as almonds, artichokes, and broccoli) are grown almost nowhere else in the country. This project would benefit the California specialty crops first and foremost. Data will enhance the safety record of California specialty crops. Any tolerance violation report would help growers to monitor their own process and operation.

The California consumers would benefit as they can be assured their food supply is being monitored for potentially carcinogen, Glyphosate.

The specialty crop industry will benefit from the project as past PR laboratories' surveillance data clearly demonstrate that California specialty crops are safe, enhancing the value of California's specialty crops. There are 45,646 farms in California producing specialty crops with a market value of $30,451,932,000 [United States Department of Agriculture National Agricultural Statistics Service, 2012 Census of the Agriculture, Specialty Crops] that will potentially benefit from this project.

Lessons Learned

This project progressed smoothly and on schedule even though the dedicated instrument (the Quantiva LCMS) has not been deemed ready for use. It was the right decision to start the method development and validation on a loaned instrument because of the timing constraint. The loaned LCMS will be used temporarily until the validation of the Quantiva LCMS is complete.

Additional Information

No additional information.

2013
Specialty Crop Block Grant Program – Farm Bill (SCBGP-FB)
FINAL REPORT
APPENDIX

USDA, AMS Agreement No:
Specialty Crop Agreement No. 12-25-B-1657

State of California
Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Contact(s):

Stephen Tachiera, Manager
Office of Grants Administration
Email: stephen.tachiera@cdfa.ca.gov
Phone: (916) 403-6525
Fax: (916) 653-0206

Kristi Duprey, SCBGP Manager
Office of Grants Administration
Email: kristi.duprey@cdfa.ca.gov
Phone: (916) 403-6536
Fax: (916) 653-0206

Date Submitted:
December 23, 2016

California Department of Food and Agriculture
2013 Specialty Crop Block Grant Program –Farm Bill
Final Report
CFDA # 10.170

APPENDIX
TABLE OF CONTENTS

SPECIALTY CROP BLOCK GRANT PROJECTS

Buy California - final digital report

+ VISIT CALIFORNIA

3/1 - 6/30/2014

8/1 - 11/31/2014

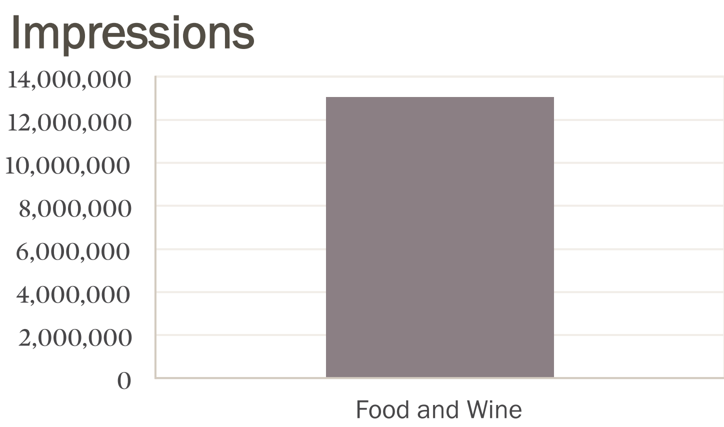
Prepared by MeringCarson

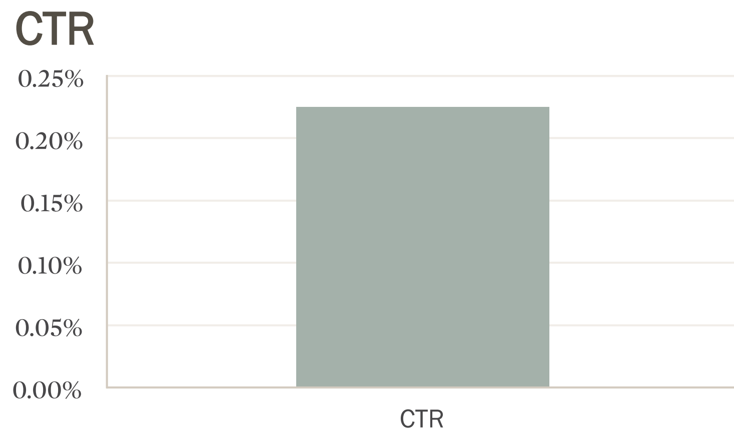
+ CAMPAIGN HIGHLIGHTS

60MM impressions	Over a nine month flight the BuyCA campaign delivered 59,511,082 impressions sourced from Food and Wine's print, display and social media. Print media's total readership reached 46,200,000 over six print insertions. Display targeting recorded 13,055,594 impressions and social – 255,488.
29K clicks	Food and Wine's banner, rich media, and e-newsletter display placements drew 29,422 total clicks to the foodandwine.com/california microsite. A 0.23% campaign click-through rate was achieved - nearly three times the industry standard display benchmark 0.08%. High impact brand block placements on the Food and Wine homepage lent to a strong 0.40% click-through rate indicating strong contextual affinity to the BuyCA content. Food and Wine's social audience yielded 12,205 social engagements including likes, comments, shares, favorites and mentions.
760K video plays	Six custom California Grown videos accumulated 759,612 video plays from only 421,657 visits. Upon visiting the site, the auto-play video feature immediately captures user attention - leading to a efficient 180.15% visit to video engagement rate. Individual video views ranged from 80,000 - 150,000 where popular San Diego and Fresno videos each recorded approximately 150,000 video plays.
308K entries	The chance to win the ultimate California foodie vacation sweepstake garnered 308,368 total applicants. Efficient behavioral targeting across Food and Wine's run of site and homepage placements converted 73% of all site traffic into a sweepstake entry. Explicit banner call-to-actions to "Enter To Win" combined with high post-click share of voice on the landing page ultimately enticed visitors to enter to win immediately upon visiting the site.

display

+ F&W DELIVERY - CAMPAIGN



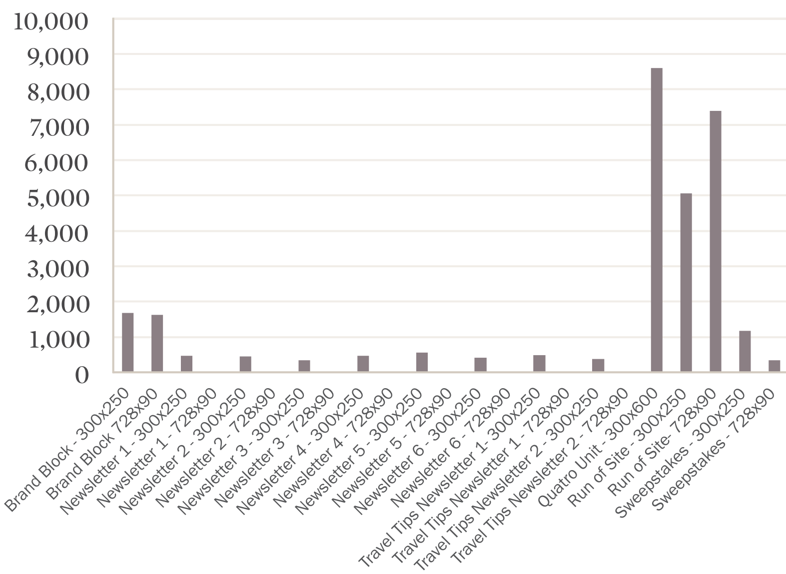


PUBLISHER	IMPRESSIONS	CLICKS	CTR
Food and Wine	13,055,594	29,422	0.23%
totals	13,055,594	29,422	0.23%

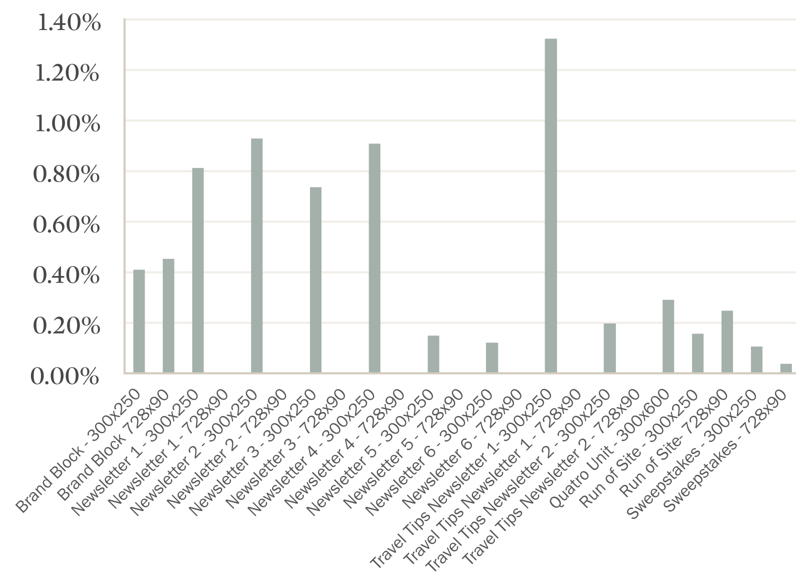
*Does not include social impressions
*Industry benchmark CTR: 0.08%

+ CREATIVE - CAMPAIGN

CLICKS



CTR



CREATIVE	IMPRESSIONS	CLICKS	CTR	EMAILS SENT
Brand Block - 300x250	410,607	1,679	0.41%	N/A
Brand Block 728x90	357,361	1,616	0.45%	N/A
Newsletter 1 - 300x250	57,935	471	0.81%	268,318
Newsletter 1 - 728x90				
Newsletter 2 - 300x250	49,242	457	0.93%	266,597
Newsletter 2 - 728x90				
Newsletter 3 - 300x250	45,943	338	0.74%	265,476
Newsletter 3 - 728x90				
Newsletter 4 - 300x250	51,975	472	0.91%	265,476
Newsletter 4 - 728x90				

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<tr><td>Newsletter 5 - 728x90</td></tr>
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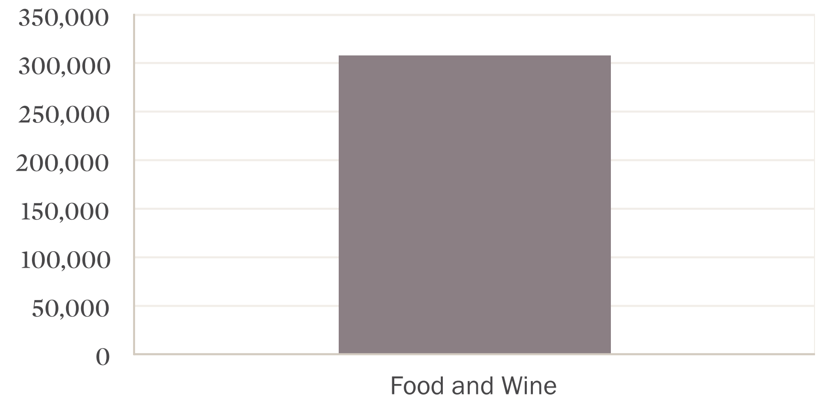
Note: run of site creatives include additional layer of contextual and behavioral targeting

+ F&W MICROSITE - CAMPAIGN

SITE VISITS

SWEEPSTAKE ENTRANTS

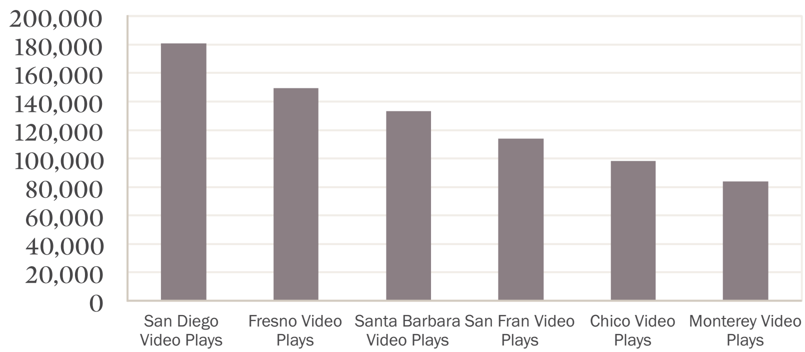


PUBLISHER	VISITS	ENTRIES	VIDEO PLAYS	VIDEO PLAY RATE
Food and Wine	421,657	308,368	759,612	180.15%
Total	421,657	308,368	759,612	180.15%

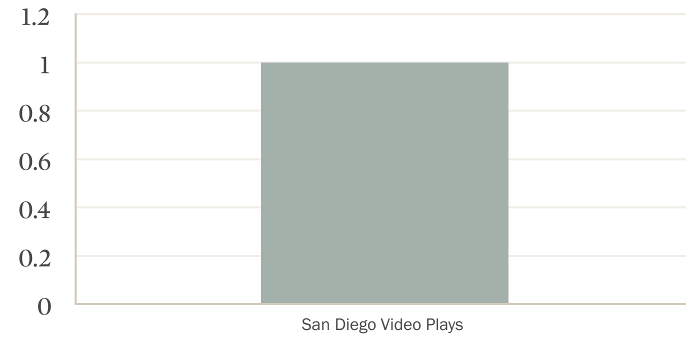
Note: Onsite Data provided by Food and Wine

+ VIDEO ASSETS

VIDEO PLAYS



% VIDEO PLAYS

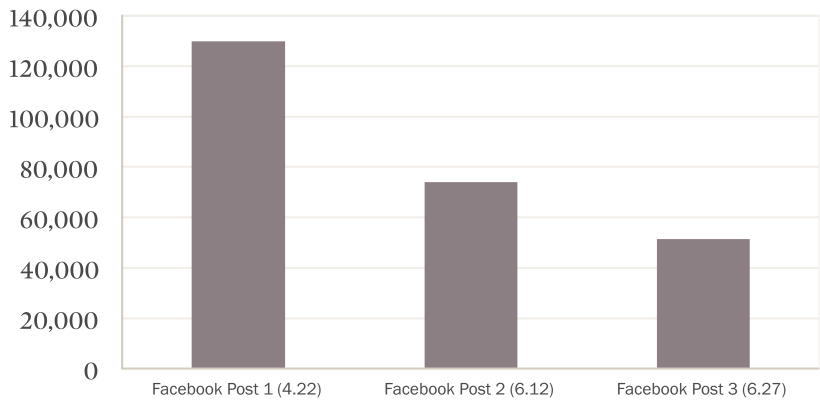


VIDEO	VIDEO PLAYS	% VIDEO PLAYS
San Diego Video Plays	181,047	24%
Fresno Video Plays	149,215	20%
Santa Barbara Video Plays	133,351	18%
San Fran Video Plays	114,052	15%
Chico Video Plays	98,181	13%
Monterey Video Plays	83,766	11%
Totals	759,612	100%

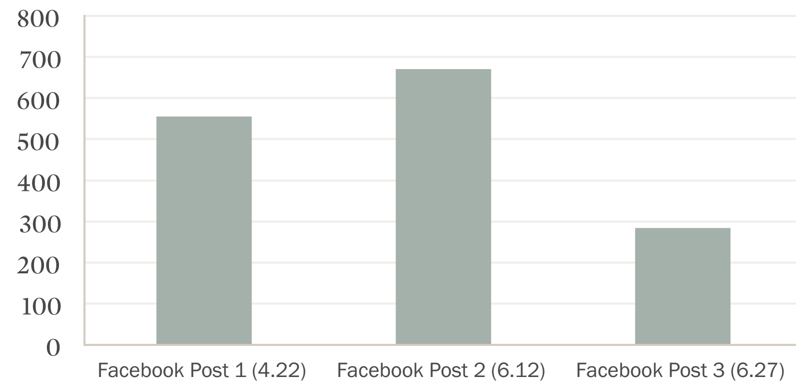
Note: run of site creatives include additional layer of contextual and behavioral targeting

+ FACEBOOK

Impressions



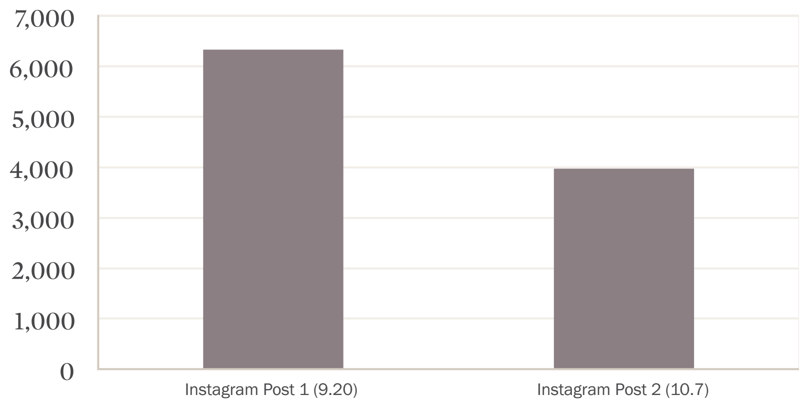
LIKES



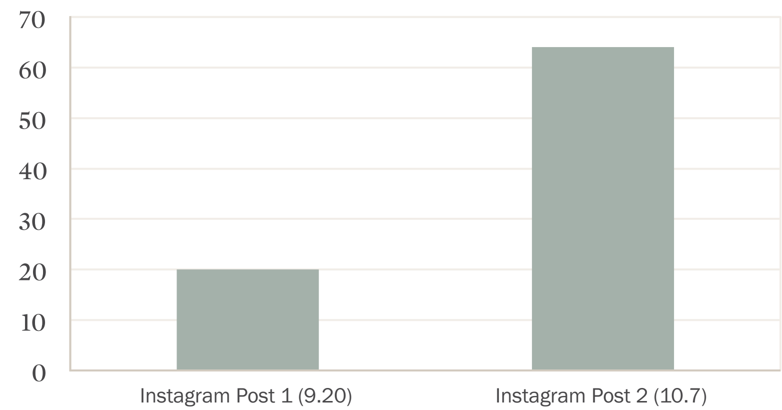
POSTS	IMPRESSIONS	LIKES	SHARES	COMMENTS	ENG. RATE
Facebook Post 1 (4.22)	129,933	556	99	10	0.51%
Facebook Post 2 (6.12)	74,053	671	104	6	1.05%
Facebook Post 3 (6.27)	51,502	284	34	0	0.62%
Totals	255,488	1,511	237	16	0.69%

+ INSTAGRAM

LIKES



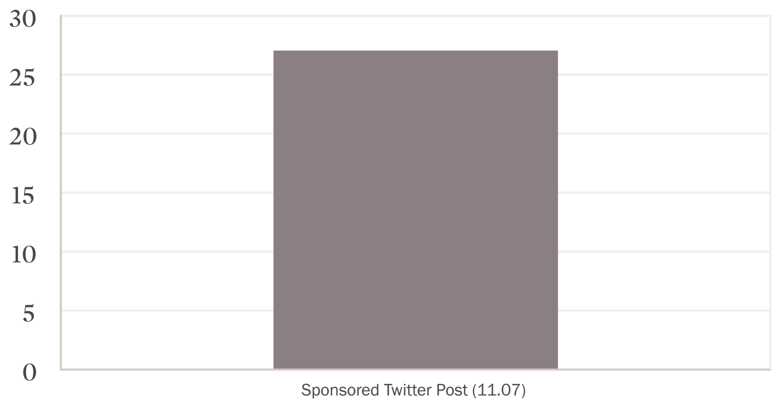
COMMENTS



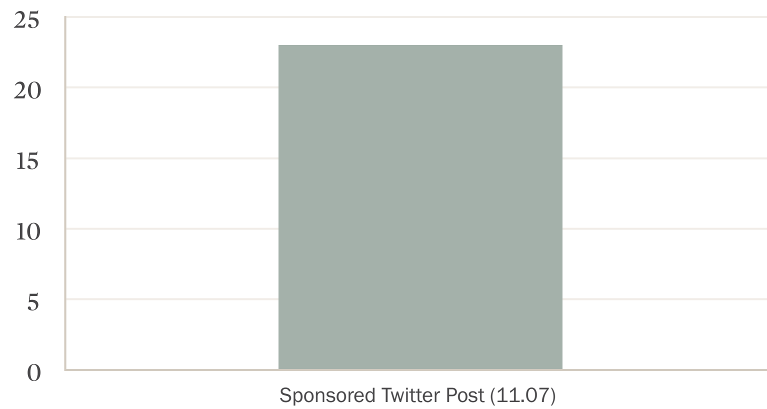
POSTS	LIKES	COMMENTS
Instagram Post 1 (9.20)	6,335	20
Instagram Post 2 (10.7)	3,972	64
Instagram Post 3 (11.25)	3,918	45
totals	14,225	129

+ TWITTER

LIKES



FAVORITES



POSTS	LIKES	COMMENTS	FAVORITES
Sponsored Twitter Post (11.07)	27	0	23
totals	27	0	23

*Two Twitter Posts Remain

+ F&W FACEBOOK POST 6.12

+ F&W FACEBOOK POST 6.27

FOOD & WINE

Food & Wine
June 27

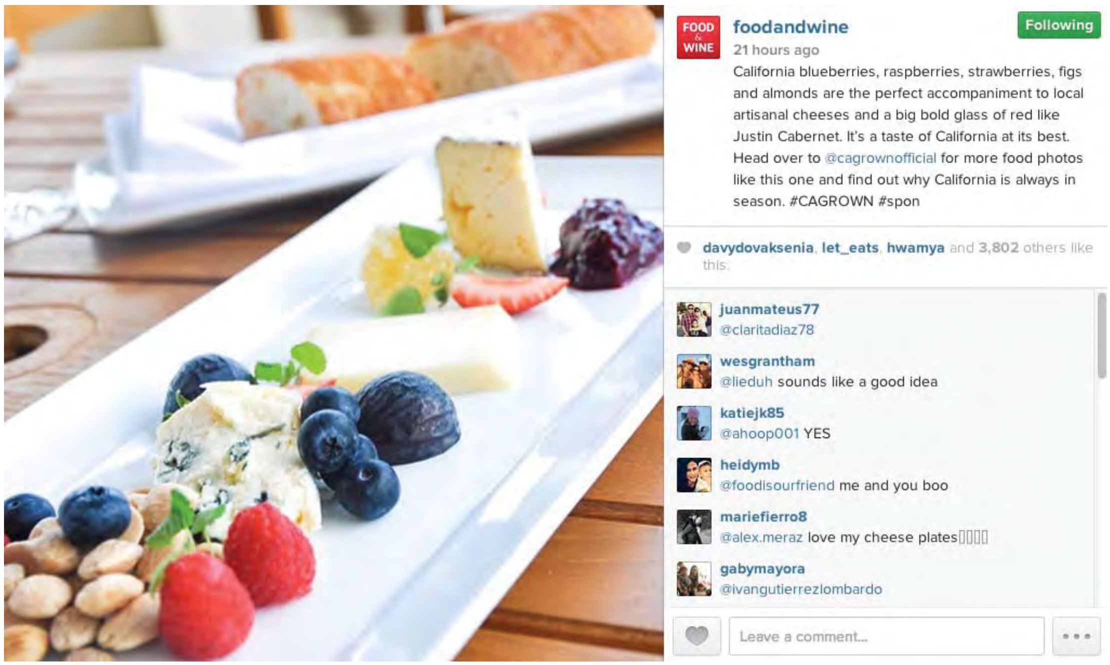
[sponsored] The CA Bartlett Pear (http://www.calpear.com/) is America's first pear; the first to be grown in the U.S., the first to harvest each year and the first choice for foodies! Learn more about the many crops California produces at foodandwine.com/California and enter for a chance to win a 7-day foodie vacation across the Golden State. #CAGrown

Like · Comment · Share 34 Shares

288 people like this.

+ F&W INSTAGRAM 9.20

+ F&W INSTAGRAM 10.7



+ F&W INSTAGRAM 11.25

+ TWITTER 11.07

Food & Wine magazine @foodandwine · Nov 7
Ad: Celebrate CA kiwi season with a refreshing kiwi margarita! @cagrownofficial shows you how
oak.ctx.ly/r/20bv7 pic.twitter.com/9H2Go6cvU5

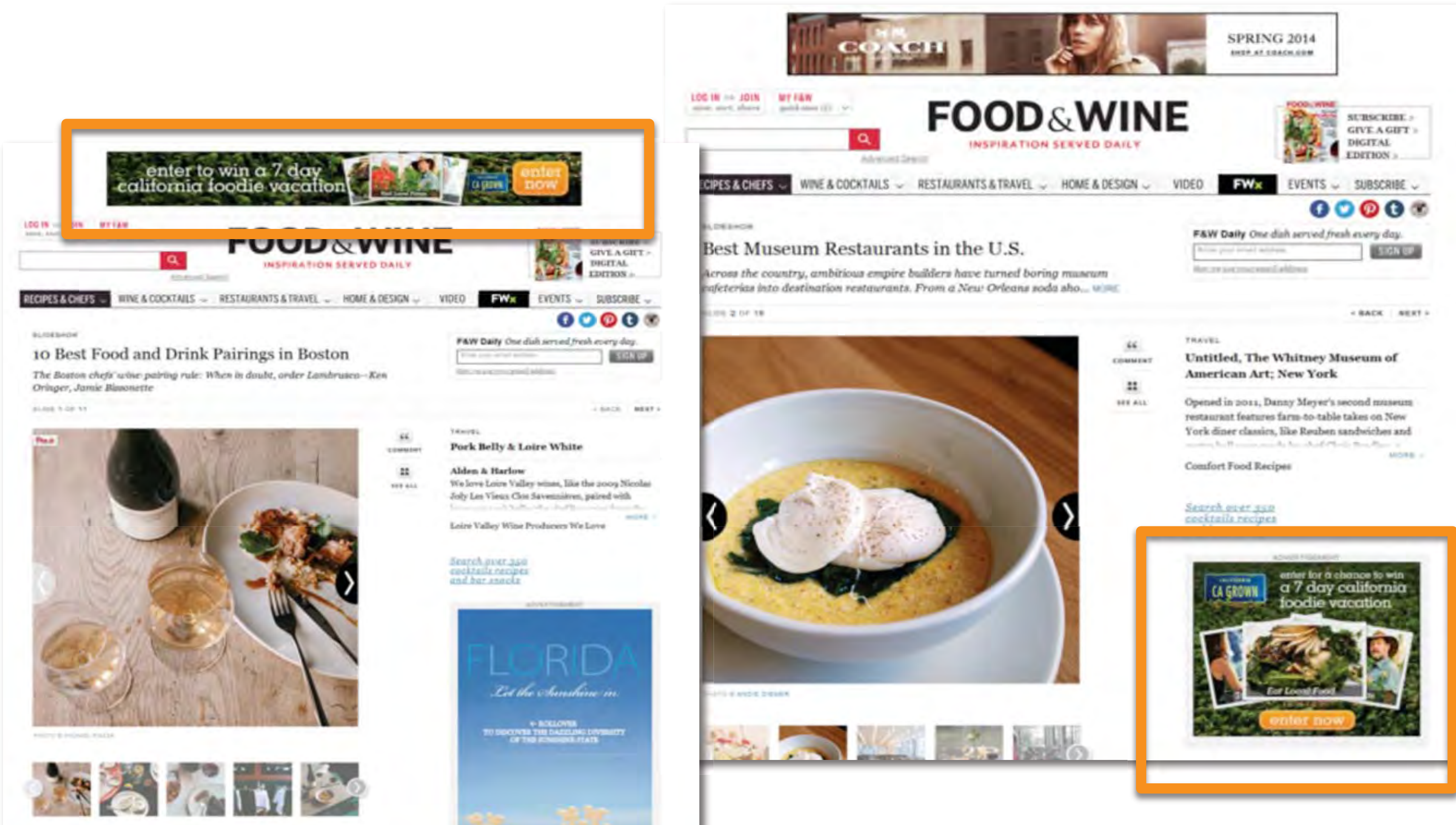
27 23

+ BRAND BLOCK TAKEOVER

Banner Sizes: 300x250, 728x90
Section Targeting: 100% Share of voice on hompepage and sections.

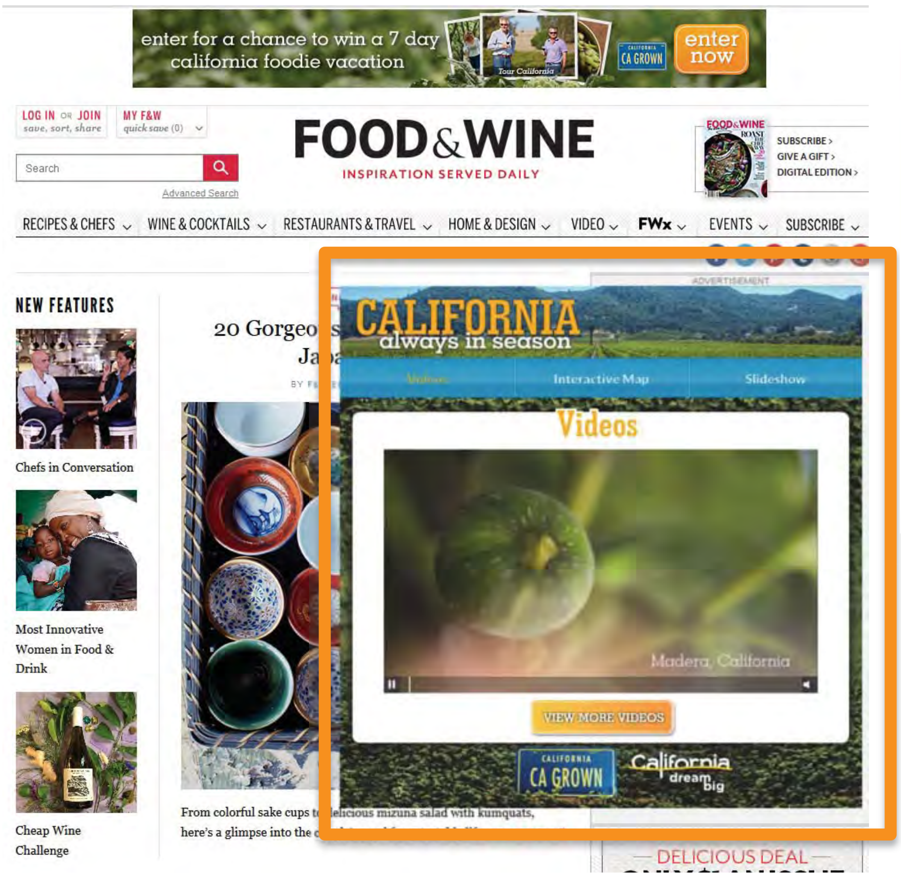
+ ROS

Banner Sizes: 300x250, 728x90
Run of Site: Includes contextual, behavioral targeting as well as added value.

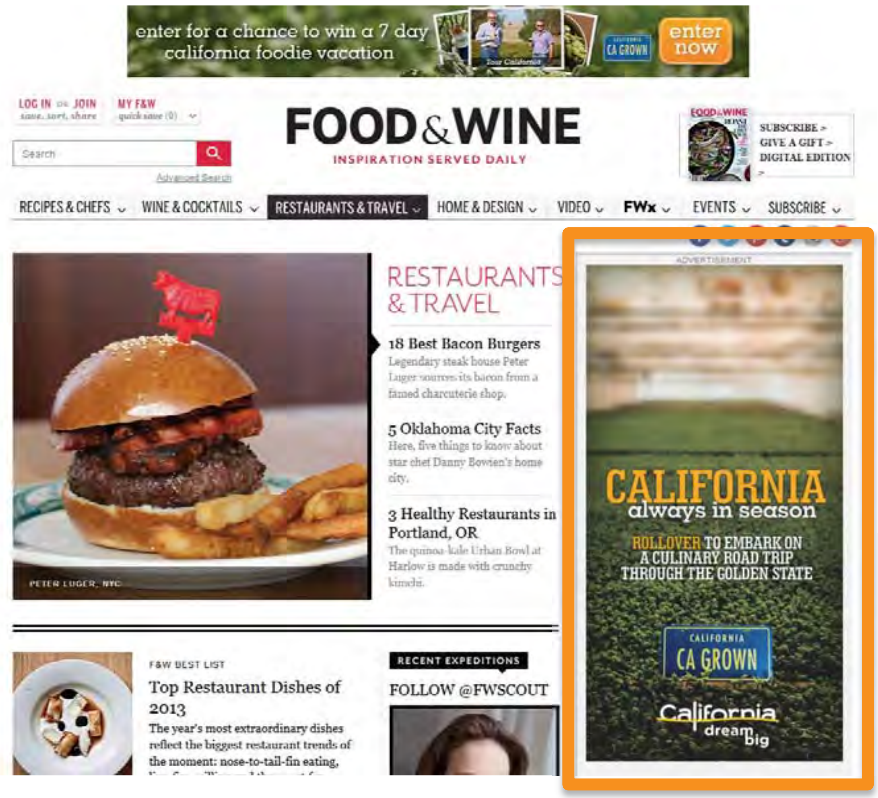


+ QUATRO

Banner Sizes: 300x600
Run of Site: Includes contextual, behavioral targeting as well as added value.



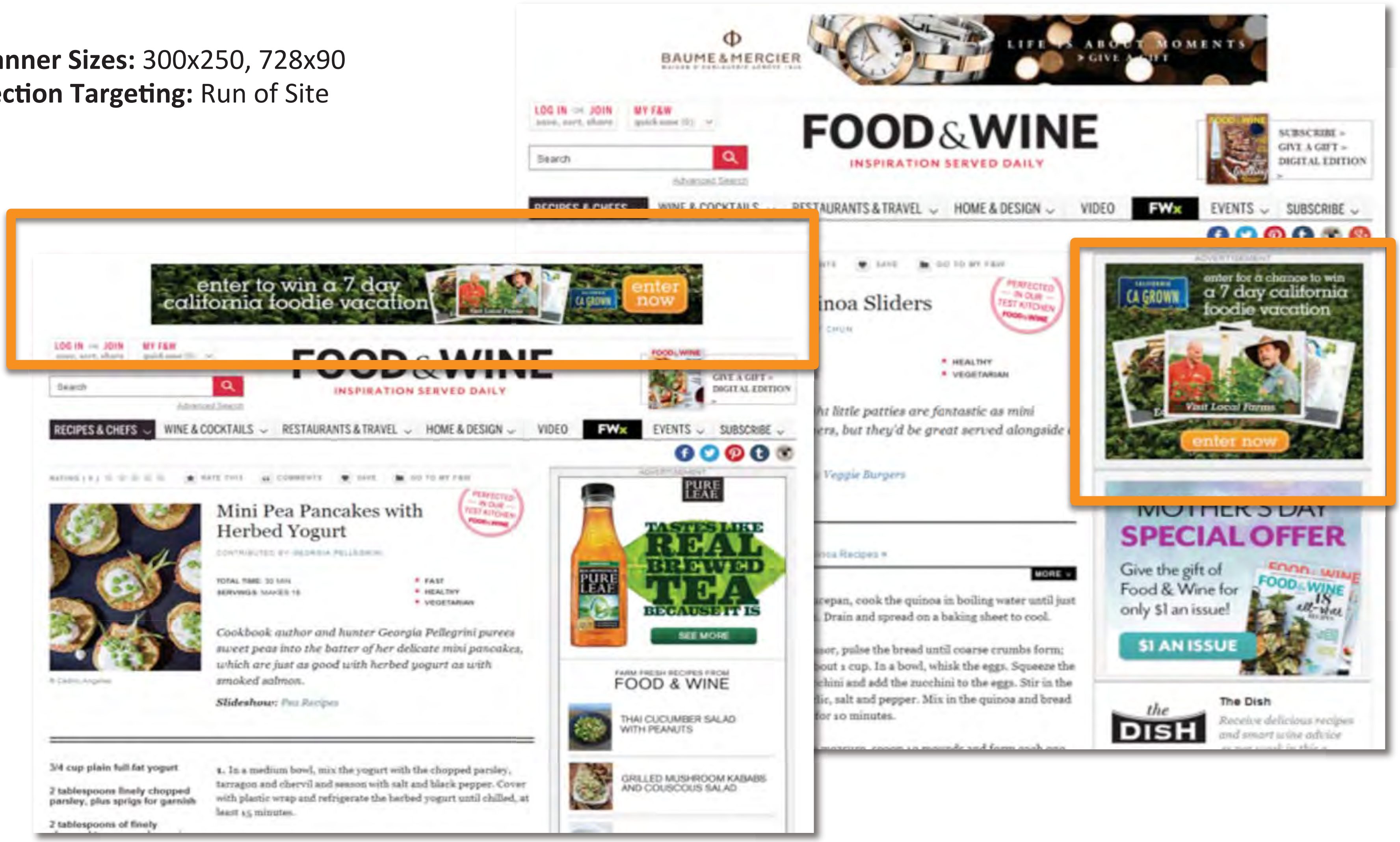
Expanded 300x600



Non-Expanded 300x600

+ SWEEPSTAKES BANNERS

Banner Sizes: 300x250, 728x90
Section Targeting: Run of Site



+ APRIL PRINT CIRCULATION

Circulation: 944,000
Total Readership: 7.7 MILLION

+ MAY PRINT CIRCULATION

Circulation: 944,000
Total Readership: 7.7 MILLION

ADVERTISEMENT

Paul Muller on location at Full Belly Farm

CALIFORNIA
always in season

PART 2: San Francisco & Capay Valley, *with* farmer Paul Muller of Full Belly Farm *and* Chef Michael Tusk of Quince

watch the accompanying video at foodandwine.com/california

70 different crops are grown at Full Belly Farm

Each and every day of the year, something wonderful is taking root in California. Just ask farmer Paul Muller of Full Belly Farm and Chef Michael Tusk of the seasonal French- and Italian-inspired Quince restaurant in San Francisco.

Muller's been growing produce in northern California's Capay Valley for over 30 years—everything from classic American favorites like summer peaches and corn to varieties "borrowed" from other cultures, such as Asian vegetables and Persian melons. "We have about 30 tomatoes, from small, intensely-flavored Russian types to an unusual German white tomato, plus heirloom varieties that Thomas Jefferson grew in his own garden," he says.

The farmers at Full Belly collaborate with chefs like Tusk to select crops that have character and integrity, and taste better than what's commonly available. "At Quince, they really celebrate the subtleties and unique qualities of the crops we grow," says Muller. He also appreciates the role Tusk and his crew play in helping change attitudes about food. "By educating themselves and their diners, they're contributing to this wonderful revolution. The public is becoming more and more aware of their options for better food, and how local and regional agricultures can serve them."

California Grown cabbage picked fresh at Full Belly Farm

Full Belly harvests 65,000 pounds of asparagus a year

California Grown asparagus is one of Chef Tusk's favorite spring crops from the farm

Quince restaurant in San Francisco showcases the seasonal bounty of Northern California

Chef Michael Tusk changes his tasting menus daily to showcase ingredients at their very peak

local champion

Chef Michael Tusk learned the importance of sourcing high-quality local ingredients and building relationships with farmers while working for the famed Alice Waters, of Chez Panisse. The restaurant called on a huge network of small farms for just one or two superior products. "Instead of just calling in one big order to stock the kitchen, we visited individual farms to touch, taste and smell the products for ourselves, and that forever changed my approach to cooking."

Twenty years later, Chef Tusk is still buying produce from Full Belly Farm, and it's a relationship that's proved mutually beneficial. "We wouldn't be here without each other," says Tusk. "As chefs, it's our job to pay homage to all the labor and care farmers put into their crops. And then hopefully we can convince them to take a break from their work in the fields and markets to come into the restaurant and see their products shine on the plate."

Quince's salads often combine local vegetables, fruits and cheeses with edible flowers

Q&A with Chef Michael Tusk

What makes California such a great culinary destination?
The bounty here is like nowhere else in the world. And it's not just the produce, but also the viticulture, fresh flowers and all the other amazing products you can discover and taste from farms throughout the state.

How often do you change your menus at Quince?
Daily. In California, the offerings change every day, 12 months a year, so we follow suit. One day you'll see the first English peas of the season at the market, and another it might be blood oranges, cardoons or lemon verbena that catch my eye.

Why is it so important to support local farmers?
We work with over 80 purveyors, and I share those sources with other chefs. That way I can help increase the demand for great products, and ensure they'll be around next season.

california calling
foodandwine.com/california

From asparagus to kohlrabi and kale, there's a bounty ripe for the picking every day of the year in California. Over 400 crops are grown here, and the diversity is a boon to farmers and chefs alike. Visit foodandwine.com/california to learn their stories, and enter for a chance to win a 6-night foodie vacation in the Golden State, complete with dinner at Quince and a chance to visit Full Belly Farm.

California dream big

CALIFORNIA CA GROWN

+ JUNE PRINT CIRCULATION

Circulation: 944,000
Total Readership: 7.7 MILLION

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FROM LEFT: Mike Sanders, Chef Foshee and Chris Ambuul tour the avocado groves

CALIFORNIA always in season

PART 3: San Diego *with* Mike Sanders & Chris Ambuul of Rancho Santo Tomas Farm, *and* Chef Trey Foshee of George's at the Cove

watch the accompanying video at **foodandwine.com/california**

In 2012, 500 million pounds of avocados were grown in California

For the third part of our chef-farmer series, we tour the verdant, blossoming avocado groves of Rancho Santo Tomas with growers Mike Sanders and Chris Ambuul. Join us as we stroll through the orchards Sanders planted decades ago, and learn how Trey Foshee, Executive Chef and Partner at George's at the Cove, makes a light and healthy alfresco lunch showcasing the quintessential California fruit.

a farming legacy

Mike Sanders helped pioneer the avocado industry nearly 40 years ago when he transformed untamed brushland into irrigated orchards using machetes, pick axes, and hammers. Today he runs Rancho Santo Tomas with the help of his son-in-law Chris Ambuul, and gets to see his grandkids grow up on the land he developed. Sanders appreciates being part of an agricultural and culinary community that has a mutual respect for each other's work: "As farmers, our job is to figure out the best use for the land. That's why we grow avocados here. In turn, people like Chef Trey put our product to the best possible use and make its flavor sing."

"Avocados are synonymous with Southern California," says farmer Mike Sanders

Chef Foshee halves and grills avocados, then uses them as a vessel for cucumbers, tomatoes and quinoa

Chef Foshee's kitchen creatively delivers San Diego on a plate

George's at the Cove uses up to 600 avocados per week

Foshee hits the waves every morning solo, or with his two young daughters

local flavor

Chef Trey Foshee began his career in a roundabout sort of way: working in restaurants allowed him to surf all morning, then make money at night. San Diego suited him well, and was a great influence on his cooking. "The lifestyle here is so healthy, active and unpretentious, and that translates to lighter, produce-based food." For Chef Foshee, sourcing ingredients locally—like Rancho Santo Tomas' creamy, rich avocados—is an essential component of what makes his food unique. "We look at every dish and ask does this really fit where we are, who we are, and this time and place? We want to offer an experience you can only get in San Diego."

Q&A with Chef Trey Foshee

How do you cook with avocados?
Of course I love them in guacamole or fish tacos. Pan con tomate with avocado is my daughters' favorite breakfast. But they're so versatile. At the restaurant we grill and deep fry avocados, and use them in cheesecakes.

Why is locally sourced food so important?
Because of the restaurant's proximity to exceptional farms, a lot of our produce doesn't even see a refrigerator. When corn, tomatoes and melons are picked in the morning, served that night, and aren't broken down by refrigeration, the flavor is that much more intense.

Do you visit the farms?
I do, and so do our servers. When we've met that farmer and seen the crops grow, it creates a dialogue between us and the customer that's much different than if the food just came out of a box.

Chef Foshee unpacks ingredients for a picnic lunch showcasing avocados from Rancho Santo Tomas Farm

california calling
foodandwine.com/california

From avocados to tomatoes and oranges, there's a bounty ripe for the picking every day of the year in California. Over 400 crops are grown here, and the diversity is a boon to farmers and chefs alike. Visit **foodandwine.com/california** to learn their stories, and enter for a chance to win a 6-night foodie vacation in the Golden State, complete with dinner at George's at the Cove and a chance to visit Rancho Santo Tomas.

California dream big

CALIFORNIA CA GROWN

This project is possible with funding from the California Department of Food and Agriculture's Specialty Crop Block Grant Program

+ SEPT. PRINT INSERTION

Circulation: 944,000
Total Readership: 7.7 MILLION

CALIFORNIA
always in season

PART 4: The Central Valley with Kevin Herman of The Specialty Crop Company and Chris Mariscotti, owner of The Vineyard Restaurant & Bar.

watch the accompanying video at foodandwine.com/california

In part 4 of this 6-part series, we invite you to join us for a taste of California's sweet spot: the Central Valley. With its moderate, Mediterranean climate and its central location, the Central Valley is a hidden gem nestled between San Francisco and Los Angeles. Once overlooked by visitors driving between cities, the Central Valley today has become a destination for travelers in search of a few days of relaxation—and some amazing food and wine.

"We really are the heart of California," says Kevin Herman, the farmer behind The Specialty Crop Company, the world's largest grower of fresh figs. With the backdrop of the Sierra Nevada Mountains, the Central Valley offers easy access to Yosemite, Sequoia and Kings Canyon National Parks, hiking trails, fishing and a host of winter sports. In the summers, which are hot and dry, you can reach the Pacific Ocean in a few short hours. The valley itself is home to long stretches of farmland, where you'll find pistachios, almonds, grapes, citrus and persimmons as well as figs, and a growing number of boutique wineries, a compliment to the nearby restaurants—like Chris Mariscotti's The Vineyard Restaurant & Bar in Madera—that rely on local ingredients to shape their menus.

38,660 pounds of figs were grown in California in 2012.

Figs are nutrient powerhouses, with calcium, magnesium and vitamin B6.

local flavor

A fourth-generation restaurateur, Chris Mariscotti has always offered dishes that highlight local produce. "There are 40 or 50 crops we can source locally," he says. And of all the locally grown fruit and vegetables that shape his menu, California figs from Kevin Herman's farm are often the star.

But Chris and Kevin's relationship goes beyond farm to table: A shared interest in wine sparked a friendship that has spanned two decades and taken the pair—and their families—on local ski trips and far-flung vacations. "Through our relationship I've gotten to know a lot about farming," says Chris. "We have a lot of fun together and once in a while we're able to incorporate work with the fun."

Some of The Vineyard Restaurant & Bar's finest fare: an award-winning fig-and-almond cheesecake, bacon-wrapped Mission figs drizzled with a balsamic reduction and a fig-topped pizza.

Chris and Kevin inspect this season's crop of figs.

195 types of figs are showcased in the USDA's federal collection.

Q&A
with Chris Mariscotti, owner of The Vineyard Restaurant & Bar

What makes the Central Valley in California such a great culinary destination?
People are discovering what locals have known for generations: It's a great place to live and a great place to visit. Visitors come to explore the growing food and wine scene, and they come back when they see all that our central location gives them access to.

Why have figs become so popular over the past few years?
Thanks to farms like Kevin's, figs are available outside of their once-limited seasonal window; consumers and chefs now have access to figs almost year round. When people pick up figs and smell them, they get excited about them.

How do you enjoy the Central Valley when you're not working?
Kevin and I had a professional-grade bocce court built at one of the ranches we're involved in. Playing bocce, drinking wine and watching the sun go down from 100 feet above the fig trees is a very nice way to spend an evening.

california calling
foodandwine.com/california

From figs to pistachios and almonds, there's a bounty ripe for the picking every day of the year in California. Over 400 crops are grown here, and the diversity is a boon to farmers and chefs alike. Visit **foodandwine.com/california** to learn their stories, and enter for a chance to win a 7-day foodie vacation in the Golden State, complete with dinner at The Vineyard Restaurant & Bar.

California dream big

CALIFORNIA CA GROWN

This project is possible with funding from the California Department of Food and Agriculture's Specialty Crop Block Grant Program

+ OCT. PRINT INSERTION

Circulation: 944,000
Total Readership: 7.7 MILLION

+ NOV. PRINT INSERTION

Circulation: 944,000
Total Readership: 7.7 MILLION

CALIFORNIA
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PART 6: Chico, *with* Berton Bertagna of Bertagna Orchards and Bertagna Son Kissed Vineyard and Leigh Ann Byerly of Farwood Bar & Grill

watch the accompanying video at foodandwine.com/california

80% of the world's almonds are produced in California

You'd be hard-pressed to find anyone more passionate about California than the farmers who work its land. In the final chapter of our six-part series, we meet Berton Bertagna of Bertagna Orchards and Bertagna Son Kissed Vineyard. Berton's passion runs four generations deep: His great-grandfather left Italy to settle in Chico, California, in 1914, and the Bertagna family has been a farming family there ever since.

What started out as his great-grandfather's 5- to 10-acre "ranchette" has grown 100 years later to almond and walnut orchards, olive and mandarin groves, a commercial winery and an all-natural cattle ranch, Baja Vaca, that was built on Berton's passion for farming and his love of the land. "Going to work for me is not like 'going to work,'" he says. "It's waking up every day and doing something I'm passionate about, something I love."

Leigh Ann Byerly, whose restaurant, Farwood Bar & Grill, sources wine, olive oil, beef and nuts from the Bertagnas, says that passion comes through in the product. "The farm has been built on generations and it's been carried on from father to son, and that adds a really special element to what they're doing."

Q&A
with Leigh Ann Byerly, owner of Farwood Bar & Grill

What is the best part about working with local farmers?

Why are you so passionate about local food and wine?

What are your favorite foods to buy local?

a taste of chico

Owning a restaurant, for Leigh Ann Byerly, is about so much more than serving a meal. For her, it's a chance to bring her customers locally grown and made products, and to share the stories behind them. "What local farmers, dairies and wineries are producing is so beautiful and special that we consider the restaurant a place to showcase all of it," she says. "I want our customers to understand that there's so much meaning behind the food we're eating and so much heart and passion that goes into producing it."

To that end, Farwood's menu changes even more quickly than the seasons, with a constant eye on what's fresh and new and at its prime. Says Berton: "You really get a good taste, when you go into Farwood, of what our area has to offer."

870,000

california calling
foodandwine.com/california

Experience the taste of California! With over 400 crops grown here, from almonds and walnuts to olives to grapes and kiwifruit, there is a bounty ripe for the tasting every day of the year. The incredible diversity is celebrated by farmers and chefs alike. Visit foodandwine.com/california to learn their stories, and enter for a chance to win a 7-day foodie vacation in the Golden State, complete with dinner at Farwood Bar & Grill.

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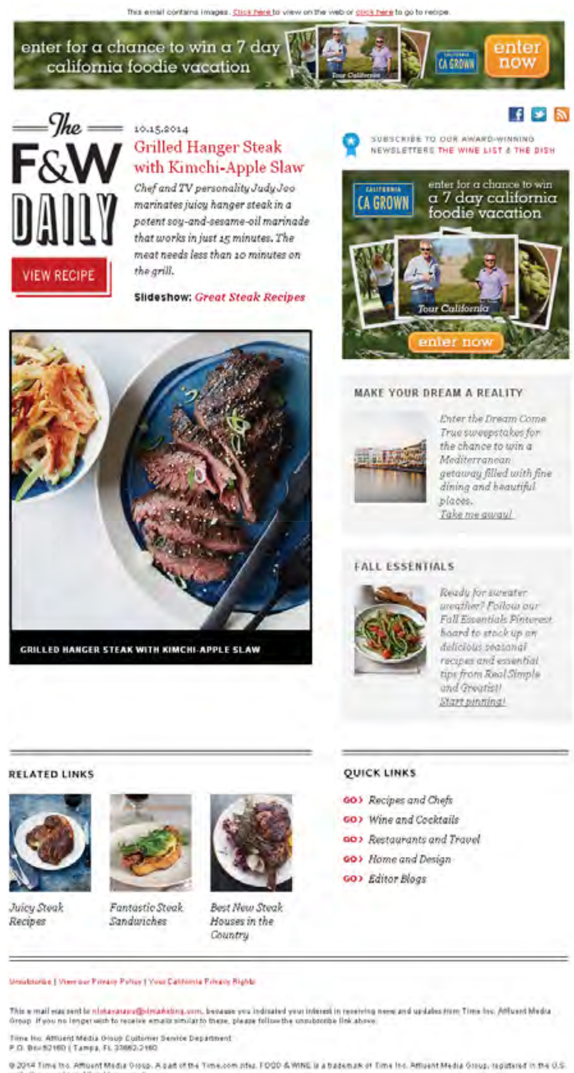
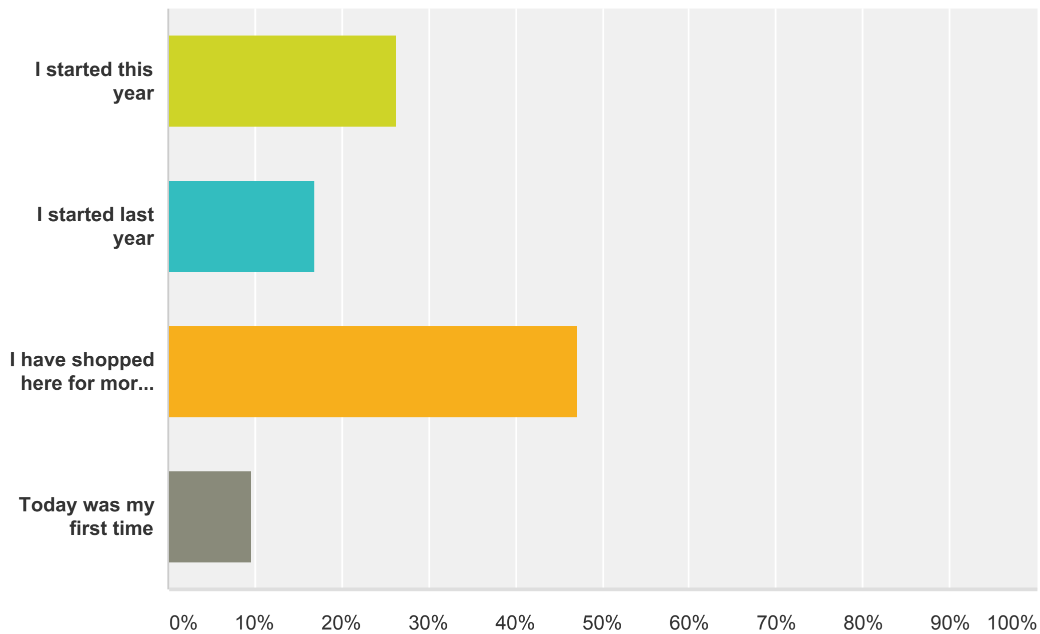


thank you

Q1 How long have you shopped at this farmers' market?

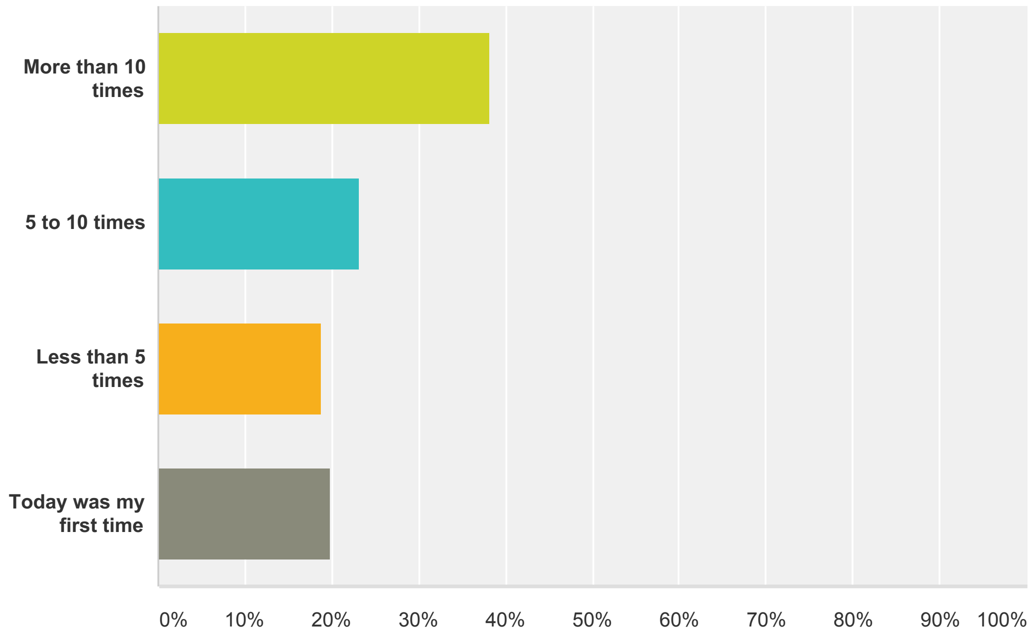
Answered: 501 Skipped: 2



Answer Choices	Responses	
I started this year	**26.35%**	132
I started last year	**16.97%**	85
I have shopped here for more than 2 years	**47.11%**	236
Today was my first time	**9.58%**	48
Total		**501**

Q2 How often have you used CalFresh/EBT at this farmers' market?

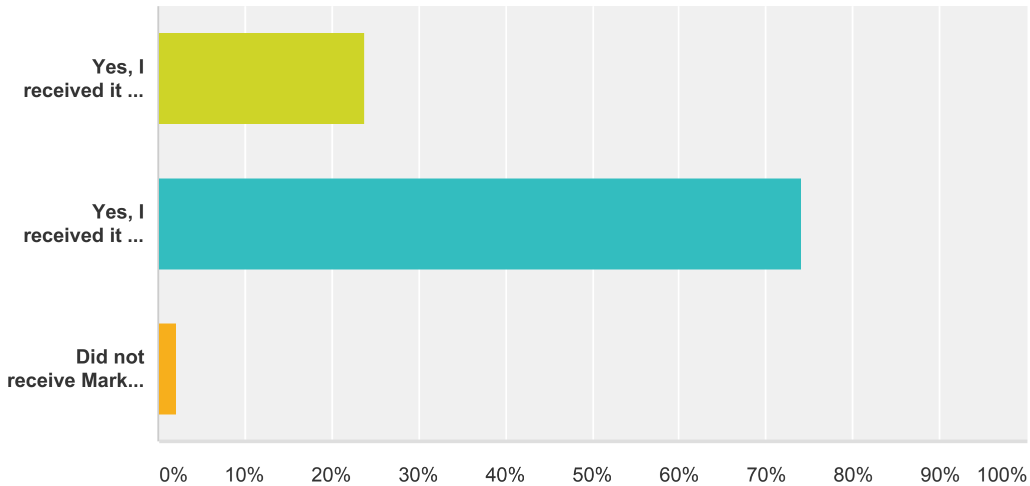
Answered: 491 Skipped: 12



Answer Choices	Responses	
More than 10 times	**38.29%**	188
5 to 10 times	**23.22%**	114
Less than 5 times	**18.74%**	92
Today was my first time	**19.76%**	97
Total		**491**

Q3 Did you receive Market Match benefits/tokens today?

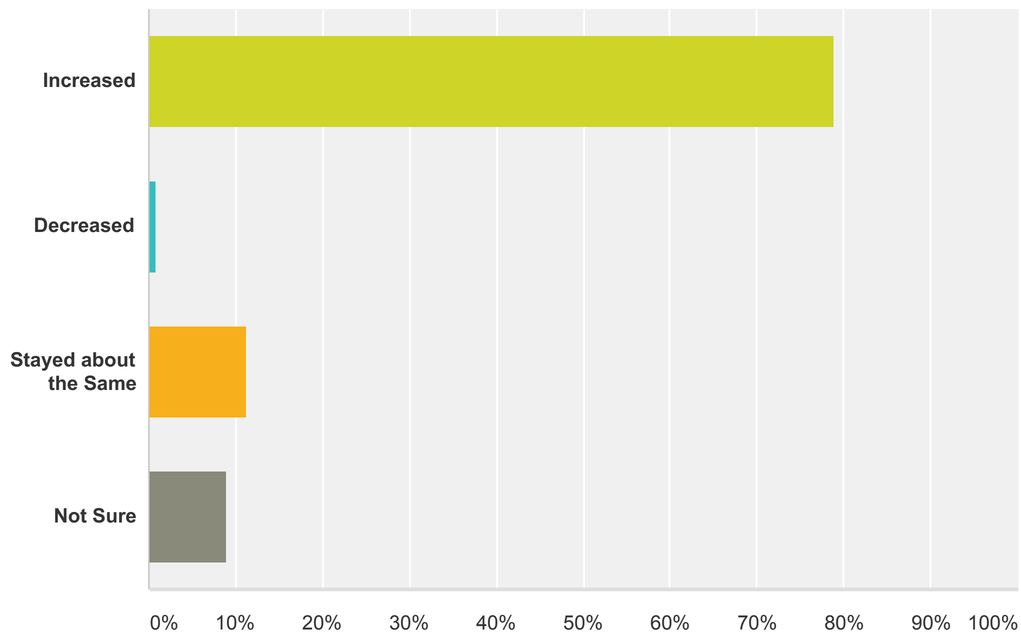
Answered: 432 Skipped: 71



Answer Choices	Responses	
Yes, I received it for FIRST TIME today	**23.84%**	103
Yes, I received it and had received it before	**74.07%**	320
Did not receive Market Match	**2.08%**	9
Total		**432**

Q4 Would you say that because of Market Match the amount of fruits and vegetables in general that you buy has…

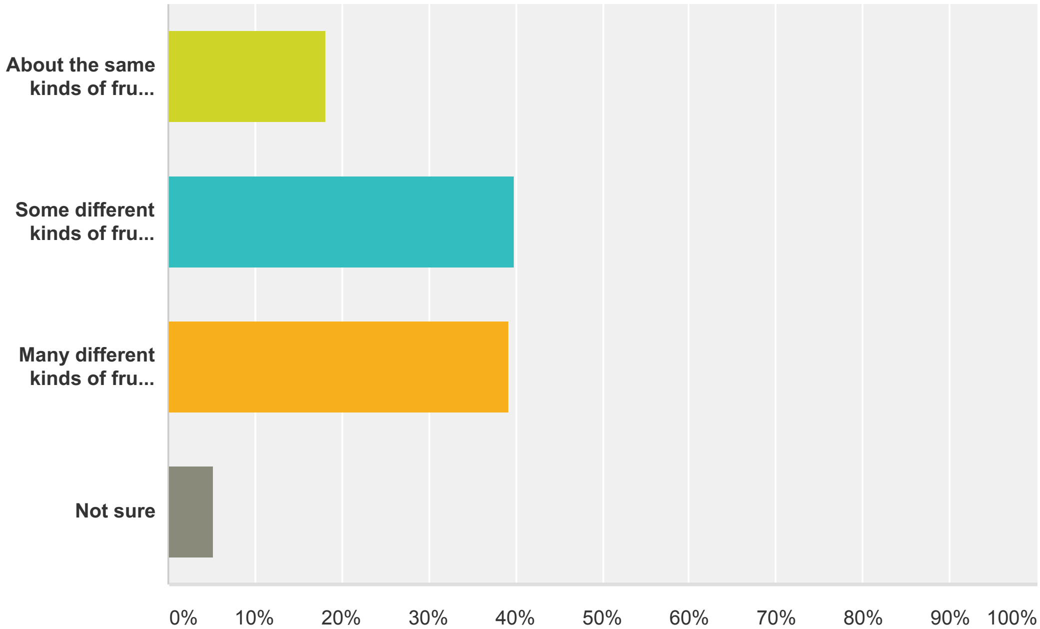
Answered: 431 Skipped: 72



Answer Choices	Responses	
Increased	**78.89%**	340
Decreased	**0.93%**	4
Stayed about the Same	**11.37%**	49
Not Sure	**9.05%**	39
Total Respondents: 431		

Q5 Because of Market Match, are you buying…

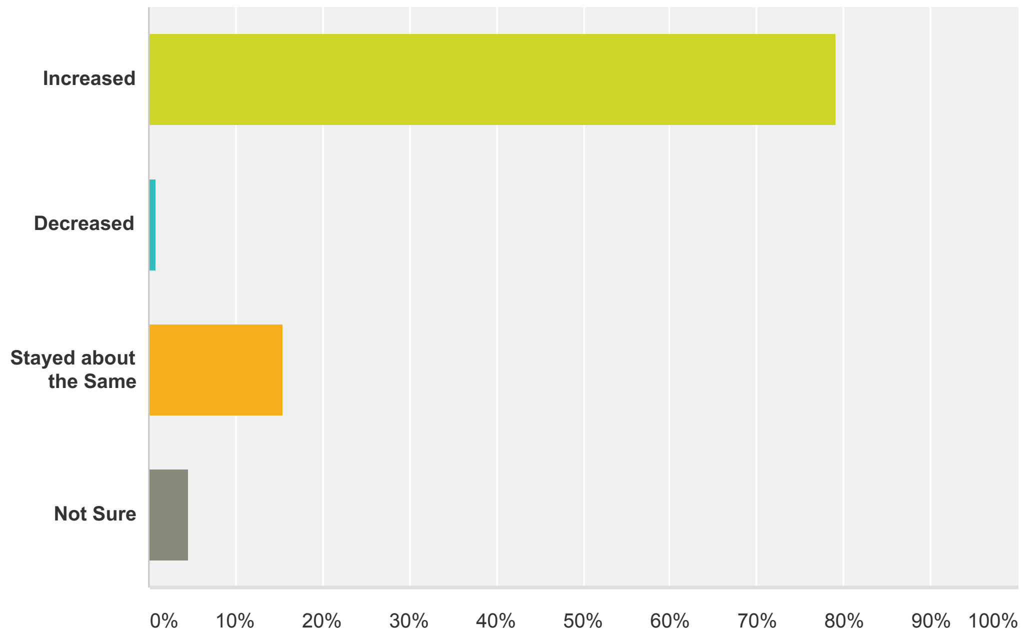
Answered: 433 Skipped: 70



Answer Choices	Responses	
About the same kinds of fruits and vegetables you used to buy before you used Market Match	**18.24%**	79
Some different kinds of fruits and vegetables	**39.95%**	173
Many different kinds of fruits and vegetables	**39.26%**	170
Not sure	**5.31%**	23
Total Respondents: 433		

Q6 Would you say that because of the Market Match program, your trips to farmers' markets have…

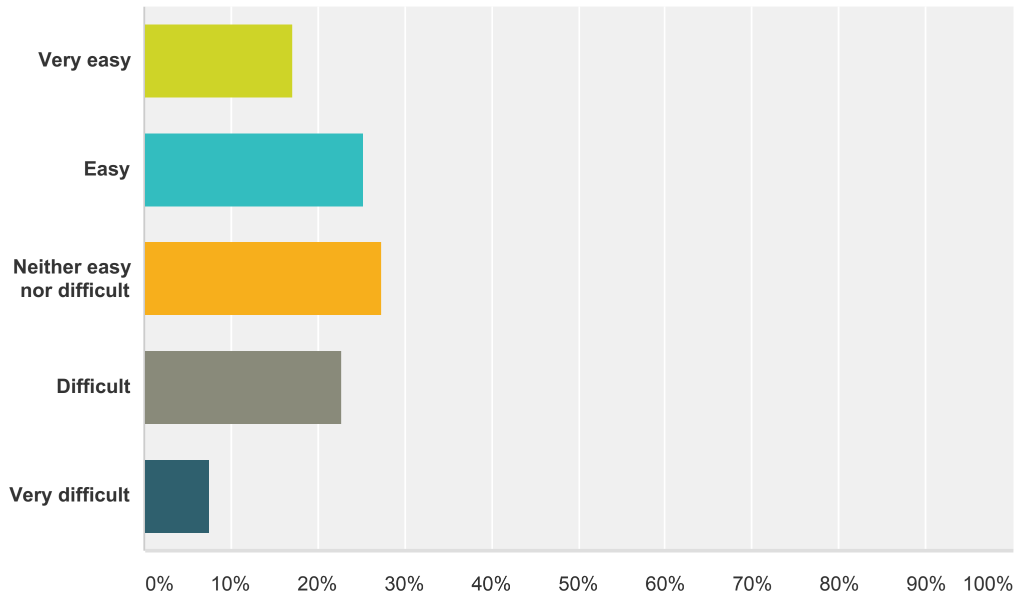
Answered: 429 Skipped: 74



Answer Choices	Responses	
Increased	**79.02%**	339
Decreased	**0.93%**	4
Stayed about the Same	**15.38%**	66
Not Sure	**4.66%**	20
Total		**429**

Q7 Outside of this farmers market, how easy or difficult is it to buy quality fresh fruits and vegetables in your neighborhood?

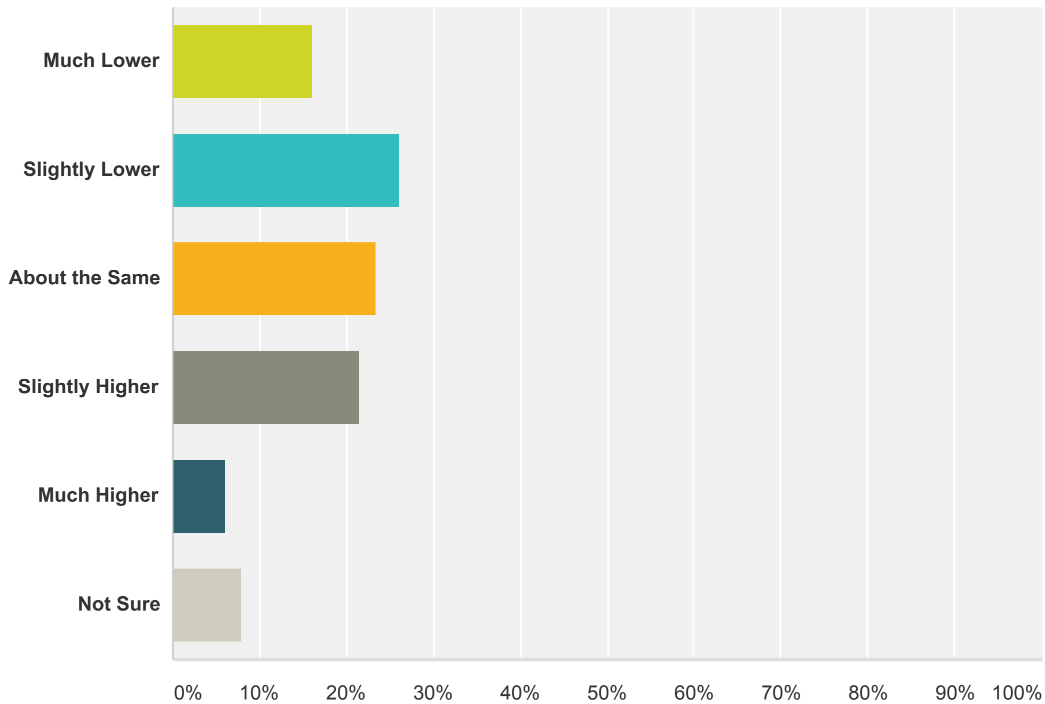
Answered: 487 Skipped: 16



Answer Choices	Responses	
Very easy	**17.04%**	83
Easy	**25.26%**	123
Neither easy nor difficult	**27.31%**	133
Difficult	**22.79%**	111
Very difficult	**7.60%**	37
Total		**487**

Q8 Compared to other places where you shop, the prices of fruits and vegetables at this farmers' market are…

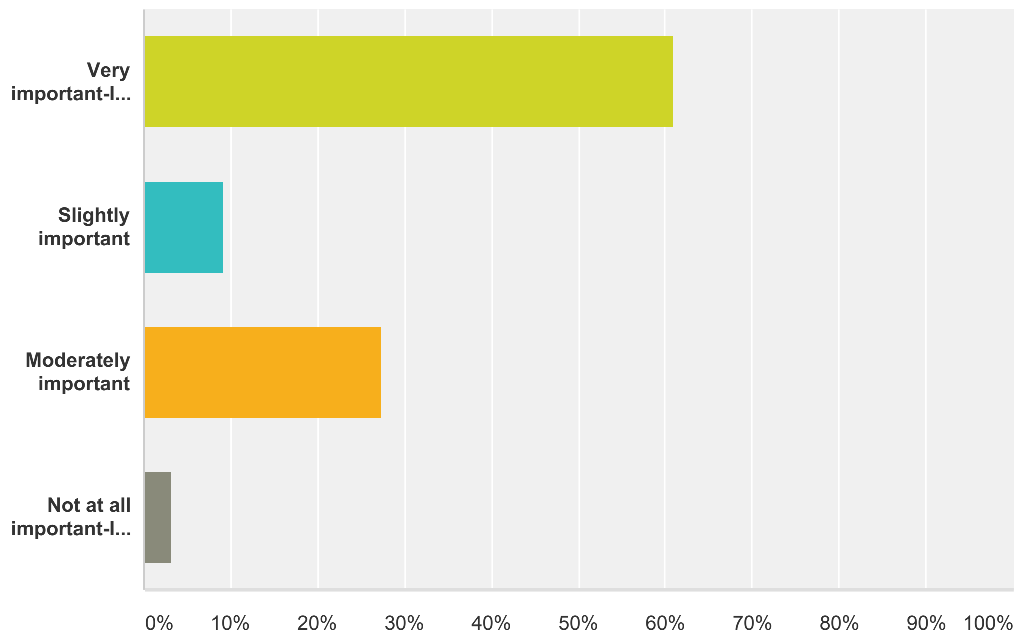
Answered: 493 Skipped: 10



Answer Choices	Responses	
Much Lower	**16.02%**	79
Slightly Lower	**26.17%**	129
About the Same	**23.33%**	115
Slightly Higher	**21.50%**	106
Much Higher	**6.09%**	30
Not Sure	**7.91%**	39
Total Respondents: 493		

Q9 How important is the Market Match program in your decision to spend your CalFresh/EBT benefits at this farmers market instead of elsewhere?

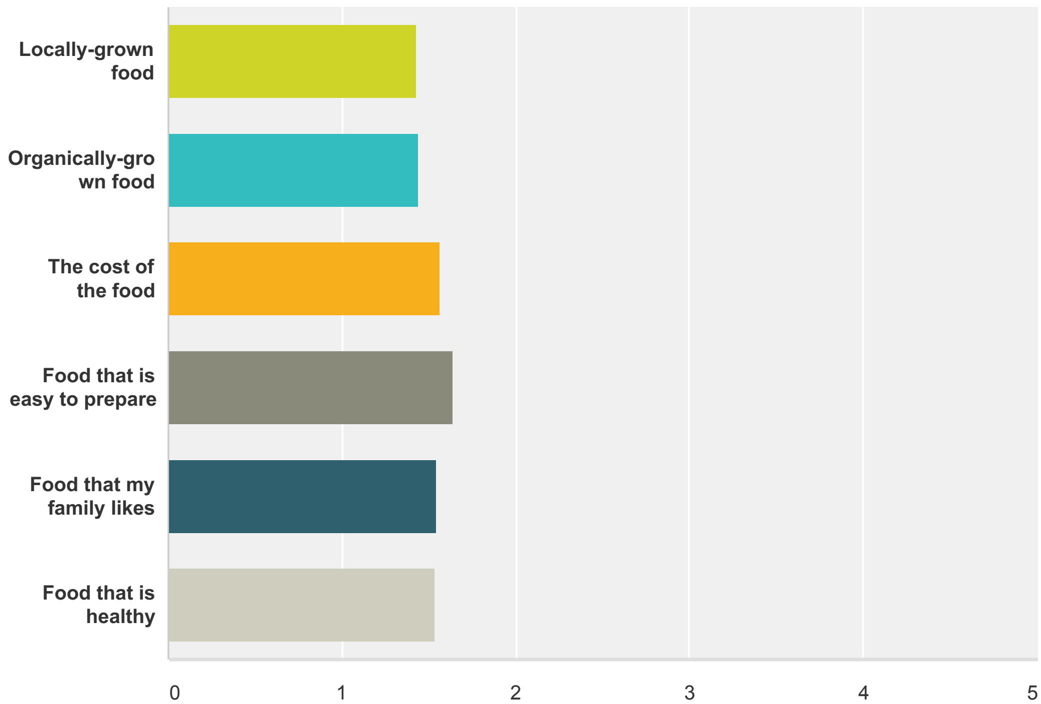
Answered: 491 Skipped: 12



Answer Choices	Responses	
Very important-I wouldn't have come without them	**60.90%**	299
Slightly important	**9.16%**	45
Moderately important	**27.29%**	134
Not at all important-I would have come without them	**3.05%**	15
Total Respondents: 491		

Q10 How important are following when deciding what food to buy for yourself and your family?

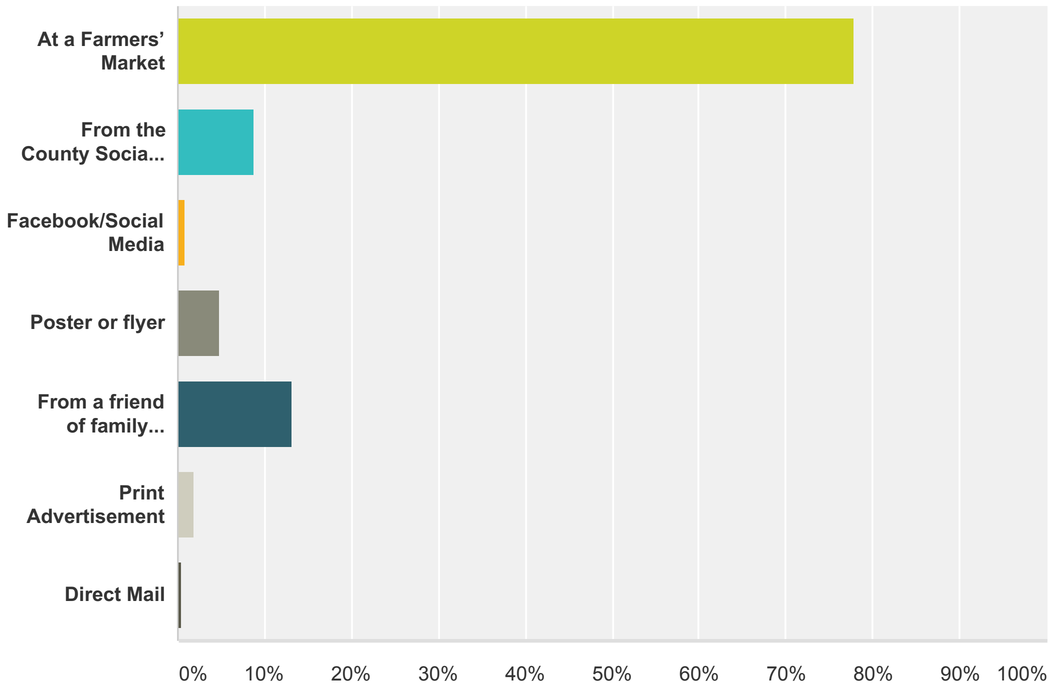
Answered: 486 Skipped: 17



	Enter ONE that is most important	Any others that are also important	Total	Weighted Average
Locally-grown food	**57.18%** 215	**42.82%** 161	376	1.43
Organically-grown food	**56.02%** 200	**43.98%** 157	357	1.44
The cost of the food	**42.57%** 126	**57.43%** 170	296	1.57
Food that is easy to prepare	**36.42%** 59	**63.58%** 103	162	1.64
Food that my family likes	**45.34%** 107	**54.66%** 129	236	1.55
Food that is healthy	**47.34%** 169	**52.66%** 188	357	1.53

Q11 How did you learn about Market Match? (Mark all that apply.)

Answered: 461 Skipped: 42



Answer Choices	Responses	
At a Farmers' Market	**77.87%**	359
From the County Social Services Dept/other agency	**8.68%**	40
Facebook/Social Media	**0.87%**	4
Poster or flyer	**4.77%**	22
From a friend of family member	**13.23%**	61
Print Advertisement	**1.95%**	9
Direct Mail	**0.43%**	2
Total Respondents: 461		

Q12 What is the zip code where you live?

Answered: 495 Skipped: 8

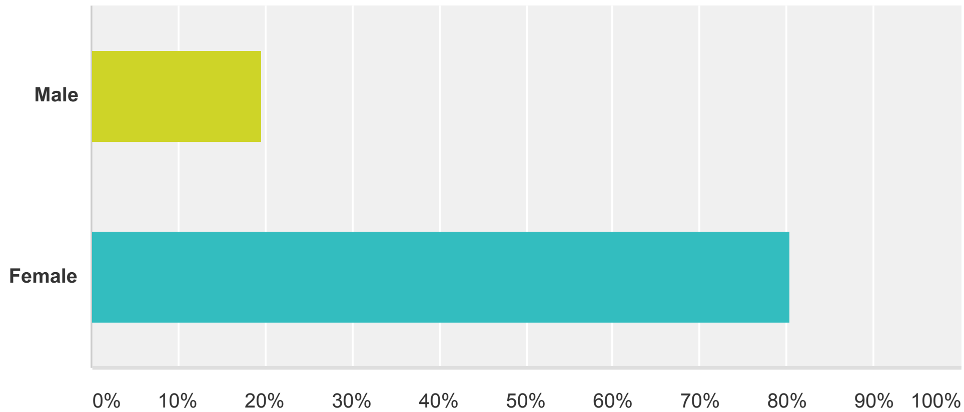
Q13 How many children age 5 or younger live with you? How many children age 6-18?

Answered: 470 Skipped: 33

Answer Choices	Responses	
0-5 years old	**94.89%**	446
6-18 years old	**85.11%**	400

Q14 Are you?

Answered: 486 Skipped: 17



Answer Choices	Responses	
Male	**19.55%**	95
Female	**80.45%**	391
Total		**486**

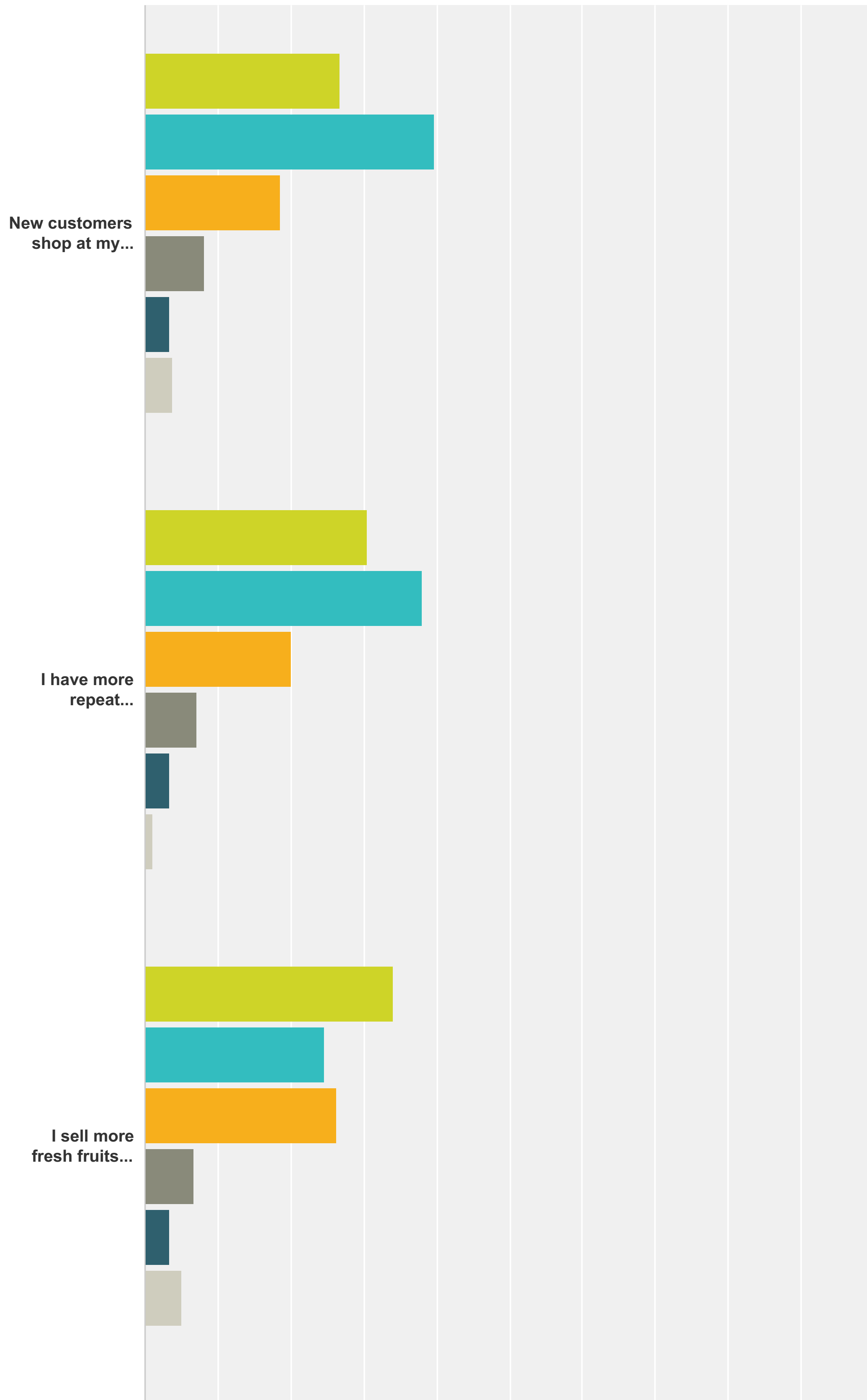
Q15 For CMMC Partner: Please fill the following info (this will help if we need to follow-up on data inconsistencies.)

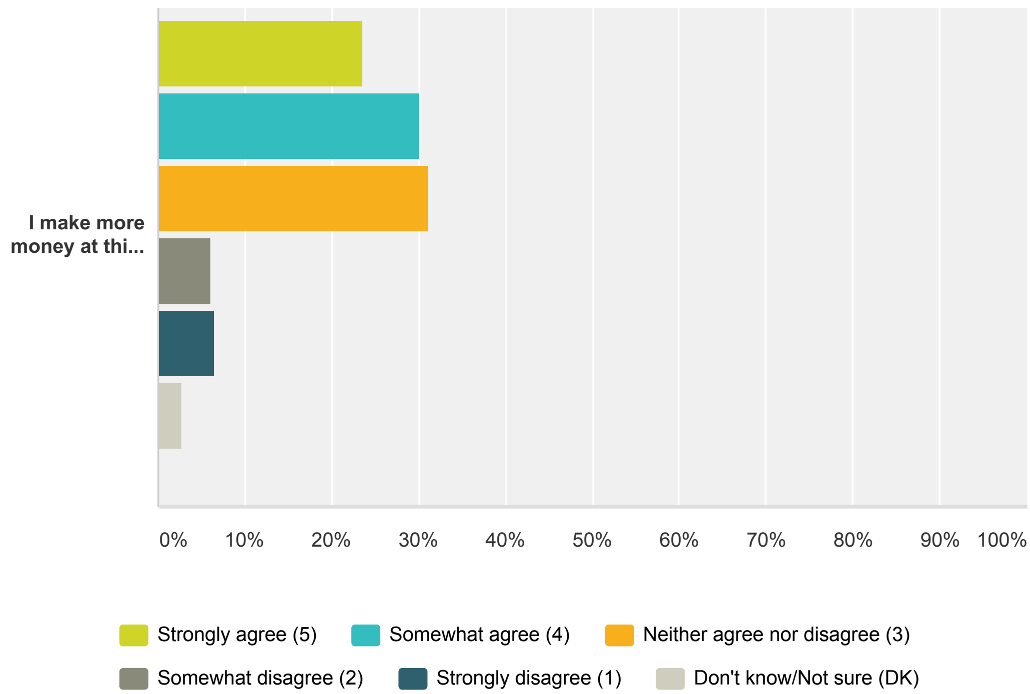
Answered: 502   Skipped: 1

Answer Choices	Responses	
Market	**99.60%**	500
Date	**94.02%**	472
Last 4 of Card	**72.51%**	364

Q1 Because I accept Market Match this year at my farmers' market or association...

Answered: 185 Skipped: 2

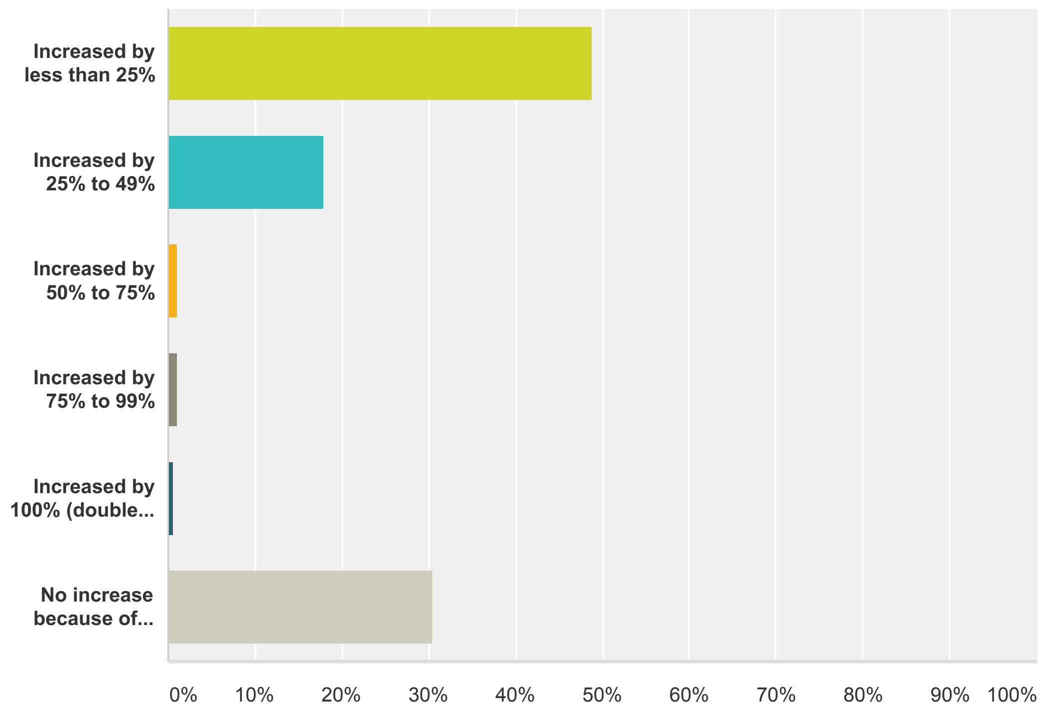




	Strongly agree (5)	Somewhat agree (4)	Neither agree nor disagree (3)	Somewhat disagree (2)	Strongly disagree (1)	Don't know/Not sure (DK)	Total
New customers shop at my stand or stall more often	**26.63%** 49	**39.67%** 73	**18.48%** 34	**8.15%** 15	**3.26%** 6	**3.80%** 7	184
I have more repeat customers	**30.43%** 56	**38.04%** 70	**20.11%** 37	**7.07%** 13	**3.26%** 6	**1.09%** 2	184
I sell more fresh fruits and/or vegetables	**34.07%** 62	**24.73%** 45	**26.37%** 48	**6.59%** 12	**3.30%** 6	**4.95%** 9	182
I make more money at this market	**23.50%** 43	**30.05%** 55	**31.15%** 57	**6.01%** 11	**6.56%** 12	**2.73%** 5	183

Q2 Because of Market Match and CalFresh EBT my overall sales at this farmers' market/association have

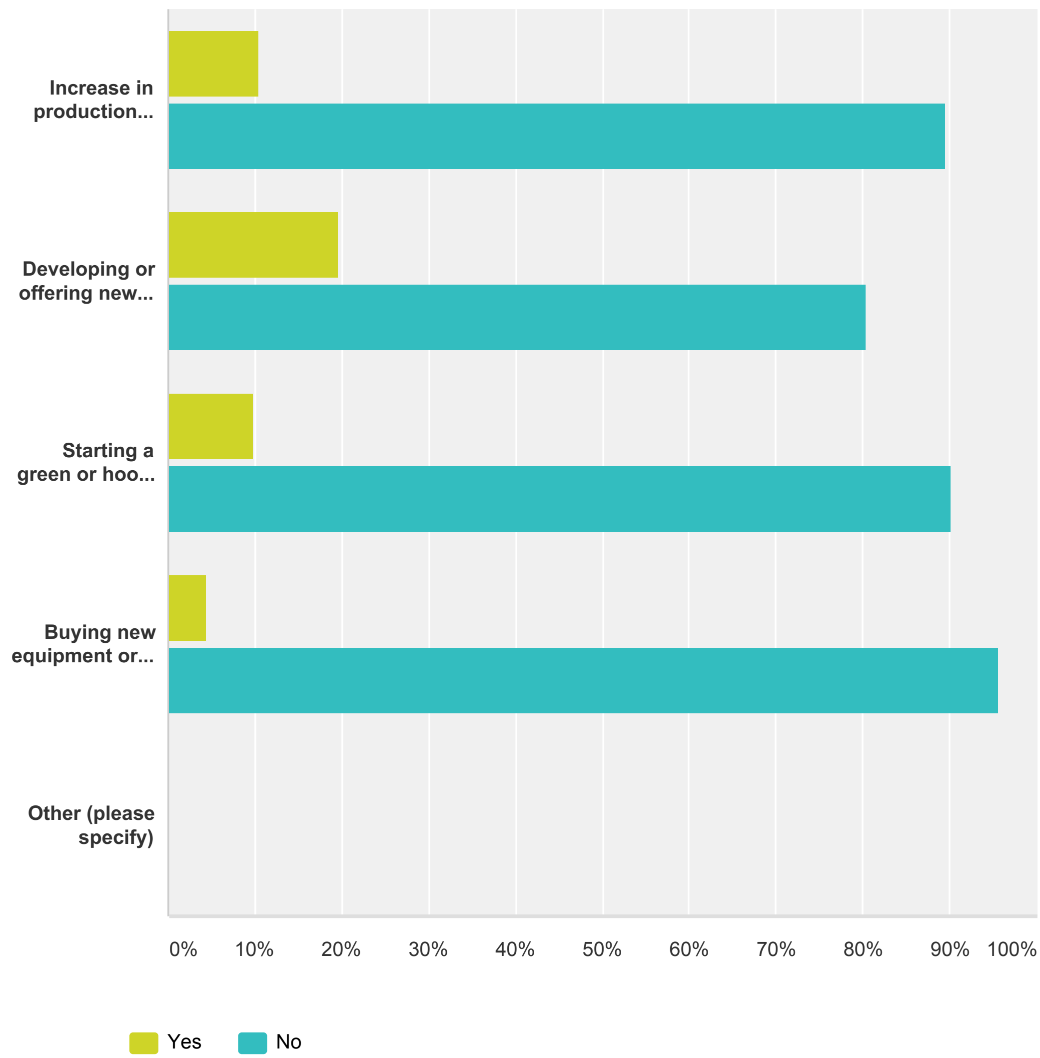
Answered: 184 Skipped: 3



Answer Choices	Responses	
Increased by less than 25%	**48.91%**	90
Increased by 25% to 49%	**17.93%**	33
Increased by 50% to 75%	**1.09%**	2
Increased by 75% to 99%	**1.09%**	2
Increased by 100% (doubled) or more	**0.54%**	1
No increase because of Market Match and CalFresh EBT	**30.43%**	56
Total		**184**

Q3 Have you made any of the following kinds of changes as a result of accepting Market Match?

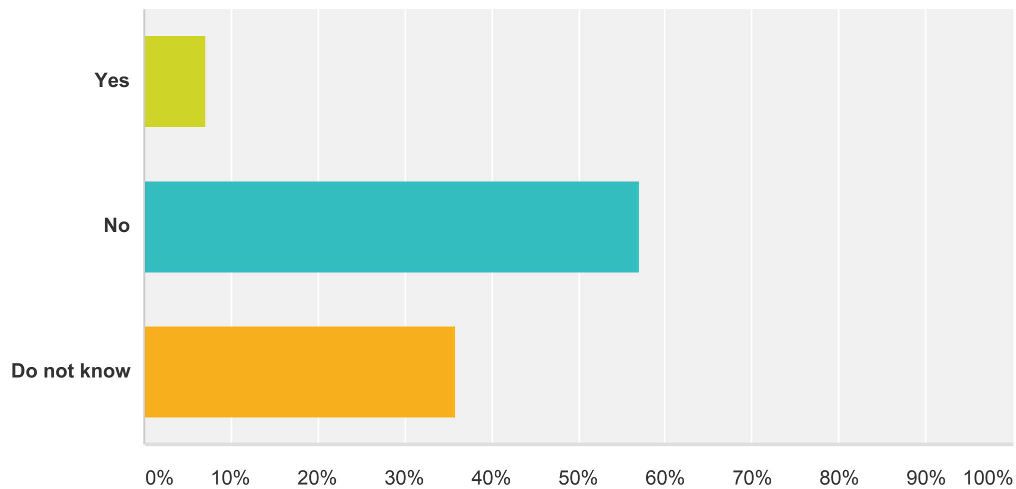
Answered: 184 Skipped: 3



	Yes	No	Total
Increase in production acreage	**10.44%** 19	**89.56%** 163	182
Developing or offering new or different products	**19.57%** 36	**80.43%** 148	184
Starting a green or hoop house to extend your growing season	**9.84%** 18	**90.16%** 165	183
Buying new equipment or vehicles	**4.42%** 8	**95.58%** 173	181
Other (please specify)	**0.00%** 0	**0.00%** 0	0

Q4 In thinking about next year, do you plan to grow or sell new or different products because of Market Match?

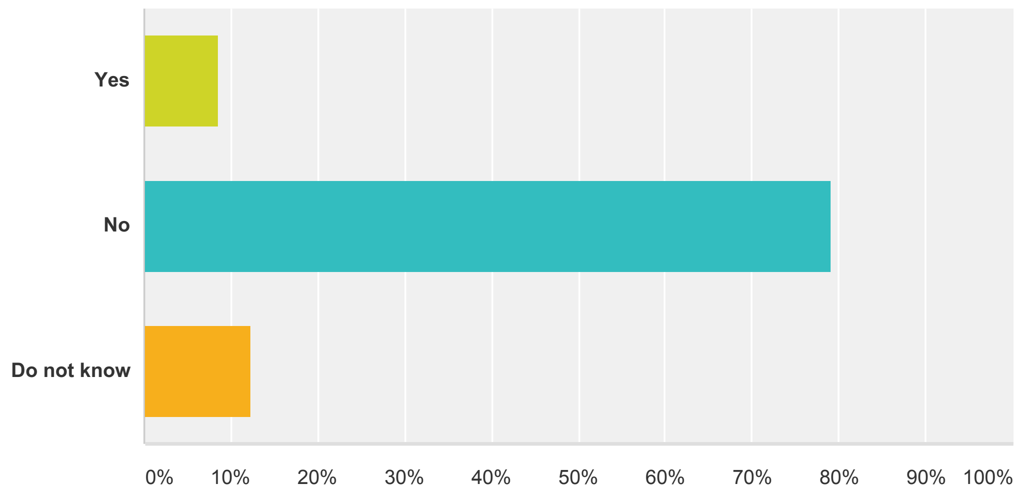
Answered: 184 Skipped: 3



Answer Choices	Responses	
Yes	**7.07%**	13
No	**57.07%**	105
Do not know	**35.87%**	66
Total		**184**

Q5 Because of Market Match have you had to pay more workers to help at the market?

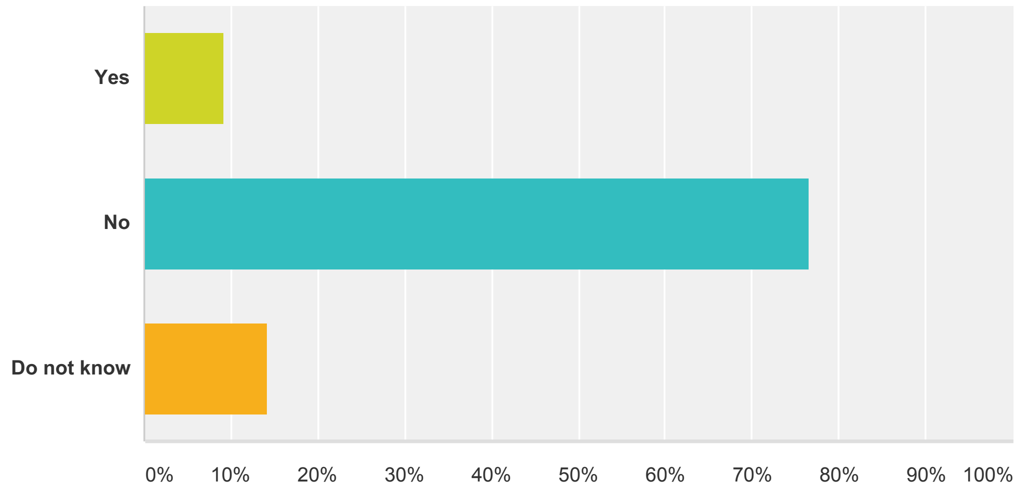
Answered: 186 Skipped: 1



Answer Choices	Responses	
Yes	**8.60%**	16
No	**79.03%**	147
Do not know	**12.37%**	23
Total		**186**

Q6 Because of Market Match have you had to pay more workers to help on the farm?

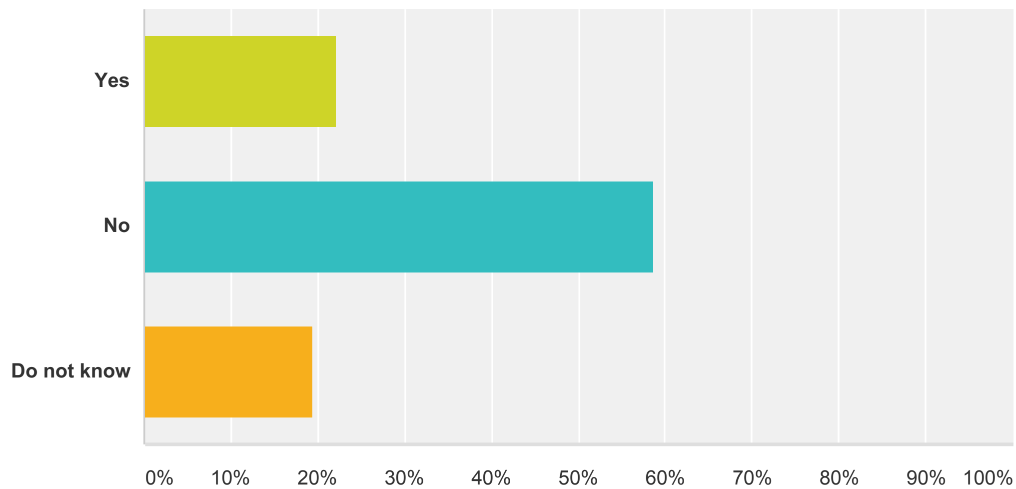
Answered: 184 Skipped: 3



Answer Choices	Responses	
Yes	**9.24%**	17
No	**76.63%**	141
Do not know	**14.13%**	26
Total		**184**

Q7 Has your base of customers changed (the people who buy from you) because you accept Market Match?

Answered: 186 Skipped: 1



Answer Choices	Responses	
Yes	**22.04%**	41
No	**58.60%**	109
Do not know	**19.35%**	36
Total		**186**

Q8 For CMMC Partner: Please fill the following info (this will help if we need to follow-up on data inconsistencies.)

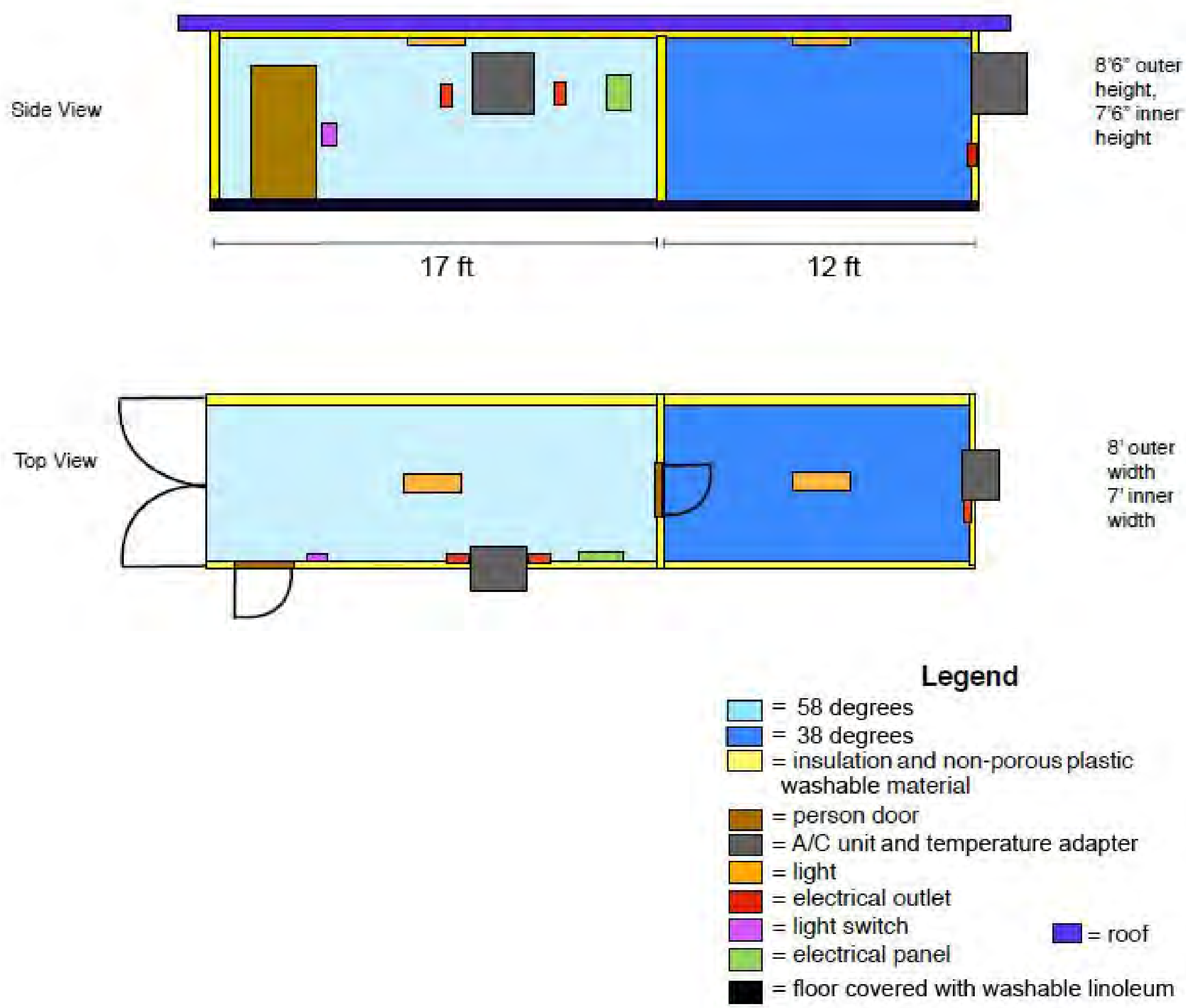
Answered: 183 Skipped: 4

Answer Choices	Responses	
Market	**60.66%**	111
Date	**96.72%**	177

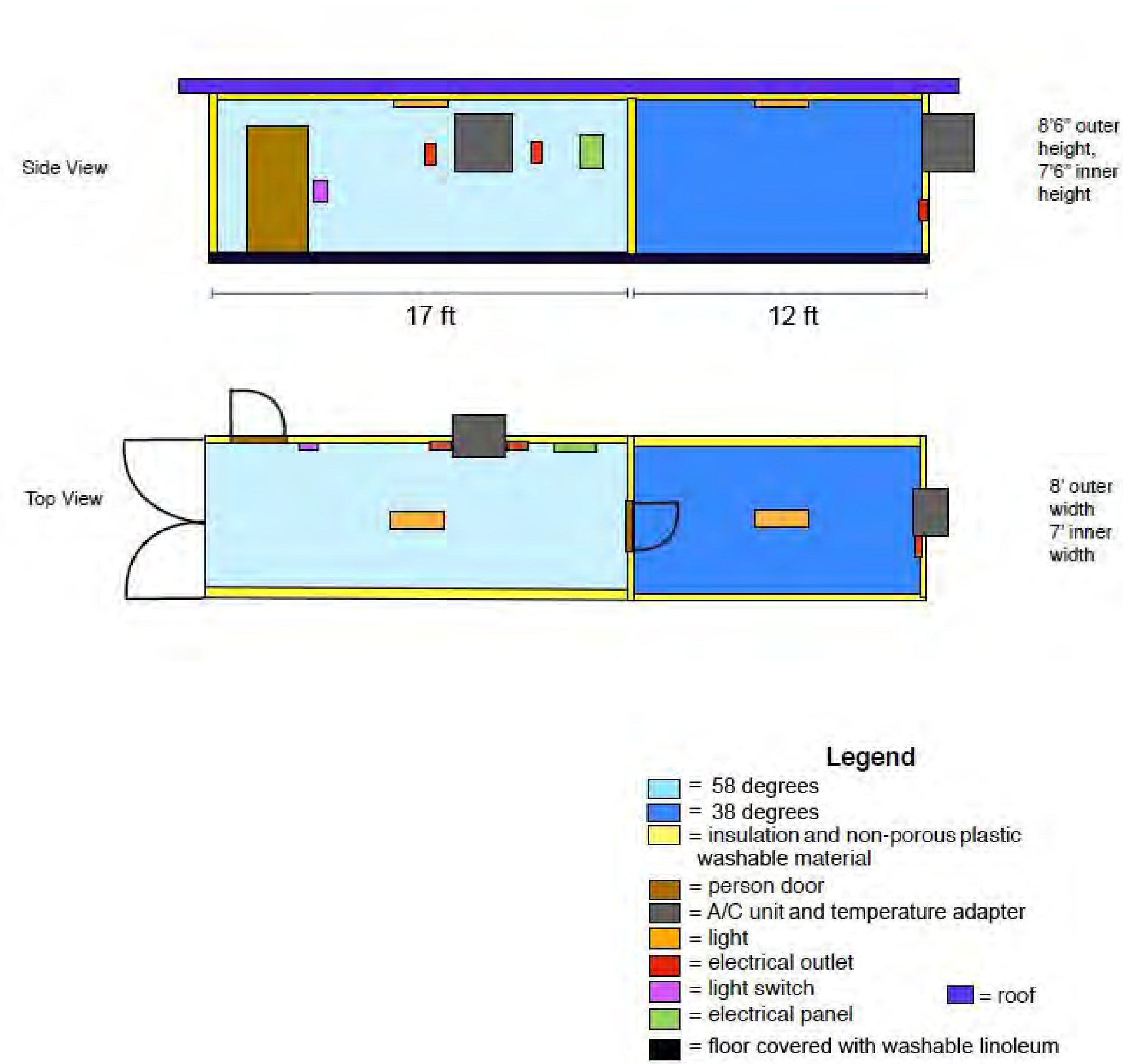
Attachment 1. Food Hub Node and Route Map

Attachment 2. Food Hub Node Diagrams

Willits Location:



Ukiah and Caspar Locations:



Attachment 3. Food Hub News Articles

Connecting local farmers with eaters, Food Hub launches in May

By Adrian Baumann, Willits News

Wednesday, March 18, 2015

Part agronomist, part trucker, part salesperson small farmers are a harried bunch, balancing the need to work their land with the economic necessity of spending large portions of time hawking and delivering their produce. Tackling distribution is a particular problem for local farmers in this huge county, and for local stores and restaurants that wish to carry more local produce. A local non-profit, North Coast Opportunities (NCO), saw this problem and thought they knew a way to help. March 10, at the Farmer's Convergence conference at the Ridgewood Ranch, they unveiled plans for the new MendoLake Food Hub.

Food hubs are generally non-profits that manage aggregation, storage, distribution, and other logistical hurdles for local and regional farms— acting as a hub to smooth interactions between producer and consumer.

North Coast Farmers Convergence conference is a one-day event that brings together small food farmers from across the North Coast. As the event's chief organizer Elizabeth Archer put it, "We really wanted a day where farmers could come together and talk with each other rather than be talked at...and sort of get pumped before the growing season."

Plans for the hub have been in the works for a couple years now, spearheaded by Food Hub Coordinator John Bailey, with initial start-up costs have been covered through a $390,000 block grant from the U.S. Department of Agriculture, routed through the California Department of Agriculture. The hub should be up in running by May, in time to start delivering early crops.

Ruth King, Director of the Grange Farm School at the Ridgewood Ranch, said of the announcement, "The food hub talk was particularly inspiring— I could feel farmers in the room bristling with excitement." Adding, "Cooperative distribution is an obvious and important step for the rural farmers to take."

The MendoLake hub will focus on distribution, partnering with Mendocino Coast Produce, local farms, stores and restaurants, to create a distribution network for area farmers. The hub will markup produce about 15 percent as opposed to the roughly 30 percent that's common with larger distributors, passing on the saving to consumers, and allowing local producers to compete more closely with larger farms.

As Bailey explained, "The traditional distribution model doesn't offer the farmers a very good price...So a shared goal of all food hubs is to be a very "minor middleman… a food hub will actively work to get the farmer the highest price possible. With the lower markup Bailey hopes that local produce prices will be closer to standard wholesale, though not quite as low as the prices of major distributors like General Produce or Sysco.

An important step in building out the infrastructure has been the creation of refrigeration “nodes” across the region, with cold-boxes in Lake County, Willits, the Ukiah Valley, Anderson Valley and on the coast. The partnership with Mendocino Coast Produce, a Fort Bragg based distribution company, will reserve space for 100 cases of produce on each truck, piggybacking on the company’s existing distribution network.

About ten farms have enrolled including: Covelo Organics, Leonardis Organics, Heely’s Farm Stand in Upper Lake, Fortunate Farm in Casper, Sky Hoyt Specialty Produce in Kelseyville, Irene’s Garden in Laytonville, the Grange Farm School and Lovin’ Mama in Potter Valley. Interested stores include Mariposa Market in Willits; Raley’s and the Natural Foods Co-op in Ukiah and Harvest Markets on the Coast.

In addition to handling the physical aspects of distribution, the hub will also streamline overhead for farmers, performing basic accounting. Said Bailey, “Rather than farmers getting maybe a dozen checks 30 to 45 days later, they will get one check from the food hub.”

One farmer who signed up early is Mai Nguyen, who grows heirloom varieties of wheat and rye on five acres in the Ukiah valley. Since starting up the farm last year she’s been trying to find distribution outlets, something she believes the hub will be key to accomplishing, “It’ll greatly reduce my operations costs...enabling a wider distribution of my goods. For instance, I might be able to make it to Ukiah, but I couldn’t easily get to the coast.”

Nguyen listed a range of other benefits, from being able to spend more time farming, instead of driving to farmers markets, to the food hub streamlining her accounting process by generating her invoices, “It’s one less thing for me to worry about.” She also pointed out that with the food hub covering her distribution in Mendo-Lake, she can try to branch out her marketing efforts to other counties.

The hub’s USDA grant only applies to what the federal government calls “specialty crops,” a designation that includes vegetables, fruits, tree nuts and herbs, so basically anything that isn’t a grain or row crop. This means that farms such as Nguyen’s or Doug Mosel, another area grain farmer, aren’t technically eligible for those monies.

But, points out Bailey, by charging the markup for distribution, the hub is able to service a larger range of local farms that might not fit within the grant’s strictures. And ensuring that the hub can pay for its own costs of operation will allow it to one day become fully self sustaining. Bailey sees the goal of the hub as becoming something like a farmer owned distribution co-op. But also acknowledges that much will depend on farmer and consumer feedback.

Mariposa Market will be one of the buyers once the hub gets up and running. Owner and manager Mary Anne Trevey has long been a booster for local produce. She noted that though the impacts to her stock won’t be huge it will definitely allow her to carry more local food, and sees this as an important step, “The big problem around here is distribution...we talk to these farmers but they can never get the produce to us...and if we had a hub, a place where all the farmers could come and bring the food, I think that would be helpful.”

Mendocino Coast Produce's owner Josh Cavender is also enthusiastic in his support of the project, emphasizing the difficulties farmers currently face in bringing their product to market, and noting that, "The demand is there...so we want to be the company the supplies restaurants with local food." Adding, "A lot of the reason that customers shop with us is that we're local, so it kind of makes sense to try to do the same thing."

Though established food hubs exist across the country both Archer and Bailey commented that food hubs tend to be very specific to the community's needs and the exact operations of this food hub have yet to be seen or tested. Said Nguyen, "I think we're all curious about it...we haven't seen anything in play, so I think we're optimistic, but I'm interested to see how it pans out."

The third North Coast Farmers Convergence brought together food producers from Mendocino, Lake, Humboldt, Sonoma, Marin, and Napa counties, along with the agencies and organizations that serve the food and farming community.

If you're interested in participating in the MendoLake Food Hub contact NCO Market Manager John Bailey at (707) 467-3238

Mendo-Lake Food Hub launched: One stop shop for local produce delivered direct to your business

By Karen Rifkin, for Ukiah Daily Journal

Saturday, July 4, 2015

The Mendo-Lake Food Hub, a grant-funded program initiated by North Coast Opportunities to connect local farmers with local retailers and restaurants in order to meet the growing demand for local food, is up and running.

Coordinator John Bailey, the man at the helm, explains that the program is funded by a two-year, nine-month grant from the California Department of Food and Agriculture, developed and written by NCO employees Susan Lightfoot, Miles Gordon and Patty Bruder.

"It originated from the Farm to Fork grant to help create the connections and infrastructure for local foods to be used in food processing at local schools—to re-establish the knowledge and equipment to deliver fresh food.

"From this came the knowledge that a lot of farmers were struggling to get food to the market. The next step was to establish these connections and a base to create a system that can work and keep on working," he says.

Many local growers earn retail dollars at farmers markets but there are only so many people who go there, and most food that is eaten is not bought at a farmers market.

Bailey asks, “How do we help smaller local farmers get into places where most food is bought and consumed?”

Lake and Mendocino counties are spread out, with a small population base and a lot of small farms, some of which are hours away from food centers.

“We are talking about one- to five-acre farms, maybe 10,” he says.

Lightfoot created a database of information and researched other food hub models throughout the country. Many food hubs have sprung up over the past 15 years, and in the last five years many more have been developed to figure out how to revitalize local food systems.

A traditional food hub model is a vegetable distributor with a main warehouse, trucks and full time staff.

“You need a million dollars a year gross revenue to make that model work,” says Bailey.

In working out the puzzle pieces, individuals were interviewed and it was determined that barriers for suppliers were transportation and cold storage and for buyers they did not know who the farmers were or what they had for sale.

Bailey connected with Josh Cavender, a Mendocino coast producer who was already distributing produce on the coast that he purchased from wholesale markets down south.

They came to an agreement, per box, for Cavender to carry local produce from farmers in Fort Bragg to retailers in Willits and Ukiah on his regular trip south. From there the produce is delivered to retailers in smaller vehicles.

John Foster Trucking is in the process of creating the nodes, retrofitting 30-foot shipping containers complete with insulation, a roof, refrigeration and internal lights. The Kelseyville node is up and running; the Willits and Ukiah nodes will be in place next; and the Caspar node will be there in late July.

The nodes have two temperatures, one in the mid to high 30s for leafy greens and one a bit higher with temperatures in the mid to high 50s for watermelon, peppers and tomatoes.

Additionally, Gowan Orchards has offered to make part of its cold storage available if needed.

The website—www.mendolakefoodhub.com— a fully functional shopping cart, provides a sales platform for farmers to display their produce and for buyers to purchase by the case. It is open for buying clubs, restaurants and grocery stores.

“Our biggest goal is to support local food systems, our local farmers selling fruits, vegetables and nuts,” says Bailey.

Produce is available from conventional growers; no spray; Mendocino Renegade, a local certification that conforms to organic standards, certified by a committee of farmers with less paperwork at a lower cost; and fully certified USDA organic.

“Young people who get into farming do it for a few years, realize they cannot make a go of it and give up. I operated a row crop farm in Potter Valley for four years; it was very hard to sell my produce wholesale and the farmers market did not bring in enough money. I didn’t see a future in it. This kind of system can make it viable. Farmers can make retail dollars at the farmers market and sell wholesale without having to drive everywhere.

“Independent farmers are the bedrock of American democracy and tradition. We have to have those independent voices that know what it takes to make a living off the land and supply food to people. Without that kind of link to the land and our tradition, we risk losing something valuable for our culture. The healthy food is part of it but there is a deeper cultural importance to independent farming,” he says.

Local farmers participating include: Lovin’ Mama, Covelo Organic, Irene’s Garden, Sky Hoyt, Fortunate Farm, Black Dog, Seely’s Farm Stand, and more are being added every week.

Buyers so far include Harvest Market in Fort Bragg and Mendocino, Ukiah Co-op, Taste Buds, Saucy, and Patrona. In addition, Lake County Public Health is purchasing through the Hub for its Harvest of the Month program. The number of producers and buyers is expected to climb in the coming weeks.

If you are interested in participating in the Food Hub as a farmer, a business that wants to purchase local crops, or an individual who wants to organize a group to purchase in bulk quantities, visit www.MendoLakeFoodHub.com or contact John Bailey at (707) 467-3238 or jbailey@ncoinc.org.

Attachment 4. Farmers Guide to How Food Hub Operates

Farmer Standard Procedures

This document is meant to help you, the producer, sell and distribute your products through the MendoLake Food Hub. If you have any questions, you can call into the office at 707-467-3238.

What we do

We help you distribute your goods to Mendocino and Lake County buyers. Our website helps buyers order local produce from multiple farmers all at once, and the cold storage nodes enable you to drop off at your convenience for us to deliver to further reaches so you can have more time for other needs.

What we Sell

Mendocino and Lake County specialty crops: vegetables, fruit, and cut flowers.

Requirements

- Certified Producer Certificate
- Mendocino County Approved Source
- Smallest sales unit must have a minimum value of $25
- Product must be delivered to nodes in clearly labeled case boxes

Sales Suggestions

- Create and maintain contact with customers: While we at the Food Hub try to develop new farmer-customer relationships, we also need your help to maintain good relationships with new and old customers. Some ways to do that include calling for feedback on their orders, letting them know what's coming up, and talking with them before the growing season to see what they need or want.
- Be consistent: Customers look for farms they can rely on to fulfill orders and can trust will provide quality products. Regularly posting enables customers become familiar with you and your product.
- Communicate: If anything changes, please inform us and the customer immediately.
- Product descriptions: Customers prefer photos and enticing descriptions of products. If you want to sell a unique product, adding a sales call or sending us a message elaborating on the special qualities will help you and us pitch your goods.
- Highest quality produce: If it's not, clearly list it as "Seconds"

Website

Create an Account

Got to www.mendolakefoodhub.com. Click on the "Become a Member" link on the main page. Fill out the form, submit, and contact us at orders@mendolakefoodhub.com or 707-467-3238 to inform us of your listing. We'll need a copy of your Certified Producer's Certificate, notice

that you have signed onto and abide by the Mendocino County Approved Source program, and a completed W-9 form, which we'll send to you, along with our MendoLake Food Hub suppliers guide agreement.
Once you create an account, we invite you to explore the tabs and familiarize yourself with the various functions available through the website.

Logging In

Go to mendolakefoodhub.com and click on "Shop Now." Scroll to the bottom of the page and click on "Producer Login" to access your account.
Your login page includes tabs: Summary, Producer Info, Products, History, and Reports

Listing Products

Once you've logged in, go to the "Products" tab. You'll see two sections: "All Products I Have" and "Current Items I Sell".

1. <u>"All Products I have"</u>

This is your full set of crops. You may not be selling them all the time, but it's your stock. Consider it your seed bank.
Add new items by clicking on 'Add Products to Sell'. You can choose from a list of pre-existing items or create a new item by going to the "Create a New Product" tab and fill out the following information. If you are creating a new product, the Market Manager has to approve it. After setting it up, please call 707-467-3238 for quickest response. If you have questions about what each section means, hover your cursor over the question mark to the left of the blank space. Each case should be worth a minimum $25, for example 24 heads of lettuce, not 12. After you have listed the product go to the storefront to make sure that everything is correct.

2. <u>"Current Items I Sell"</u>

These are the items you're selling in an order period. To list them, you can do it in bulk by going to "Bulk Entry" or individually by clicking on the plus sign to the far right of each item in the "All Products I Sell" section.

Checking on Orders

To see what has been ordered, check your account page on Monday and Thursday at 10:00 am. Under the Summary tab, click on "Detailed Pick Ticket" to see who ordered, what product, and quantities.
Please deliver to your nearest node. The note for the delivery destination is for us. You drop it off at your nearest node. We'll take it to the customer, which will be indicated by a node or "Direct to Customer."

Delivery

Packing Your Produce

Please package your produce such that the box top is flat. Remember that the boxes will be stacked, such that your product may get bruised or crushed if not packed correctly. If products are changed due to improper packaging such that the customer refuses the order, then we cannot pay you for that produce.
Each box of produce packed needs to have a sticker that identifies:

- **Customer** name
- **Destination**
- **Quantity** of Contents included in package (i.e. 24 bunches kale; 10 lbs. tomatoes)
- **Case Count** (i.e. Qty: 1 of 4)
- **Producer** name
- **Packing** Date

Please make sure that the label is secure and legible. You can print labels by logging in and going to the "Reports and Labels" tab. We recommend printing the "Detailed Label with Customer name and separate quantities". We will also have blank labels in the node in case you can't print them.

Payments and Records

You do NOT need to invoice the Hub or the customer. The online software generates invoices and pick tickets. The Hub collects from the customer and pays producers from the pick tickets. If you want to refer back to records click on the "History" tab in your login page. Make sure to use the **'Detailed Pick Ticket'** which shows the Customer Came.

Attachment 5. Food Hub Food Safety Plan

Mendo-Lake Food Hub
Food Safety Manual 2016

Project Coordinator: John Bailey
jbailey@ncoinc.org

North Coast Opportunities
413 North State Street
Ukiah, CA 95482
(707) 467-3238
mendolakefoodhub.com

Table of Contents

Mission Statement:

Our mission is to increase the availability of local produce and the viability of local farmers by connecting growers to buyers through an easy to use network.

Mendo-Lake Food Hub Description:

Mendo-Lake Food Hub is an online market place and delivery service that enables Lake and Mendocino County schools, grocery stores, restaurants, caterers and retail establishments a way to order produce and other locally-produced products directly from Lake and Mendocino farmers and producers. It is part of a growing local food system which offers healthy locally produced food to our community and helps farmers reach market opportunities with ease.

As of 2015, this service is run as a socially responsible business by North Coast Opportunities (NCO). NCO, a non-profit corporation which services both Lake and Mendocino Counties, envisions communities where all people have an equal opportunity to participate, contribute, and provide for themselves and their loved ones.

Licensed by the CDFA as a Commission Merchant, Mendo-Lake Food Hub does not directly handle these products but instead acts as a broker between the farmer and the final destination customer. The farmers are responsible for packing and handling, and continue ownership of the products up until the moment of final delivery to the customer.

There are currently three ‘Nodes’, temperature controlled storage facilities, which the Mendo-Lake Food Hub uses to store pre-ordered produce from the farmers before delivering it to its final destination. These Node locations include Ukiah, Willits, and Caspar. The Nodes are identical, repurposed shipping containers which are insulated and partitioned off into two separate temperature rooms, which are cooled to 58˚ and 38˚ respectively, to make for ideal storage conditions for a broad range of crops.

All Nodes are accessible via a number combo lock, which is given upon submission of the paperwork required to become a Food Hub seller. There are no transactions conducted at the Nodes; only farmers, delivery people, and Mendo-Lake Food Hub personnel have access. Location maps to all of our Node locations, with directions and parking information, can be found in Appendix A of this document.

Please visit https://mendolakefoodhub.com/ for more information about our program, a description of how to become a member, and a way to shop through our hub to find locally-grown produce near you!

Section 1: Traceability

1. Traceability Procedures

The Mendo-Lake Food Hub traceability system allows products to be traced from the buyer back to the farmer with the use of a simple sticker, attached to each box of produce, combined with sales records generated by the online market software.

When selling cases to a buyer, it is the farmer's responsibly to attach a sticker on each box, whether it is printed it out with prefilled delivery information from the Mendo-Lake Food Hub online software, or hand written information on the blank labels provided at each Node. Each box of produce packed needs to have a sticker that identifies:

- **Customer** name
- **Destination**
- **Quantity** of Contents included in package (i.e. 24 bunches kale; 10 lbs. tomatoes)
- **Case Count** (i.e. Qty: 1 of 4)
- **Producer** name
- **Packing** Date

An example of the layout of the generated box labels is seen below in Figure 1.

Figure 1

When labeling boxes for transit, if produce is packed in a reused box, farmers are to cross off or remove any previous labels. Also, if a farmer is **NOT Certified Organic**, they are to cross off any organic labeling from their boxes. Labels must be placed on the vertical end face of each box. If all required information is not present on an outgoing label, the order will not be processed or delivered, and the farmer will not be paid for the produce.

It is the responsibility of the farmer to keep track of which date the produce was harvested and from which field the crops were harvested. This way, if there was ever a recall, farmers could narrow down to which part of their farm the contaminated produce was from and handle the issue appropriately.

2. Recall Procedures

There have never been any situations in the Food Hub that have needed to use a recall procedure; however, if there were a situation, the traceability system (See Section 1 above) would be used. There is a generated VIN number that signifies and tracks each harvest by farm and crop. These numbers are located on the last line of the label and can be traced back to which harvesting date and crop number by the Mendo-Lake Food Hub online software, with the help of the customer. By using this system, if there were a problem reported to the customer by the end consumer, they could contact the Project Coordinator, the Project Assistant, or the Executive Assistant in the main office with the VIN number and they would be able to use this system to trace back to the farmer to find the source of the problem. At this point, the Mendo-Lake Food Hub would ask the allegedly problematic produce to be taken off the shelves and set aside so the Project Coordinator, the Project Assistant, or the Executive Assistant can make arrangements for the produce to return to the main office for testing before a complete recall is made.

3. Record Keeping

Records of all Mendo-Lake Food Hub transactions are digitally kept within the Mendo-Lake Food Hub database. These records date back to the start of the Mendo-Lake Food Hub, and can be used as an alternative traceability tool if needed.

Section 2: Health and Hygiene

Affiliate Health and Hygiene

While there will not be any Mendo-Lake Food Hub employees permanently stationed at any of the Nodes or directly handling any produce, they will be trained in the Standard Operating Procedures (SOPs) found in Appendix B covering the following topics: Neutral pH Disinfectant Solution, Checking Temperature, Setting Temperature, Turning On and Off Node AC, Node Cleaning, and Packaging Requirements. In addition, there will be a Health and Hygiene Policy that all visitors to the Nodes need to follow in order to ensure the cleanliness of the Node work areas and the protection of the produce in storage. This policy and the SOPs will be kept at the Nodes for easy reference.

Health and Hygiene Policy

All handlers of produce at the Nodes shall be made aware of and practice safe food handling techniques including proper hand sanitation, which is provided at each Node, and/or changing gloves when working with potential sources of contamination. All persons visiting the Nodes should take measures to prevent contamination of produce by using hygienic practices when handling cases of covered produce. Any and all persons handling produce shall have any and all open wounds covered appropriately. Any and all persons shall not handle or be inside Node and around produce while ill. For more cleaning details, please refer to the '*Cleaning Protocols'* section under the **Node Activities** header below.

Section 3: Water Requirements

Water System Description

Ukiah- the Ukiah Node Location uses a city water service access, which can be hooked up with a hose for cleaning purposes. There is also a city sewer cap next to this city water service access that will be used for disposal of cleaning waste and any condensate from the cooling system.

Caspar- The Caspar Node, located at Fortunate Farms, is next to an Individual Private Well which has a hose connection in the barn to the left of the Node. In the barn there is also a septic system access point which will be used for disposal of cleaning waste and any condensate from the cooling system.

Willits- The Willits Node has city water access through a hose connection near the Node. Public sewer access is available through the bathroom in the main building, which will be used as a disposal point for cleaning waste and any collected condensate from the cooling system.

For specific locations of all of these access points, please refer to the Node location maps in Appendix A.

Section 4: Animal and Pest Control

Animal and Pest Control [Buildings]

The three repurposed shipping container Nodes, located in Ukiah, Willits, and Caspar, are all designed for preventative pest control measures. None of the Nodes have had any pest concerns so far; however, if there are signs of pests (wasps, flies, etc.), Node visitors should contact the main Mendo-Lake Food Hub office and they will set eradicative actions in motion. Where physical traps are applicable, Mendo-Lake Food Hub employees will use those over the use of sprays and other pesticides, especially in the presence of produce. All products used for pest control management will conform to organic practices.

Following these standards will make sure that all Nodes stay pest free:

- Keep doors closed at all times, except for entry and exit of farmers, delivery people, and Mendo-Lake Food Hub employees.
- Domestic animals are **never** permitted inside Nodes for any reason.
- No loose produce is allowed in the Nodes.

Section 5: Transportation

Produce Transportation from Farmer to Node

The goal of the Mendo-Lake Food Hub is to not have any direct farm pick-ups and to have all farmers drop off their weekly orders at each appropriate Node location. If there are still farmers that require pickup, the Mendo-Lake Food Hub will do their best to pick the order up in a refrigerated vehicle wherever they can. If there are circumstances where a refrigerated vehicle cannot be used, the produce order will be in a non-refrigerated vehicle for 30 minutes or less before it reaches any Node.

Section 6: Node Activities

Produce Sourcing and Storage

All produce and other Mendo-Lake Food Hub orders come from pre-approved farmers and distributors. All farmers that work through the Mendo-Lake Food Hub have a Certified Producers Certificate and are Mendocino County Approved Sources (MCAS).

Considering many of the farms that do business through the Mendo-Lake Food Hub are organic, conforming to organic standards is necessary within the walls of the Nodes. This will be demonstrated through Node cleaning procedures.

Produce from each farmer is stored in the Node in between harvest and final delivery. For best storing purposes, the Node has two different temperature controlled rooms, one around 58˚ and the other around 38˚. A sample list of storage temperatures for products that are moved though the Mendo-Lake Food Hub called the **Produce Storage Temperature Reference** is located in Appendix B. One of these sheets will be posted inside every Node to make it easy for farmers to quickly reference when dropping off orders.

All produce will be stored in wholesale cases that are packed by the farmer. No loose produce is allowed within the Nodes. Produce must be packed in appropriate containers: new boxes, new bags, or used boxes lined with a sanitary liner. Reusable totes are also allowed, provided that they have been sanitized prior to packing.

Non-Product Material Storage

Cleaning supplies and other non-produce materials are stored in a closed lid bin inside the Node. The supplies that will be kept in this tub are the multi-purpose cleaner, rubber gloves, sponges, towels, brushes, and spray bottle. Any chemical products purchased for pest control will also be kept in this tub.

Trash and Recycle bins are also located within the Node, as many of the Node locations are not able to have trash outside of them. Because of this, Nodes will only allow recyclables and non-liquid trash to reduce risk of contamination.

Office supplies such as labels, tape, pens, papers, and clipboard will be kept on the table. Unused packaging materials stored in the Node will be kept in orderly fashion and clean condition.

Containers and Bins

To prevent produce contamination, Mendo-Lake Food Hub requires farmers to use new or gently used boxes. If the boxes are used, farmers are asked to line them with sanitary liners. Cases are to be packed so that the box top is flat to allow for stacking within each Node and in the delivery vehicle, to reduce produce bruising. Each box packed by the farmer needs to be fully closed and be sturdy enough to support the weight of other boxes being stacked above and below it. With stacking, farmers need to also make sure that none of their produce will leak or cause damage to other products within the Node. For more packaging specifications, please refer to the *'Packaging'* section below.

Packaging

Farmers are to remove as much dirt as practical from produce before moving to packing areas for the protection of their produce and the rest of the produce within the Node. Farmers are to remove any organic or other labeling from boxes if it does not apply to them. If there is improper packaging and/ or damaged produce resulting from improper packing such that the customer refuses the order, the Mendo-Lake Food Hub cannot pay the farmer for that order. For more packaging specifications, please refer to the '*Containers and Bins'* section above.

Node Designs

The Ukiah, Willits, and Caspar Nodes are all cold storage repurposed shipping containers. See Appendix D, **Building Maps**, for internal layouts of each Node.

Cleaning Protocols

The interior surfaces of the Node facilities are made from smooth, durable, non-absorbent material to be easy to clean. Floors in both refrigerated areas are linoleum covered and clean easily. The walls of the Node are washable, racks used inside the Nodes are food safety approved and the tables are stainless steel. Each Node location will be subject to mandatory cleanings **once-a-month OR as needed.** These cleanings will include: sweeping, mopping, wiping down walls, disinfecting table tops, cleaning shelves, and cleaning out AC unit fins and other dust that has been accumulated within them. These cleanings will be done with an organically acceptable sanitizing agent, such as SaniDate.

Once a year during the off season, each Node will be emptied of all equipment and given a complete sterilization to ensure that each new season starts off with a freshly cleaned Node.

The Mendo-Lake Food Hub is responsible for conducting or arranging all scheduled cleanings of each Node; however, if a farmer enters and sees a mess, it is their duty to clean it up to the best of their ability and to notify the main Mendo-Lake Food Hub Office if the mess is unmanageable, such as mold, damaged equipment, or other produce-threatening conditions.

The Caspar Node is the only Node that is set on dirt and not a cement base. This creates extra cleaning responsibilities, making sure one's shoes are clean and as dust-free as possible before entering this Node. The Node will be surrounded with wood chips and have door mats at the entry to reduce the amount of dust entering the Node. Extra cleanings will be required at this location to make sure the floors are properly washed and that the AC unit fins are not clogged with excess debris.

Every cleaning of the Node, whether it is a farmer or a Mendo-Lake Food Hub Employee is to be reported on the cleaning log that is available at every Node. This cleaning log will hang within each Node to record when the Node was last cleaned and by whom. A sample **Node Cleaning Log** is located in Appendix E.

Monitoring Equipment

For overall monitoring, the Mendo-Lake Food Hub Office maintains a list of who has access to each Node via lock combinations.

For monitoring temperature inside the Nodes, the Mendo-Lake Food Hub will use a product called NotifEye, an Ethernet gateway that is equipped with four wireless 'thermistor' air sensors to monitor environmental temperatures. This will be connected to both rooms in each Node. This system relays data to the monitoring system inside the main office, which documents temperature readings and notifies personnel when a temperature falls outside of preset limits. If any alarms go off, the Project Coordinator, Project Assistant, or Executive Assistant will either see to the Node personally to correct the problem or will notify a Project Partner if the problem occurs in a Node too far from the main office (e.g. Caspar).

Along with the electronic Node temperature monitor, there will also be a temperature log located within each Node. The purpose of this document is for visitors to record the day, time, and temperature of the Node when they visited. It is instructed of them that if there is any serious issue, such as the temperature reading far above or far below what it should read, to contact the main office immediately to resolve this problem. A sample **Node Temperature Log** is located in Appendix F. If any alterations need to be made to the temperature system, the AC manual and the CoolBot manual are located within the Node, along with an SOP for turning the cooling units on and off and setting temperature, found in Appendix B.

The first farmer that arrives at the Node to drop off a weekly order will be responsible for turning on that Node. It takes roughly 15 to 30 minutes to cool the entire Node, with the front Cool room (≈58˚) taking less time than the back Cold room (≈38˚). If the Node is completely emptied by the delivery driver when picking up order for delivery, the driver will turn off the Node. If the Node is not emptied by the driver, a Mendo-Lake Food Hub employee or assigned individual will turn it off when emptied.

Record Keeping

Keeping records of who has access to each Node, as well as cleaning procedures and temperatures, ensures the Node stays a clean and safe environment for all stored produce.

- Node Temperature Set SOP/ Node AC On/Off SOP (Appendix B)
- Node Cleaning Log (Appendix E)
- Node Temperature Log (Appendix F)

Section 7: Final Product Transportation

Produce Transportation from Node to Final Customer

Mendo-Lake Food Hub uses Mendocino Coast Produce, a separate trucking company, for delivery services, but also has their own refrigerated truck. In rare cases where it is not possible to use a delivery truck, a private, unrefrigerated vehicle will be used if the travel time is 30 minutes or less. All delivery vehicles used to transport produce will be inspected for odors and signs of unsanitary conditions before loading. If a vehicle is found to be unsanitary, it will be cleaned and sanitized before produce is loaded. During transportation and delivery, produce must be protected from insects, flies, animals, dust and dirt, unnecessary handling, and other contamination. All records of these cleanings will be kept on the **Delivery Vehicle Cleaning Log**, located in Appendix G.

Record Keeping

- Delivery Vehicle Cleaning Log (Appendix G)

Appendices

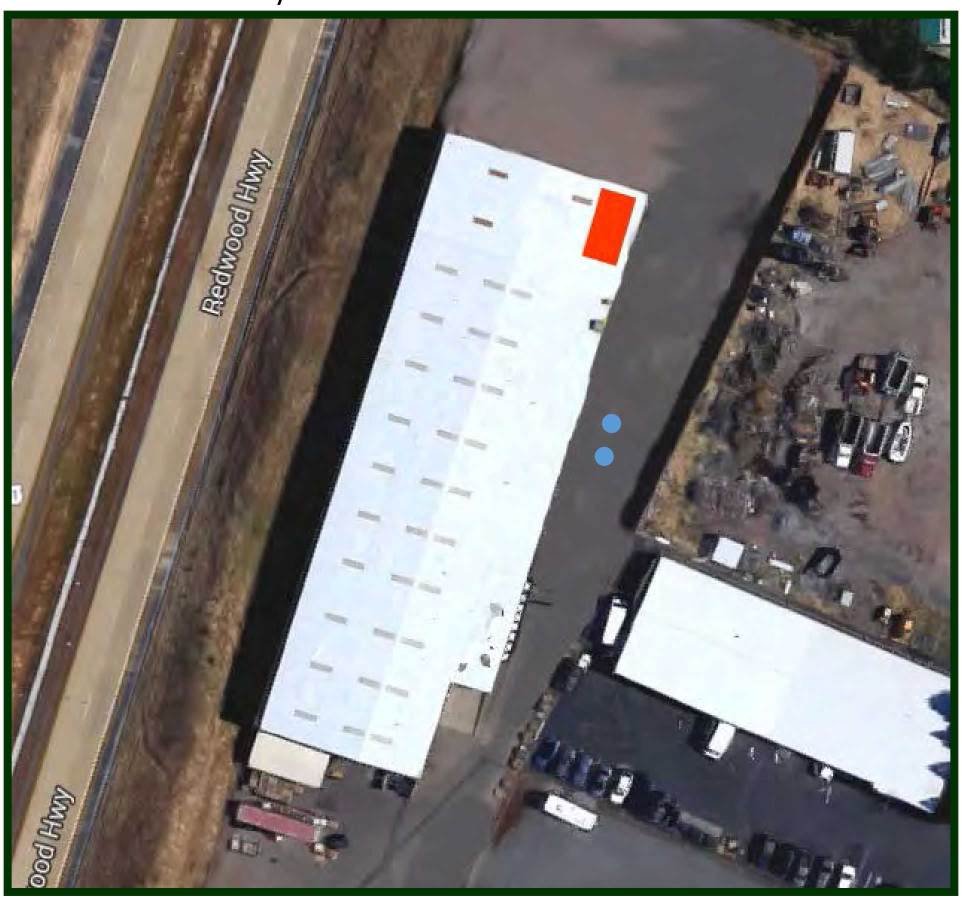
Appendix A – Location Maps

Nodes are shown as red rectangles in each location map, as well as water and sewage outlets in blue.

1. Ukiah Node

Address: 160 Parducci Road, Ukiah, CA 95482

Directions: From 101, exit Lake Mendocino Drive. Go north on North State Street for two blocks and turn left onto Parducci Road. In approximately 250 feet, just before the bridge over 101, turn right into the last driveway before the bridge railing. There is a black mailbox with the number 160 at the driveway. Drive north on the driveway PAST the first building and alongside the second (northern) one. The door to the Node is at the northeast corner in the area walled in by corrugated fiberglass sheeting. It is a person door with a numerical keypad lock. Enter the door and you will see the Node to your right. There is no additional lock on the Node so you can enter. The light switch is on the left as you enter.



The Nodes have two rooms, one at 58 degrees and one at 38 degrees. Please place your items according to their appropriate temperature. If you are not sure, look on the wall for a reference.

2. Willits Node

Nodes are shown as red rectangles in each location map, as well as water and sewage outlets in blue.

Address: 330 East Commercial Blvd, Willits, CA (across from Mendo Mill)

Directions: Head east on Commercial Blvd. from 101/Main Street. Turn in a black metal gate at 330 Commercial Blvd. Drive north across the parking area, go around metal shed building, and find the Node at the northeast corner of large warehouse building. The light switch is to the right just as you enter.
The Nodes have two rooms, one at 58 degrees and one at 38 degrees. Please place your items according to their appropriate temperature. If you are not sure, look on the wall for a reference.

3. Caspar Node

Nodes are shown as red rectangles in each location map, as well as water and sewage outlets in blue.

Address: Fortunate Farm 15401 North Hwy 1, Caspar, CA 95420

Directions: Heading Southbound on CA-1, past both the Caspar Exit on the right and the Jug Handle Creek Farm driveway on the left, take the next driveway on the left. Continue down this path by sticking to the right, passing several houses and eventually fields of flowers. The Node is located next to the barn on the left hand side. Feel free to park right in front of the Node.

Appendix B – Mendo-Lake Food Hub Standard Operating Procedures (SOPs)

1. Neutral PH Disinfectant Solution SOP

<table>
<tr><td colspan="2">SOP Name:
Neutral PH Disinfectant Solution SOP</td><td colspan="2">Created On:
June 24, 2016</td><td colspan="2">Last Modified:
June 28, 2016</td></tr>
<tr><td colspan="6">**Purpose:** To properly mix the cleaning solution for the Node, for use in the mop bucket and spray bottle.</td></tr>
<tr><td colspan="2">**Who Performs this task?**
Designated Mendo-Lake Food Hub Employees or Affiliates</td><td colspan="2">**Where is this task performed?** Each of the 3 Node locations</td><td colspan="2">**When is this task carried out?**
• Cleaning (Monthly and Weekly)</td></tr>
<tr><td colspan="3">**Equipment / Tools / Supplies**</td><td rowspan="2" colspan="2">**Record / Form Used:**

Node Cleaning Log</td><td>**Created By:** AR</td></tr>
<tr><td>• Cleaning Solution
• Spray Bottle</td><td colspan="2">• Mop Bucket
• Water</td><td>**Modified By:** JB</td></tr>
<tr><td colspan="3">**Health & Safety Warnings:**

• Mix in a well ventilated area.
• Wash hands well after handling.</td><td colspan="3">**Cautions:**
Always use disposable gloves when handling this product.

See ‘Safety Data Sheet’ in Node for full hazard information.</td></tr>
<tr><td colspan="6">**Procedure:**
1. Take gallon of concentrated cleaning solution outside of Node to mix in a well ventilated area.
2. Fill mop bucket with 1 gallon of water
3. DILUTION: 1:64 (660 ppm quat) 2 ounces per gallon of water
4. Use as directed on pack panel of gallon container
5. Allow area to air dry
6. Properly dispose of cleaning waste in a designated sewer access point or bathroom area.</td></tr>
</table>

2. Node Cleaning and Sanitation (Monthly) SOP

SOP Name: **Node Cleaning and Sanitation (Monthly) SOP**	Created On: **June 24, 2016**	Last Modified: **June 28, 2016**
Purpose: To minimize risk of microbial contamination and ensure the safety of any and all produce being stored.		
Who Performs this task? Designated Mendo-Lake Food Hub Employees or Affiliates	**Where is this task performed?** Each of the 3 Node locations	**When is this task carried out?** • Once-a-Month or as needed

Equipment / Tools / Supplies		**Record / Form Used:**	**Created By:** AR
• Mop • Mop Bucket • Broom • Brush • Spray Bottle	• Sponge • Rubber Gloves • Organic Cleaner • Towels	Node Cleaning Log	**Modified By:** JB

Health & Safety Warnings:	**Cautions:**
Keep Node well ventilated while cleaning	Ensure working area is clean, and all equipment is in good, working order before cleaning

Procedure:

1. Make sure Node is turned completely off and emptied of all produce or materials which could receive contamination.
2. Put on disposable gloves.
3. Pick up floors of larger debris and boxes. Put extra boxes away underneath table and out of the way.
4. Clean out AC unit fins from dust and other debris that accumulated within them.
5. Sweep the floor of dust and left over debris.
6. Mix organic cleaner into spray bottle, following the 'Neutral PH Disinfectant Solution SOP'
7. Use spray bottle solution to wipe down walls of any dirty or mold infected areas with sponge.
8. Using the same spray bottle solution, wash tables and shelves with towels.
9. Mix organic cleaner into mop bucket, following the instructions in the 'Neutral PH Disinfectant Solution SOP'.
10. Mop the floors with doors open, creating a well ventilated area and allow to air dry.
11. Once floors are dry, empty trash and recycling bins.
12. Empty waste water into sewer drain.
13. Put away cleaning solutions in designated areas and dispose of gloves and towels appropriately.

3. *Node Cleaning and Sanitation (Weekly) SOP*

SOP Name: **Node Cleaning and Sanitation (Weekly) SOP**	Created On: **June 24, 2016**	Last Modified: **June 28, 2016**
Purpose: To minimize risk of microbial contamination and ensure the safety of any and all produce being stored.		
Who Performs this task? Designated Mendo-Lake Food Hub Employees or Affiliates	**Where is this task performed** Each of the 3 Node locations	**When is this task carried out?** • Once-a-week

Equipment / Tools / Supplies		**Record / Form Used:**	**Created By:** AR
• Mop • Mop Bucket • Broom • Brush • Spray Bottle	• Sponge • Rubber Gloves • Organic Cleaner • Towels	Node Cleaning Log	**Modified By:** JB
Health & Safety Warnings: Keep Node well ventilated while cleaning		**Cautions:** Ensure working area is clean, and all equipment is in good, working order before cleaning	

Procedure:

1. Make sure Node is turned completely off and emptied of all produce or materials which could receive contamination.
2. Put on disposable gloves.
3. Pick up floors of larger debris and boxes. Put extra boxes away underneath table and out of the way.
4. Sweep the floor of dust and left over debris.
5. Mop if needed (See **Node Cleaning and Sanitation (Monthly) SOP**) for instructions.
6. Mix organic cleaner into spray bottle, following the instructions on the 'Neutral PH Disinfectant Solution SOP'
7. Use spray bottle solution to wipe down stainless steel table with sponge.
8. Empty trash and recycling bins.
9. Empty waste water into sewer drain.
10. Put away cleaning solutions in designated areas and dispose of gloves and towels appropriately.
11. Inventory cleaning supplies and inform the Project Coordinator if running low.

4. *Node Temperature Set SOP*

<table>
<tr><td colspan="2">SOP Name:
Node Temperature Set SOP</td><td>Created On: June 24, 2016</td><td>Last Modified: June 28, 2016</td></tr>
<tr><td colspan="4">Purpose: To set the AC Units of each Node to the appropriate temperature to make for ideal storage conditions for a broad range of crops.</td></tr>
<tr><td colspan="2">Who Performs this task?
Farmer/ Mendo-Lake Food Hub Employee/ Delivery Driver</td><td>Where is this task performed?

Ukiah, Willits, and Caspar Nodes</td><td>When is this task carried out?
When first produce enters the Node weekly.</td></tr>
<tr><td colspan="2">Equipment / Tools / Supplies</td><td rowspan="2">Record / Form Used:
Node Temperature Log</td><td>Created By: AR</td></tr>
<tr><td>• AC Unit</td><td>• CoolBot</td><td>Modified By: JB</td></tr>
<tr><td colspan="2">Health & Safety Warnings:</td><td>Cautions:
Dry hands before performing this SOP.</td><td>Terminology:</td></tr>
</table>

Procedure:

1. Plug in CoolBot (Black Plug hanging from CoolBot Unit)
2. Press ‘Power’ on the AC Unit- fan will click on. If fan does not turn on, check plug. Press reset button on plug if fan still does not click on.
3. Make sure ‘Fan Speed’ is set to ‘Auto’ and ‘Mode’ is set to ‘Cool’ in both rooms.
4. The temperature should be preset to 58°F in Cool room and 38°F in Cold room.
5. If temperature is **NOT** set, press ‘✓’ on the CoolBot once which sets the display to flashing. This displays the set temperature. If it is not correct, use the right arrow to increase, or the left arrow to decrease temperature until desired temperature is reached. Press ‘✓’ again to set, which stops the blinking display.
6. Record when the AC unit and CoolBot were turned on with the **Node Temperature Log**, located in the Node.

5. Node AC Off SOP

SOP Name: **Node AC On/Off SOP**	Created On: **June 24, 2016**	Last Modified: **June 28, 2016**
Purpose: To turn off the AC Units of each Node once completely cleared of produce.		
Who Performs this task? Farmer/ Mendo-Lake Food Hub Employee/ Delivery Driver	**Where is this task performed?** Ukiah, Willits, and Caspar Nodes	**When is this task carried out?** When Node is emptied of produce for the week.
Equipment / Tools / Supplies • AC Unit • CoolBot	**Record / Form Used:** Node Temperature Log	**Created By:** AR **Modified By:** JB
Health & Safety Warnings:	**Cautions:** Dry hands before performing this SOP.	**Terminology:**

Procedure:

ON

1. Plug in CoolBot (Black Plug hanging from CoolBot Unit)
2. Press 'Power' on the AC Unit- fan will click on. If fan does not turn on, check plug. Press reset button on plug if fan still does not click on.
3. Make sure 'Fan Speed' is set to 'Auto' and 'Mode' is set to 'Cool' in both rooms.

OFF

4. If AC Unit is on, press the 'Power' button to turn off.
5. Unplug the CoolBot from the wall.
6. Record when Node was turned off on the **Node Temperature Log** located in the Node.

6. *Packaging Requirements SOP*

<table>
<tr><td colspan="2">SOP Name:
Packaging Requirements SOP</td><td>Created On: **June 24, 2016**</td><td>Last Modified: **June 28, 2016**</td></tr>
<tr><td colspan="4">**Purpose:** To establish packaging requirements for farmers before delivery to the Node.</td></tr>
<tr><td colspan="2">**Who Performs this task?**
Farmer</td><td>**Where is this task performed?**
Farm before delivery to Node</td><td>**When is this task carried out?**
Before delivery to Node for weekly deliveries.</td></tr>
<tr><td colspan="2">Equipment / Tools / Supplies</td><td rowspan="2">**Record / Form Used:**
Node Temperature Log</td><td>**Created By:** AR</td></tr>
<tr><td>• Produce
• Box or Bag</td><td>• Food Hub Label
• Sanitary Liners</td><td>**Modified By:** JB</td></tr>
<tr><td colspan="2">**Health & Safety Warnings:**
• New or Gently used boxes only
• No dripping or leaking boxes
• Used boxes MUST be lined with a new sanitary liner.</td><td>**Cautions:**
All boxes must be properly packed or they could be refused by the Food Hub. Boxes must be stackable, without risk of bruising.</td><td>**Terminology:**</td></tr>
<tr><td colspan="4">**Procedure:**
1. Put a new sanitary liner inside the box (if needed for used box)
2. Pack produce to fit within box, without overflowing, making sure box closes completely and the closed lid is flat. Fill to customer order, matching weight and case count. Inform Food Hub main office if out of compliance.
3. Add label on the vertical end face of the box, pre filled out via Mendo-Lake Food Hub online software or handwritten label with the following information:
• **Customer** name
• **Destination**
• **Quantity** of Contents included in package (i.e. 24 bunches kale; 10 lbs. tomatoes)
• **Case** Count (i.e. Qty: 1 of 4)
• **Producer** name
• **Packing** Date
4. Cross off or peel off any old labels and organic labeling from boxes if not applicable.</td></tr>
</table>

Appendix C – Produce Storage Temperature Reference

Mendo-Lake Food Hub
List of Produce by Storage Temp

Cold Room (38°)	Cool Room (58°)
Apples	Basil
Apricots	Eggplant
Artichokes	Garlic
Asian Pears	Ginger
Asparagus	Lemons
Beets	Melons (Honeydew)
Berries	Onions
Broccoli	Pears
Cabbage	Peppers
Carrots	Potatoes
Cauliflower	Pumpkins
Chard	Tomatoes
Corn	Watermelons
Cucumbers	Winter Squash
Figs	
Grapes	
Green Beans	
Herbs (NOT Basil)	
Kale	
Kiwis	
Leeks	
Lettuce	
Melons (Cantaloupe,	
Mushrooms	
Nectarines	
Oranges	
Peaches	
Peas	
Persimmons	
Plums	
Radishes	
Salad Greens (Arugula, bok choi, salad mix)	
Spinach	
Zucchini and Summer Squash	

Appendix D – Building Maps

(see previous attachment)

Appendix E – Node Cleaning Log

Mendo-Lake Food Hub

Node Cleaning Log

Instructions: This facility is to be kept clean by those who use it. If you see or make a mess, clean it up with designated cleaning supplies and sign your name and date of cleaning.

Operation Name: Mendo-Lake Food Hub **Year:** 2016

Type of Cleaning/ Notes	Date Cleaned	Name

Additional Notes and Observations:

Appendix F – Node Temperature Log

Mendo-Lake Food Hub
Node Temperature Log

Instructions: The back refrigerated room should be about 38°F and the front refrigerated room should be about 58°F. Temperature readings should be confirmed using both CoolBot digital readout and the circular analog thermometer. If the rooms are *drastically* (+/- 5°) above or below these temperatures, please call to notify the Mendo-Lake Food Hub Office at **(707) 467- 3238**.

Month/Year: _____________ **Node Location:** ______________________________________

Date	Room ('Cool' or 'Cold')	Time Temp Taken	Temperature (°F)	Initials	Notes (Please note if the rooms are just turning on, or you are turning them off)

Supervisory Employee's Initials and Date:

____

Appendix G – Delivery Vehicle Inspection and Cleaning Log

Mendo-Lake Food Hub

Delivery Vehicle Cleaning Log

Date	Vehicle Description	Inspection Results	Actions Taken	Initials

Reviewed by: ___________________________ Date: ______________

A sampling of the additional support materials and details follows:
Sample 1. Ingredient look:

CALIFORNIA FIG
INGREDIENT DEVELOPMENT
When You Think Figs, Think California!

Sample 2. Photography and presentation look (extracted from meeting materials/powerpoint):

Figs- Culinary Innovation

California Fig Swirl Bread

- California Fig Powder
- California Fig Pieces (Nuggets)

✓ Fig Powder is used as a starter for bread dough
✓ Fig Powder allows for a moister finished product
✓ Designed using California fig powder because of its hydroscopic properties

Figs- Culinary Innovation

Gluten Free Fig-Ginger Bread Biscotti

- California Fig Powder
- California Fig Juice Concentrate

✓ Fig Powder and Fig Concentrate help mimic the browning that is found in products containing gluten
✓ Fig Powder retains more moisture while cooking, providing better texture and flavor

Figs- Culinary Innovation

California Fig Korean BBQ

- California Fig Concentrate
- California Fig Paste

✓ California Fig ingredients blend with savory ingredients to produce "meaty" flavors that have rich smoky aroma and taste

Figs- Culinary Innovation

California Fig Coffee

- California Fig Pieces

✓ Decaffeinated options for coffee and tea without added sugars
✓ Can be made into small pucks or packed into tea bags for steeping
✓ Utilizes Fig ingredients

Figs- Culinary Innovation

California Fig Chocolate

- California Fig Powder

✓ Supplement or replacement for cocoa
✓ Healthy dessert alternative

Figs- Culinary Innovation

California Fig Kombucha

- California Fig Juice Concentrate
- California Fig Soaking Liquid

✓ The addition of California Fig Juice Concentrate or fig water creates an antioxidant rich Kombucha with more flavor

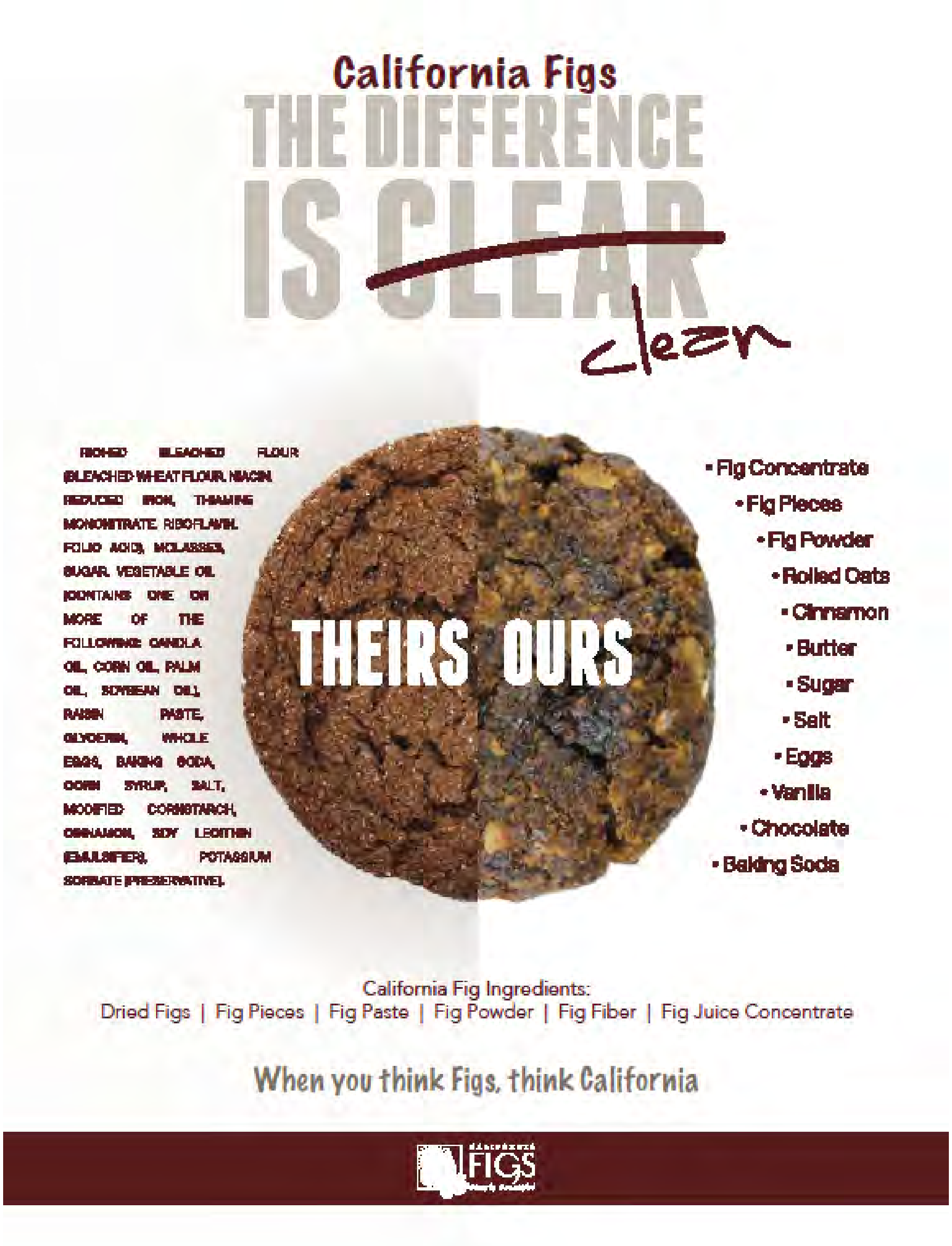

Figs Culinary Innovation – California FIG Cookie


Figs Culinary Innovation – California FIG Thai Sauce


Figs Culinary Innovation – California FIG Steak Sauce


Figs Culinary Innovation – California FIG Horchata Beverage

Sample 3. The Difference is ~~Clear~~ Clean presentation:



Sample 4. California Fig Ingredient Sheet:

California Fig Ingredients

DRIED CALIFORNIA FIGS

California Whole Dried Figs are a contemporary fruit that has been produced the same way for centuries. Figs are the only fruit to fully ripen to complete sweetness and semi-dry right on the tree before falling to the ground to continue drying. This process allows for optimal moisture and sweetness.

Figs are harvested in the late summer and early fall, but because they are dried and conveniently packaged, they are available all year long. After harvest, the figs are inspected, washed and packaged at state of the art processing facilities to ensure the highest quality figs in the world.

Naturally dried figs, such as Black Mission, are dark purple in color. Lighter figs, such as Calimyrna, Kadota and Conadria, may be sulfured or bleached to prevent browning. California produces six primary dried fig varieties, which include Mission, Calimyrna, Conadria, Kadota, Sierra and Tena.

CALIFORNIA DICED FIGS

California Diced Figs fit the size and shape specifications of the food industry. California figs are chopped, diced and sized to customer specifications. This allows precision integration into food products. The diced and sliced figs are free flowing and nicely integrate into food products. They are available as natural pieces or flavored and colored. Diced figs are used in breads, cookies, packaged mixed, cakes and a variety of cereals and confectionery items.

CALIFORNIA FIG NUGGETS

California Fig Nuggets are made with natural fig paste, formed into cubes of different dimensions along with other binding ingredients such as fruit solids, glycerin, cornstarch, vegetable oils or dextrose. Fig nuggets are available with or without seeds. The finished product is coated with dried corn syrup solids to keep it free flowing. Fruit flavor can be added such as mango or passion fruit to be used as natural fruit ingredients. Fig nuggets provide uniform size and physical characteristics perfect for your product development needs.

CALIFORNIA FIG PASTE

California Fig Paste is specially blended to order with one or more varieties of California food grade figs (Adriatic, Calimyrna, Mission, Kadota, Sierra and Tena) to meet product development requirements for flavor and color.

California Figs are ground into a variable consistency paste for use in extrude products. The paste is tempered to remain soft and works well with co-extrusion, cookies, confectionery and other items. Fig paste is available with and without seeds in a smooth format. It is also available in a variety of consistencies from soft to firm. Some of the most popular sauces in the USA are made using California Fig Paste. Fig paste can also be run through chocolate rollers to produce a smooth and creamy paste. Moisture content is normally 24 percent.

CALIFORNIA FIG POWDER

California Fig Powder is an excellent low moisture ingredient. California Figs are air dried to less than 10% moisture and ground to form a fig powder that is used in low moisture products. California Fig Powder is a cost-effective replacement for more expensive fruit powders. High in fiber and free flowing, this light to medium brown powder has a mild flavor which is perfect for use as a binding or bulking agent in bakery items, pet food and cosmetics.

CALIFORNIA FIG JUICE CONCENTRATE

Fig Juice Concentrate (FJC) is a natural liquid containing no preservatives or additives. It is a pure concentrated water extract of dried figs derived by leaching the dried figs with water and concentrating the resulting extract under vacuum to a minimum of 70° Brix (70% fruit soluble solids). The pH range is 3.8 to 4.4 which makes it more compatible with food systems. The amber to dark brown colored liquid of 70° Brix has a mild and fruity flavor that works well in sauces.

Excellent source of Dietary Fiber | Fat, Cholesterol and Sodium Free
For recipes and more information: californiafigs.com | info@californiafigs.com

Sample 5. Presentation materials:

BE CALIFORNIA FIG-INSPIRED

California Fig Sesame Ball

YIELD: ½ SHEET TRAY, 50 PORTIONS
CATEGORY: SNACK | REVISION DATE: 7/2014 | RECIPE: CALIFORNIA FIG SESAME BALL | SHELF LIFE: 7 DAYS

Almonds, whole, natural, roasted	28 ounces
Almonds, sliced, toasted	14 ounces
Oats, thick-rolled, toasted	10 ounces
Almond Flour	2 ounces
Cardamom, ground	½ ounce
Flax Seeds, ground	1 ounce
Pumpkin Seeds, toasted	17 ounces
Honey	11 ounces
Agave Nectar	18 ounces
Fig Paste	11 ounces
Dried Figs, diced	16 ounces
Sesame Seeds, toasted	3 ounces

1. In a stand-up mixer combine whole almonds, sliced almonds, oats, almond flour, cardamom, flax seeds, and pumpkin seeds.
2. In a medium, heavy-bottomed sauce pan, add the honey and agave nectar; bring to a boil over high heat.
3. Cook syrup to 240 degrees Fahrenheit; then remove from heat.
4. Add fig paste and dried figs to the syrup mixture and incorporate thoroughly.
5. Pour the fig and syrup mixture into the stand-up mixer. Using the paddle attachment, coat the dry ingredients thoroughly.
6. On a half-sheet tray lined with parchment, lay out the mixture.
7. Once cool, portion into small, equal balls.
8. Roll each ball in sesame seeds and serve.

Sample 6. Presentation materials:

Be California FIG-INSPIRED

California Fig Bar

YIELD: ½ SHEET TRAY, 40 PORTIONS
CATEGORY: SNACK | REVISION DATE: 7/2014 | RECIPE: CALIFORNIA FIG BAR | SHELF LIFE: 7 DAYS

Almonds, whole, natural, roasted	28 ounces
Almonds, sliced, toasted	14 ounces
Oats, thick-rolled, toasted	10 ounces
Almond Flour	2 ounces
Flax Seeds, ground	1 ounce
Sea Salt	2 teaspoon
Pumpkin Seeds, toasted	17 ounces
Fig Powder	1 ounce
Fig Pieces	16 ounces
Honey	11 ounces
Agave Nectar	18 ounces
Almond Butter	11 ounces
Fig Paste	3 ounces

1. In a stand-up mixer, combine whole almonds, sliced almonds, oats, almond flour, flax seeds, sea salt, pumpkin seeds, fig powder, and fig pieces.
2. In a medium, heavy-bottomed sauce pan, add the honey and agave nectar; bring to a boil over high heat.
3. Cook syrup to 240 degrees Fahrenheit; then remove from heat.
4. Add the almond butter and fig paste to the syrup mixture and incorporate thoroughly.
5. Pour the almond butter and syrup mixture into the stand-up mixer. Using the paddle attachment, coat the dry ingredients thoroughly.
6. On a half-sheet tray lined with parchment, evenly lay out the mixture.
7. Once cool, remove from sheet tray and cut into 40 equal portions.
8. Store in an airtight container.

America Pistachio & California Prune Baking Seminars

Summary Report

May, 2014

【Event Summary】

The American Pistachio & California Prune Bakery Seminar was held on the 22nd and 23rd of April in Tokyo and the 25th of April in Osaka. We had made the preparations for 3 months and put all our effort to achieve the project's goal.

We finished the seminar with great success and increased the understanding of the quality attributed with American pistachios and Californian prunes through chef Robert Jorin`s wonderful bakery demonstrations.

【Activities of Secretariat】

●Meeting with APG and Internal Meeting

●Researched and listed the expected attendees for the seminars in Tokyo and Osaka. (Bakery, Hotel, Restaurant, Culinary School, Company, Home Chefs, Food Coordinators, and media)

●Prepared and printed out the invitations and certificates.

●Designed the envelope for distributing the invitation.

●Distributed the invitations to bakeries, hotels, restaurants culinary schools, and home chefs via post, email, and fax.

●Sent the certificates to the attendees.

●Followed up on attendees to make sure of their attended date and time via phone and email.

●Communicated with both main persons from the venue at Tokyo and Osaka.

●Organized the list of kitchen tools and ingredients.

●Ordered and purchased the ingredients from distributors and grocery stores.

●Translated and printed out the surveys.

●Translated and proofread the recipes.

●Prepared all other material for seminars.

●Scheduled and prepared the date and ingredients for the trial.

●Conducted a cooking trial and fixed the ingredient list.

●Prepared the seminar time table and scenario.

●Fitting the assistant and service staff.

●Conducted the seminars.

●Set up the venues both Tokyo and Osaka.

●Followed up on the media and attendees after the seminars.

●Designed the display and tasting tables.

●Prepared the materials for display and tasting tables.
(Name plates, Plates, Paper Napkins, Baskets and others)

<Display the 8 items and pistachios and prunes>

<Display the 8 items and pistachios and prunes>　Osaka

<Tasting table for pistachios and prunes>

<Tasting table>

<Seminar>　Tokyo

<Seminar> Osaka

【Conclusion】

●March 13th to March 20th,Distributed to approximately 2000 targeted attendees via post, email, and fax and 1500 via email.

●Followed up on about 300 attendees to make sure of their attended date and time via phone and email.

●March 27th, Trial for the recipe.

●April 20th and 21st, Preparations

●Number of attendee (Please refer the attached list of attendee for more details.)

April 22nd in Tokyo・・・・Expected 113 attendees (including 20 media)
→96 attendees (including 17 media)

April 23rd in Tokyo・・・・Expected 104 attendees (including 13 media)
→72 attendees (including 6 media)

April 25th in Osaka・・・・Expected 89 attendees (including 3 media)
→70 attendees (including 3 media)

●Survey (Please refer the attached aggregate survey list for more details.)

April 22nd in Tokyo・・・・Collected 92 surveys from 96 attendees

April 23rd in Tokyo・・・・Collected 65 surveys from 72 attendees

April 25th in Osaka・・・・Collected 62 surveys from 70 attendees

●Prepared 300 binders and recipe set.

【Time Table】

12:30	Registration	●registration starts from 12:30pm
13:00 (3min)	Seminar starts	●MC is Izumi Amano (APG Japan rep)
13:03 (10min)	Greetings	●APG & CPB
13:13 (3min)	Short Speech	●Shoei / Iwase Esta
13:16 (6min)	Itinerary	●go through itinerary
13:22 (30min)	Break	●Tasting(Pistachio & Prune) / Coffee Break
13:52 (8min)	Introduction	●Introduction of chef Jorin
14:00 (90min)	Demonstration	●lecture and demonstration by chef Jorin
15:30 (15min)	Q&A	
15:45 (45min)	Tasting	●Tasting and questionnair
17:00	End of seminar	●Everyone leaves by then

Bakery Seminar Tatalization

4/22 92 Surveys (96 Attendees)
4/23 65 Surveys (72 Attendees)
4/25 62 Surveys (70 Attendees)

Total 219 Surveys (238 Attendees)

Questions	Number							%						
		5	4	3	2	1	N/A		5	4	3	2	1	N/A
1.Please rate your overall experience at this seminar	4/22	45	39	7			1	4/22	48.9	42.3	7.6			1
	4/23	36	25	3	1			4/23	55.3	38.4	4.6	1.53		
	4/25	25	30	4			3	4/25	40.3	48.3	6.4			4.8
	Total	106	94	14	1			Total	48.40%	42.90%	6.39%	0.40%		1.82
2.Event Facility	4/22	66	23	3				4/22	71.7	25	3.3			
	4/23	51	10	3				4/23	78.4	15.3	4.6			
	4/25	33	19	6	1		3	4/25	53.2	30.6	9.6	1.6		4.8
	Total	150	52	12	1			Total	68.40%	23.70%	5.40%	0.40%		1.3
3.Recipes and Products Produced for this Seminar	4/22	53	30	8	1			4/22	57.6	32.6	8.69	1.08		
	4/23	34	25	5	1			4/23	52.3	38.4	7.69	1.53		
	4/25	25	28	5	1		3	4/25	40.3	45.1	8	1.6		4.8
	Total	112	83	18	3			Total	51.10%	37.89%	8.20%	1.30%		1.30%
4.Quality and Expertise of Chef Jorin and Baking Assistants	4/22	67	21	4				4/22	72.8	22.8	4.3			
	4/23	44	20	1				4/23	67.6	30.7	1.5			
	4/25	42	14	2	1		3	4/25	67.7	22.5	11.2	1.6		4.8
	計	153	55	7	1			Total	69.80%	25.10%	10.70%	0.40%		1.36%
5.Recipe Binder and other Seminar Handouts	4/22	54	30	8				4/22	58.7	32.6	8.69			
	4/23	40	20	3	2			4/23	61.5	30.7	4.6	3		
	4/25	31	22	5	1		3	4/25	50	35.4	8.06	1.6		4.8
	Total	125	72	16	3			Total	57%	32.80%	7.30%	1.30%		1.36%
6.Did you find the recipes new, innovative and interesting to your business?	4/22	37	39	25	1			4/22	40.2	42.3	27.1	1.08		
	4/23	25	32	8				4/23	38.4	49.2	12.3			
	4/25	18	30	10	1		3	4/25	29	48.3	16.1	1.6		4.8
	Total	80	101	43	2			Total	36.50%	46.10%	19.60%	0.90%		1.36%
			YES		NO	N/A				YES		NO	N/A	
7.Are you already using California Pistachios or Pistachios in your business	4/22		37		47	8		4/22		40.2		51	8.69	
	4/23		35		27	3		4/23		53.8		41.5	4.6	
	4/25		36		21	5		4/25		58		33.8	8	
	Total		108		95	16		Total		49.30%		43.30%	7.30%	
8.As a result of this seminar, will you use or recommend using California Prunes or Pistachios in your business in the future?	4/22		80		1	11		4/22		86.9		1.08	11.9	
	4/23		59		3	3		4/23		90.7		4.6	4.6	
	4/25		57		2	3		4/25		91.9		3.22	4.8	
	Total		196		6	17		Total		89.40%		2.70%	7.76%	

April 22nd

Q9.Additional Comments and/or Suggestions

●As an overall experience, it was very long and I wanted to know the time table. I would like to get more details about pistachios and prunes on paper.
It was difficult to watch the screen from the back seat. Demonstrations could be much shorter. especiallv for peoble who

●It was a wonderful seminar. They (pistachios) need to be popularized in Japan and priced more reasonably (Nuts in Japan is too expensive)

●It was good that I attended and I learned much from the seminar. Thank you very much.

●I personally eat pistachio every day and really like it.
I would like to promote pistachios and prunes to schools and families like this seminar.
Do vou support schools and families?

●I learned very much from the seminar. I was just wondering if I also could use the fantastic facilities.

●Shorter seminar would be much better.

●Pistachio has high nutritional value even amongst the nut category and is good for diabetes and heart disease.
I understood the quality and safety attributed toward Californian pistachios. Thank you very much.

●Chef`s demonstration was very easy to understand. I learned much from his recipes which we hardly to find it in Japan. Thank you very much.

●I would like to participate in Prune contest next time. It would be great to send me a sample of pistachio and prune.

●I would like to use the pistachio powder which I have never used before and I also would like to participate in the prune contest.

●All items were delicious. My own store has not been built up yet but I would like to use this recipe at our own store.

●I learned much from the seminar. I would like to do my best for new product development on this occasion.

●It is a new idea for me to use prunes and pistachios which are not familiar in Japan.
I hope the both pistachios and prunes become more familiar products in the near future. Thev are still considered as verv

●I learned much from the interesting demonstration that I have never experienced before. And the Bread was tasty.

●I learned much from the seminar that is pretty much focused on pistachios and prunes.

●The combination of ingredients which I never thought of was very interesting and tasty.

●It was great that I learned the recipes to best use with pistachios and prunes in such a short time in the seminar. I am willing to attend next time too.

●Interpreter was intelligible.

●Thank you very much for such a valuable experience.

●It was tastier than I expected. I would like to use it in my menu.

●It did not exceed my expectations, even though I was very interested in American culture. But Bread was tasty and I learned much from the chef`s cu

●I felt that there were too few bread recipes were too little. It would have been good if there were recipes for baguette, pain de Campagne or sweetene

●Having a break with the Nespresso coffee tasting was great. I would like to create a menu using prune puree with greater functionality.

●How would you keep the price and quantity after passing the trace positive list?

●I would like to use the recipe for Macrobiotic specification. Thank you

●The combination of the ingredients was very interesting. I would like to use the idea in my product development in the near future. Thank you

●The seminar was very interesting. Thank you very much.

●The Seminar was wonderful. I learned much from it.

April 23rd

Q9.Additional Comments and/or Suggestions

●I would like to learn more simple recipes with more variety.

●I learned much from the seminar but It would have been good if there were recipes which is simple but sensational.

●I learned much from the seminar. Exhibition was great too. I look forward to attending the seminar and others next time.
Thank you very much.

●I did not know how to use pistachio and prune but I learned new things from the seminar and I would like to develop new recipe using new ideas.
If I have a chance next time, I would like to attened again. Thank you very much.
I attended the exhibition holding at Shoei before and I m impressed with Shoei`s facility every time.

●Wonderful

●Thank you very much

●The seminar was very interesting.

●Would bad weather cause sharp fluctuations in material price? Is it possible to get stable harvesting?

●I thougt it would be fun to bake.

●I did not use pistachio so often becouse I thought pistachio is too expensive and premium ingredients to use.
It became more familiar products after the seminar. I would like to use pistachio powder in the near future.

●Thank you very much. I learned much from the seminar.

●I really enjoyed the seminar and variety of recipes.
It was a shame that smell of perfume from the service staff was too strong. Sorry

●The seminar was very substantial and was very useful. I look forward to the next seminar.

●Thank you veru much. I learned much from the seminar.

●It would be great if the semiar was held often and regularly

●It would have been much more interesting if there was a talk about the pastry trend in America.

●I learned so much from the sminar and Thank you very much for suggesting us new idea of using pistachio and prune.

●It was good that I learned the ingredients which I was interested in. Thank you very much

●I learned much about pistachio from the seminar. Thank you very much.
I wanted to know more about the combination of other ingredients

●I would like to make the best use of the information and culinary skill for product development from now on.
Thank you very much.

●Demonstration that are fusion of Europe and American skills is very influential.
I hope to get pistachio and prune for the food industry much easier. Thank you

●I wanted to know more about the combination of other ingredients
The seminar should be held on a regular basis and be doing awareness building the understanding of pistachio and prune for food industry.

●Fantastic!

●I just started working at the Bakery and learned so much from the seminar.
I was very surprised that there are lots of variety of recipes using pistachio and prune.

●It would be great if we could get more information about purchasing the pistachio and prune.

April 25th

Q9.Additional Comments and/or Suggestions

●I enjoyed the seminar very much

●It is very important to know the ingredients we use for pastry are made particularly and safely. How do people use the pistachio and prune at home in California? It was good to get new recipes today but are there any classic recipes that people love from long time ago in America. I am very interested in food culture. How does the taste differ depending on production areas?
Demonstration was great and easy to understand. Thank you very much and looking forward to the next seminar.

●It was my first time to attend the pistchio seminar. (I have heard the benefit of Almond and Nuts at the other seminar.)
I would like to eat 10 pieces of pistachio but not more than 30 pieces (it d be too much)

●I tasted the pistachio powder for the first time. It tasts like Kinako and very good.
I would like to try bread recipes. Newtonbar was outstanding.

●Thank you!!!!

●I learned so much from the seminar.

●I would love to attend the seminar next time if it focuses on the bakery.

●Thank you very much for the recipe book. I will make the best use of this experience for the future.

●The seminar, ingredients and method were very useful. And Presentation for pistachio was very easy to understand and good reference ir

●New recipe were very interesting and useful.

●I thought it would be easy to understand to standardize the writing method eather pond or kg? and also emphasis the number.

●The seminar was very useful.

●Very interesting and easy to understand. Thank you very much.

●The seminar was very useful. Thank you very much.

●Keep holding this kind of seminar for professional baker for future too

●Thank you very much

●There were some pastry recipe in the seminar but I would like to take a standard bakery seminar next time.

●I will make the best use of this experience bakery and pastry.

●I will participate in the contest and do my best to be able to go to CIA ! ! It was very glad to see Kanako san after 14 years.

●Event entry fee was free, it took too much time (60 min) before the demonstration. It should be 20～30 min for the greetings and others

●I wanted to see chef was baking more bread.

2014 Korean Bakery Seminar Activity Report

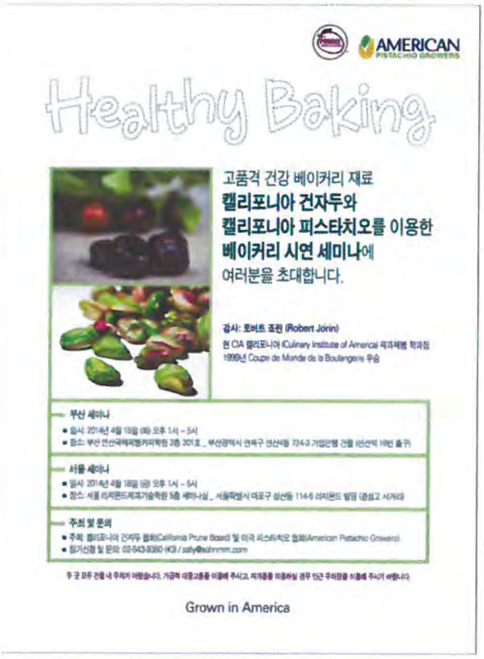
American Pistachio Growers & California Prune Board

Sohn's Market Makers

Printed Invitation Card Design

- Busan Seminar
- Seoul Seminar

Printed Advertisement for Seminar Notice and Invitation

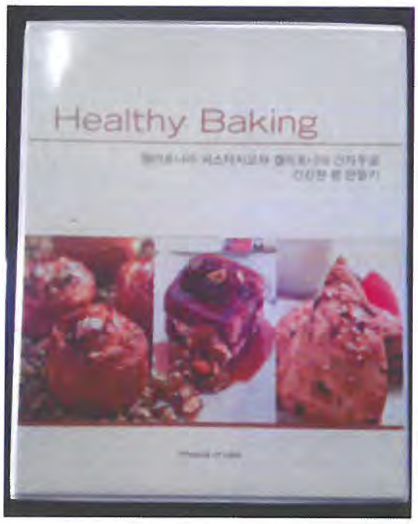


AD in 2 Bakery-specialized Magazines

Monthly Bakery (2014 April)
- Published by Korea Bakery Association, with 16,000 professional bakery chefs for its members, mostly belonging to window-bakeries
- Monthly circulation of 60,000

The Master Baker (2014 March)
- A quarterly magazine
- Published by Korean Master Bakers Association, with 607 professional bakery chefs for its members, mostly belonging to five-star hotels

Printed Materials for Hand-outs



Recipe Binder with information on American Pistachio Growers & California Prune Board / products / recipes / chef's bio / etc.

Questionnaire

Sample given-away as complimentary gift to seminar participants

5

Busan Seminar

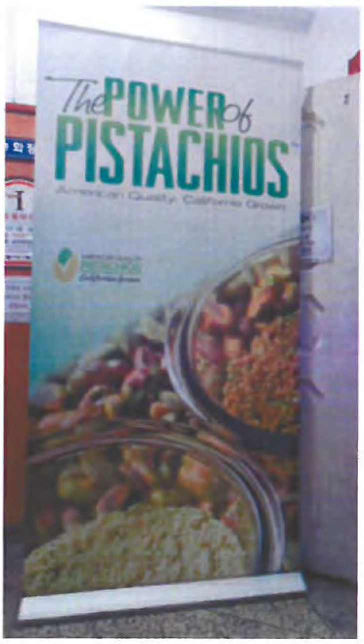
- Date & Time : April 15^{th}, 2014 / 1~5 pm
- Venue : Yeonsan International Bakery Academy
- Seminar Agenda
  - Opening Remark by SMM
  - Welcome Speech by APG
  - APG Presentation
  - CPB Presentation
  - Introduction of Chef Robert Jorin
  - Demonstration & Tasting (1hr 20min)
  - Coffee Break
  - Demonstration & Tasting (1hr)
  - Survey & Question

6

Busan Seminar

Attendee

Total	58
Baker	49
Hotel / Resort	1
Institute	8



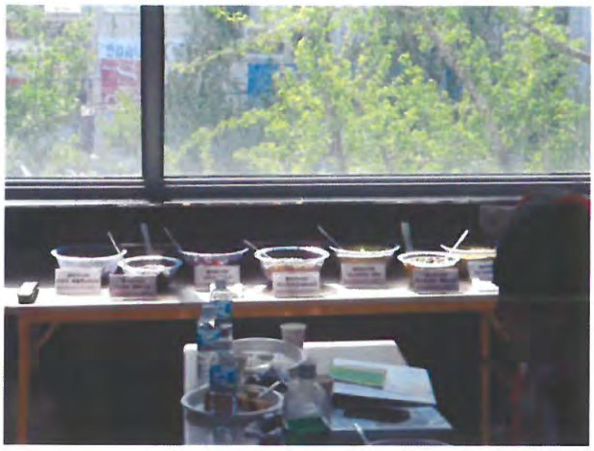



9




10

Display of Pistachios - Busan



Pistachio raw kernels, meal, paste, and small pieces

11

Display of Prunes - Busan

Pitted prunes, paste, and diced

12

Baked Products - Busan

Prune and Pistachio Frangipane Tart with Pistachio Crust (Pistachio & Prune)

Laminated Pistachio and Ham Brioche (Pistachio)

Baked Products - Busan

Pistachio and Prune "Newton Bars" (Pistachio & Prune)

Pistachio Macaroons with Brandied Cherry Ganache Filling (Pistachio)

Baked Products - Busan

Pistachio, Camembert, and
Mushroom Empanada
(Pistachio)

Fried Prune Custard Pouches
(Prune)

Baked Products - Busan

Prune Pithiviers (Prune)

Prune, Rosemary and Balsamic
Scones (Prune)

Seoul Seminar

- Date & Time : April 18^{th}, 2014 / 1~5 pm
- Venue : Richemont Bakery Academy
- Seminar Agenda
  - Opening Remark by SMM
  - Welcome Speech by APG
  - APG Presentation
  - CPB Presentation
  - Introduction of Chef Robert Jorin
  - Demonstration & Tasting (1hr 20min)
  - Coffee Break
  - Demonstration & Tasting (1hr)
  - Survey & Question

Seoul Seminar

Attendee

Total	88
Bakery	58
Food Manufacturer	3
Hotel / Resort	18
Media	3
Institute	4
ATO	2

Display of Pistachios - Seoul

Pistachio raw kernels, meal, small pieces, and paste

Display of Prune - Seoul

Diced prunes, pitted, and paste

23

24

Baked Products - Seoul

Prune and Pistachio Frangipane Tart with Pistachio Crust (Pistachio & Prune)

Laminated Pistachio and Ham Brioche (Pistachio)

Baked Products - Seoul

Pistachio and Prune "Newton Bars" (Pistachio & Prune)

Pistachio Macaroons with Brandied Cherry Ganache Filling (Pistachio)

Baked Products - Seoul

Pistachio, Camembert, and
Mushroom Empanada
(Pistachio)

Fried Prune Custard Pouches
(Prune)

Baked Products - Seoul

Prune Pithiviers (Prune)

Prune, Rosemary and Balsamic
Scones (Prune)

ATO Newsletter – Seminar Notice

<ATO Newsletter>

Seminar invitation notice with information on time / venue / instructor, and the contents.

Posted on US Embassy Seoul Agricultural Office's Korean official website / sent-out to key traders as e-newsletter

Media Coverage – Seminar Notice

On-line <The Food Service Economic News>
Viewership 600,000 / PR Value USD 150,000

Seminar invitation notice with information on time / venue / instructor, and the contents.
http://www.foodbank.co.kr/news/view.php?cat_name=%C7%C7%C7%C3&%C0%CC%BA%A5%C6%AE&secIndex=39335&section=004004&back=I

Media Coverage – Seminar Notice


캘리포니아 건자두-미국 피스타치오 협회

오는 18일, 건과류 제품 활용법 소개

캘리포니아 건자두 협회와 미국 피스타치오 협회가 공동으로 주최하는 '캘리포니아 건자두와 캘리포니아 피스타치오를 이용한 베이커리 시연 세미나'가 오는 18일 마포구에 위치한 서울 리치몬드제과기술학원 세미나실에서 열린다. 이 행사는 한국 시장에 캘리포니아 건자두와 피스타치오 제품 및 활용법을 소개하기 위해 기획됐다. 베이커리 업계 종사자와 미디어 관계자들을 대상으로 열리는 이번 세미나는 현 미국 CIA(Culinary Institute of America, California) 제과제빵 학위과정 학과장인 로버트 죠린이 직접 캘리포니아 건자두 및 캘리포니아 피스타치오를 주재료로 하는 베이커리 레시피 8가지 시연 및 시식을 진행할 예정이다.

임윤주 기자 lyj1188@

Weekly <The Food Service Economic News>
(2nd week of April)
Circulation 45,000 /
PR Value USD 12,000

Seminar invitation notice with information on time / venue / instructor, and the contents.

(The same contents as the on-line article from the previous slide)

Media Coverage – Seminar Review

On-line <Medical World News>
Viewership 1,200,000 / PR Value USD 150,000
http://www.medicalworldnews.co.kr/news/view.php?news=6030&newsid=1398071319

Media Coverage – Seminar Review


캘리포니아 건자두 · 피스타치오 이용 베이커리 시연

캘리포니아 건자두 협회와 미국 피스타치오 협회는 국내 베이커리 업계 관계자들을 대상으로 캘리포니아 건자두와 피스타치오를 이용한 베이커리 시연 세미나를 15일 부산(연산국제제빵커피학원), 18일 서울(리치몬드제과기술학원)에서 개최했다.

세미나에는 미국 피스타치오 협회 쥬디 히리고엔(Judy Hirigoyen) 글로벌 마케팅 이사와 프랭크 모건(Frank Morgan) 원료 마케팅 담당, 미국 CIA(Culinary Institute of America, California) 로버트 조린

로버트 조린 학과장은 캘리포니아 건자두와 피스타치오를 이용한 베이커리 6종을 시연하고, 참가자들에게 시식 기회를 제공했다

On-line <Food News>
Viewership 600,000 / PR Value USD 150,000
http://www.foodnews.co.kr/news/articleView.html?idxno=50354

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Media Coverage – Seminar Review


대한급식신문

캘리포니아 건자두·피스타치오 세미나 열려

제과제빵 업계 관계자 대상 레시피 소개

캘리포니아 건자두 협회(California Prune Board)와 미국 피스타치오 협회(American Pistachio Growers)가 15일 부산 연산국제제빵커피학원, 18일 서울 리치몬드제과기술학원에서 국내 제과제빵 업계 관계자 대상으로 건자두와 피스타치오를 이용한 시연 세미나를 진행했다.

이번 시연 세미나에는 미국 피스타치오 협회 마케팅 이사 쥬디 히리고엔(Judy Hirigoyen)과 원료 마케팅 담당자 프랭크 모건(Frank Morgan), 미국 CIA(Culinary Institute of America, California) 제과제빵 학과장 로버트 조린(Robert Jorin) 제빵사가 참여했다.

이 밖에도 주한 미국대사관 케빈 세이지엘(Kevin Sage-EL) 농업무역관장을 비롯해 국내 제과제빵


<사진제공_캘리포니아 건자두 협회, 미국 피스타치오 협회>

On-line <Food Service News>
Viewership 600,000 /
PR Value USD 150,000
http://www.fsnews.co.kr/news/articleListAD.html

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- Additional media coverage is being monitored, and will be picked up and reported.
- Summarized English back-translation of articles will be provided.
- More photos will be sent with invoices.

- The End -

2014 Korean/Japan Baking Seminar Survey Result

American Pistachio Growers & California Dried Plum Board

Busan Seminar on April 15, 2014
Seoul Seminar on April 18, 2014
Tokyo 1 Seminar on April 22, 2014
Tokyo 2 Seminar on April 23, 2014
Osaka Seminar on April 25, 2014

AMERICAN PISTACHIO GROWERS

PRUNES FROM CALIFORNIA

Attendees

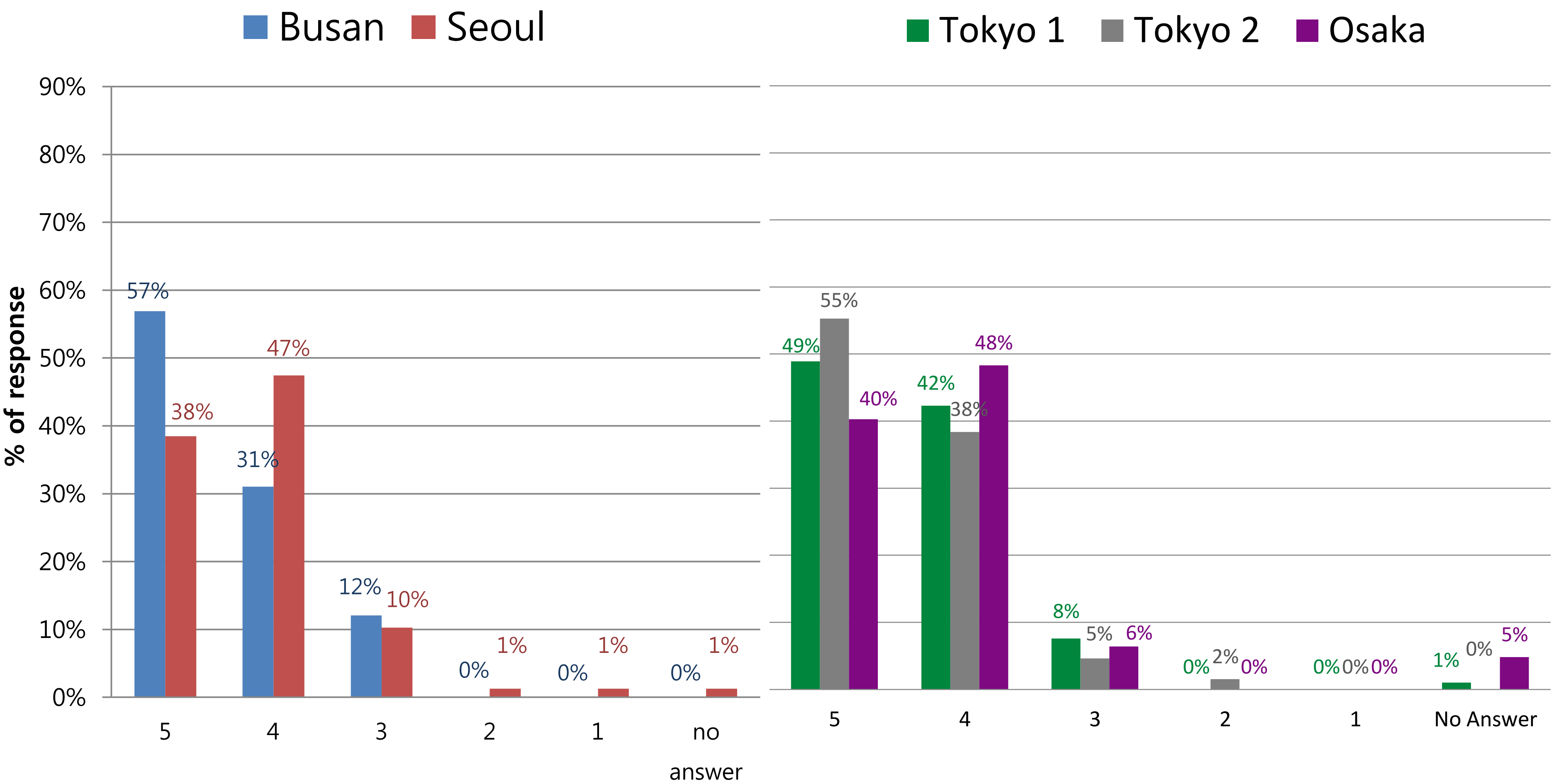
Seminar	Attendees	Surveys
Busan	58	58
Seoul	88	78
Tokyo 1	96	92
Tokyo 2	72	65
Osaka	70	62
Total	**384**	**355**

Survey

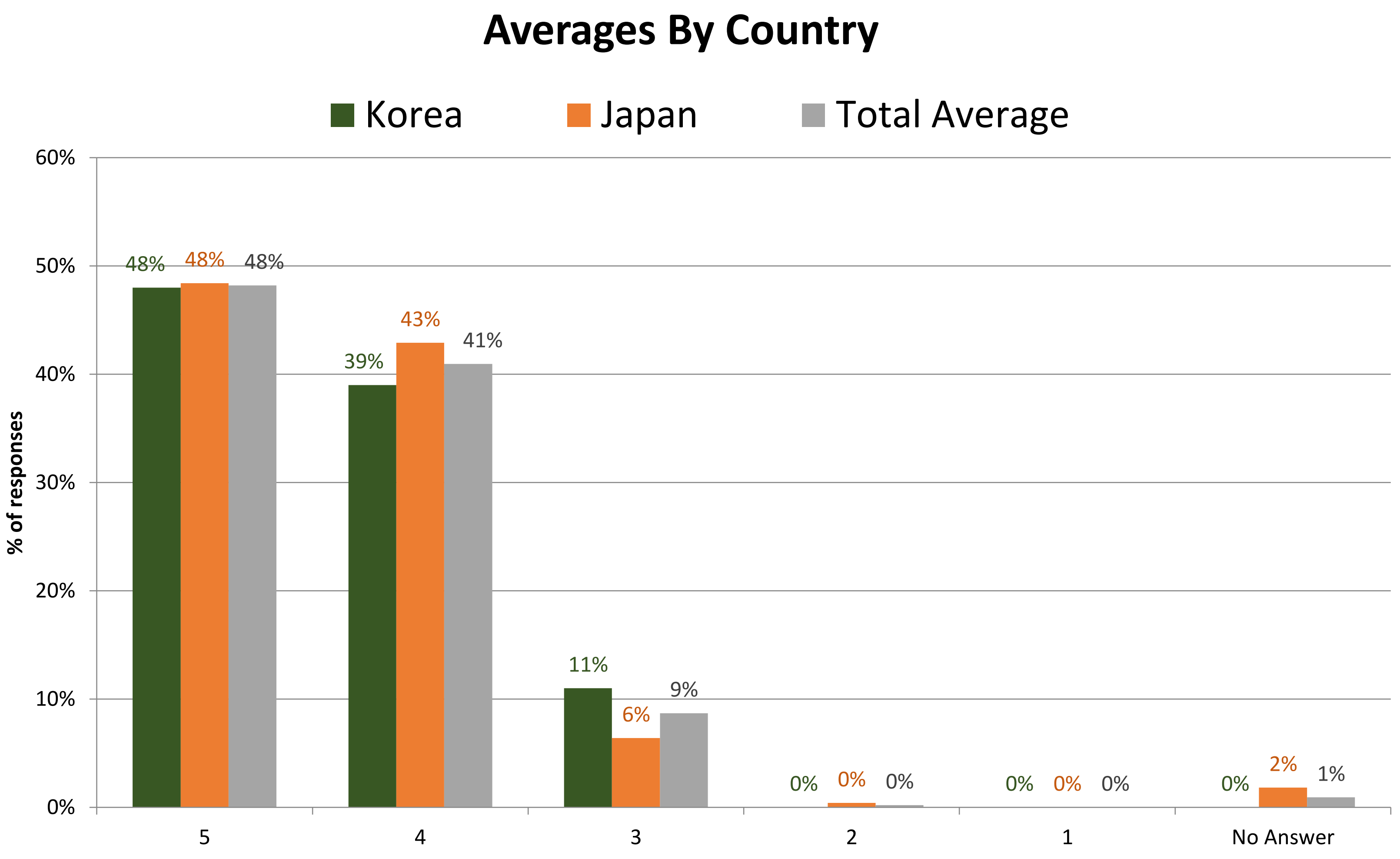
Please help us continue to improve these seminars by answering the questions below.
5 = HIGHEST RATING   1 = LOWEST RATING

1. Please rate your overall experience at this seminar
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
2. Event Facility
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
3. Recipes and Products Produced for this Seminar
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
4. Quality and Expertise of Chef Jorin and Baking Assistants
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
5. Recipe Binder and other Seminar Handouts
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
6. Did you find the recipes new, innovative and interesting to your business?
   5 ○ 4 ○ 3 ○ 2 ○ 1 ○
7. Are you already using California Pistachios or Pistachios in your business?
   Yes ○ No ○
8. As a result of this seminar, will you use or recommend using California Prunes or Pistachios in your business in the future?
   Yes ○ No ○
9. **Additional Comments and/or Suggestions** (use reverse if needed):

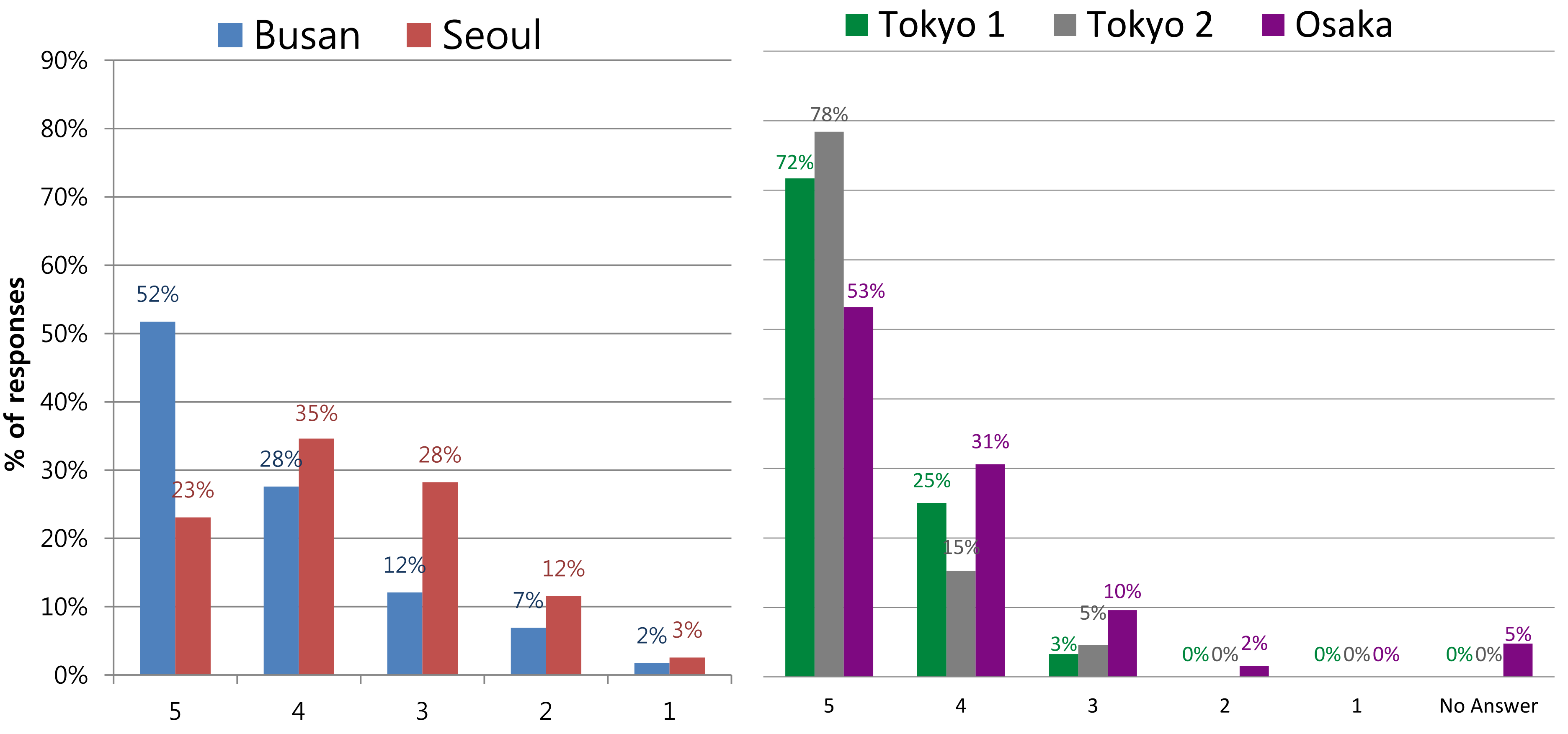
Q1. Overall Experience



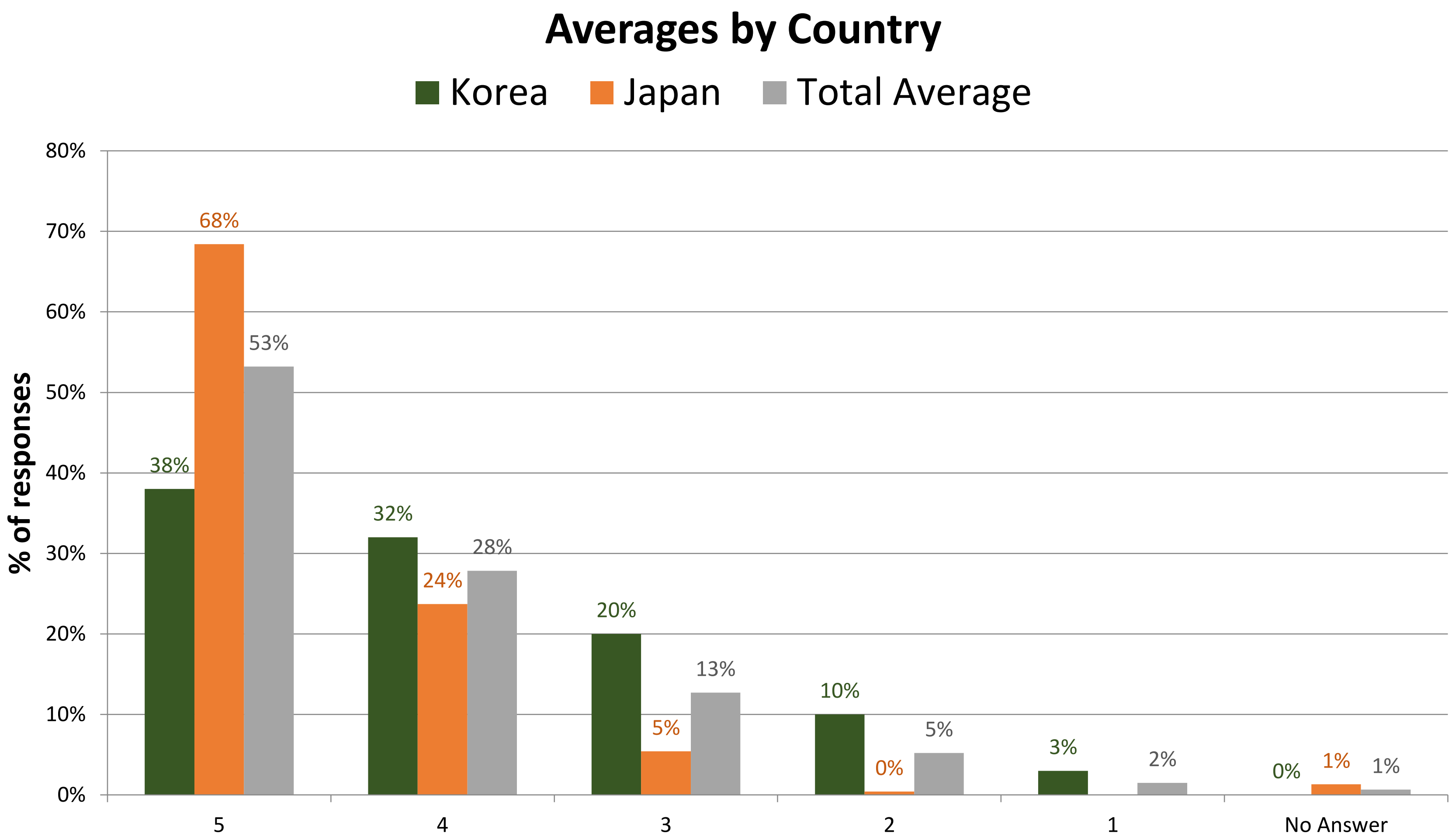
Q1. Overall Experience



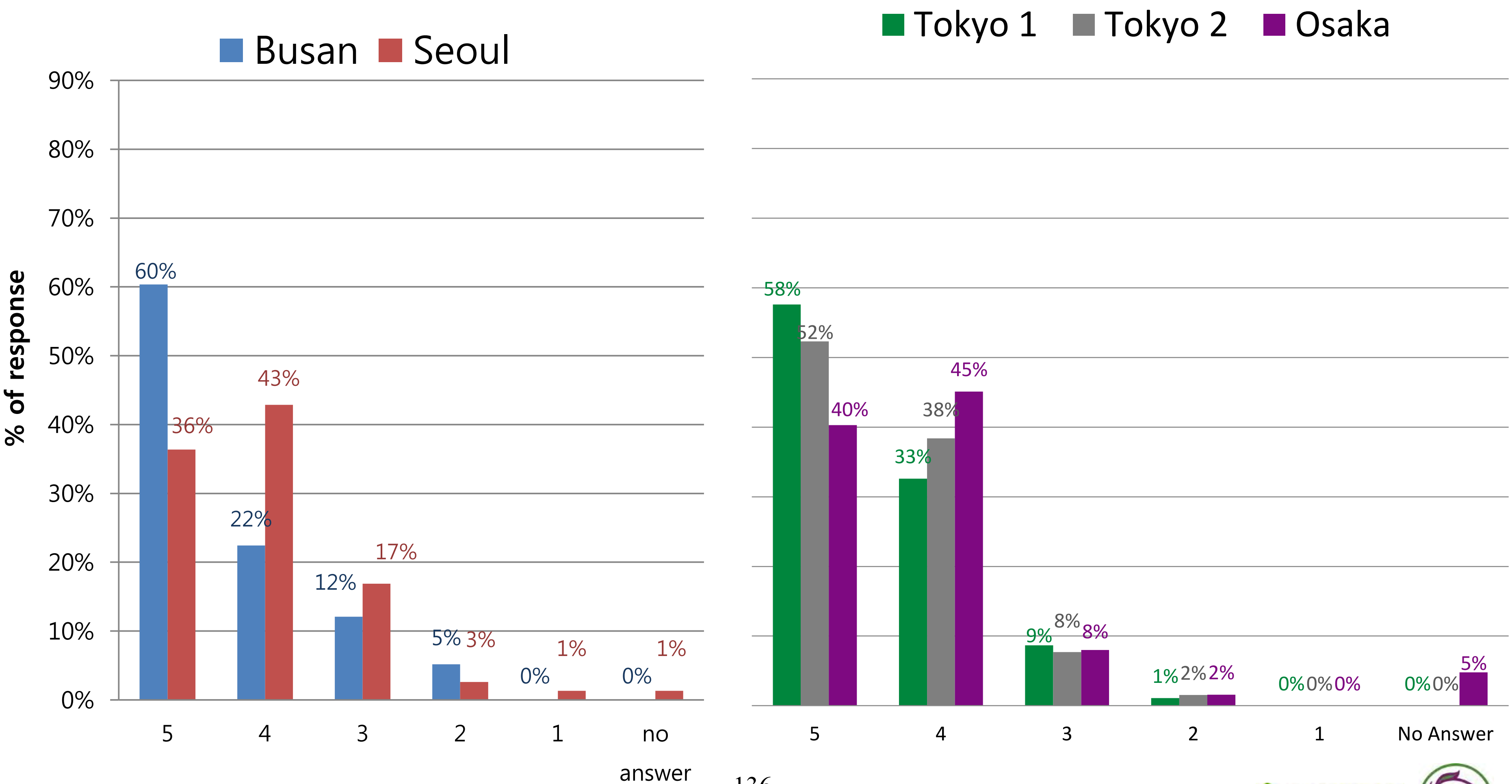
Q2. Event Facility



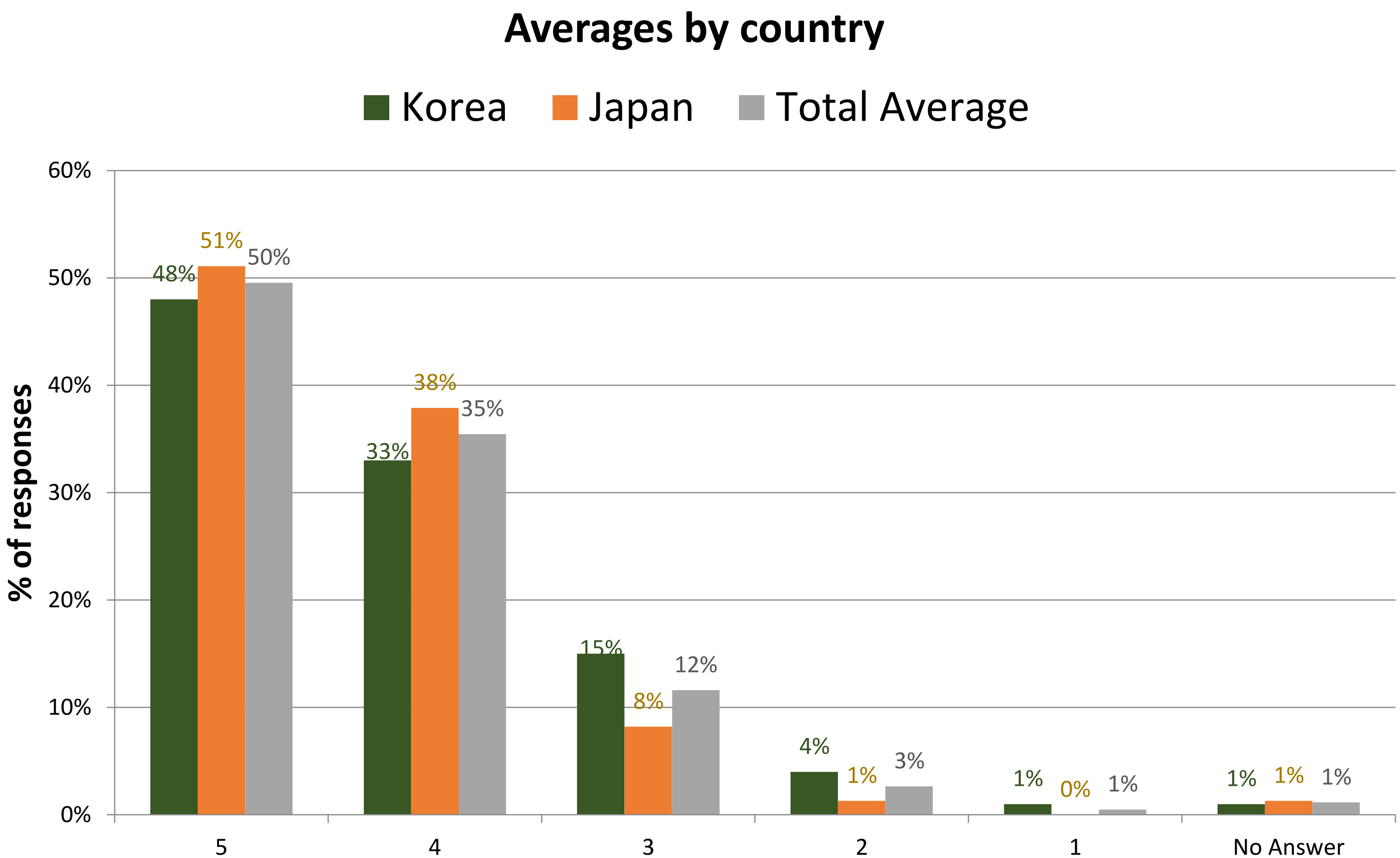
Q2. Event Facility



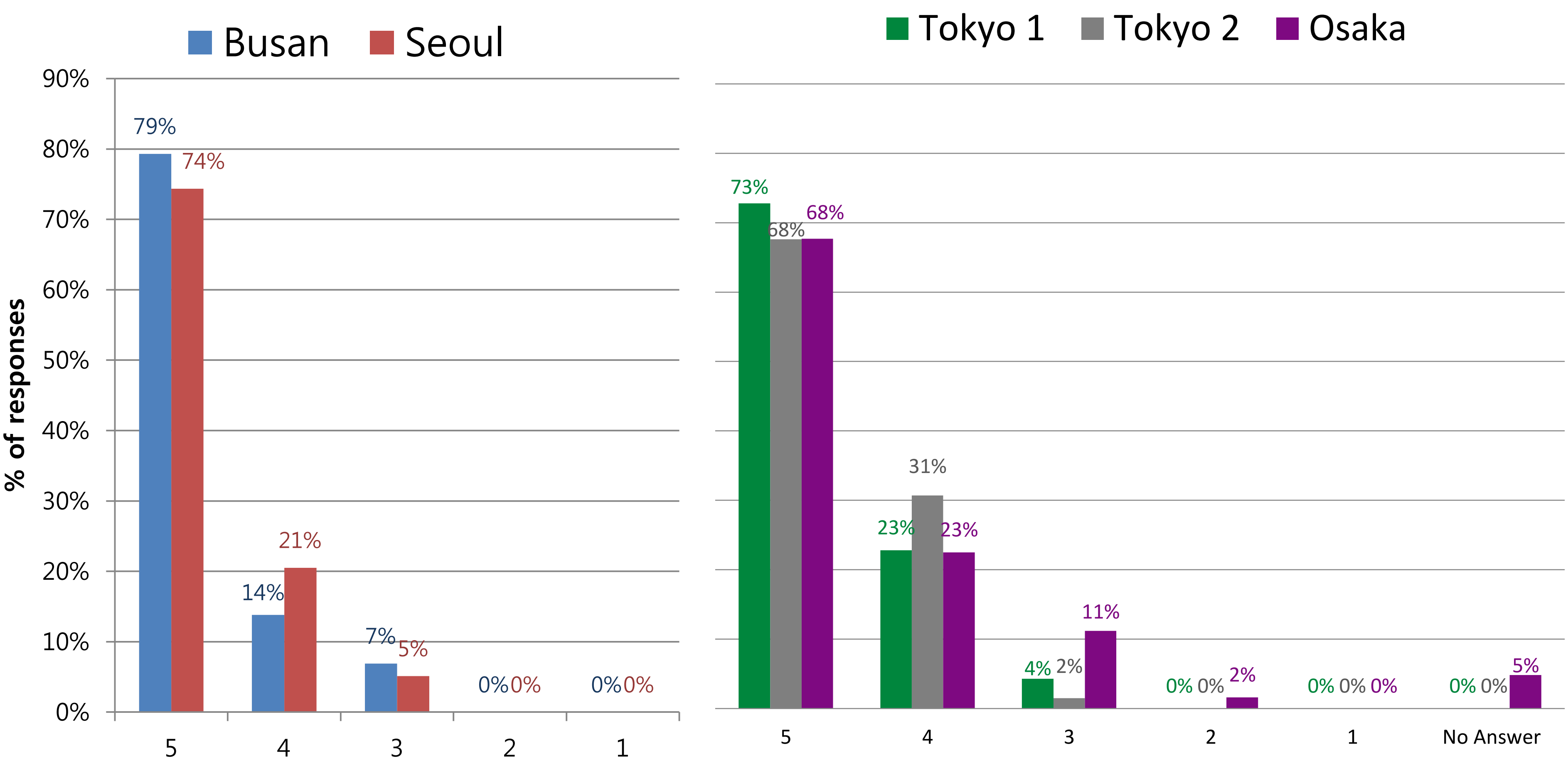
Q3. Recipes and Products



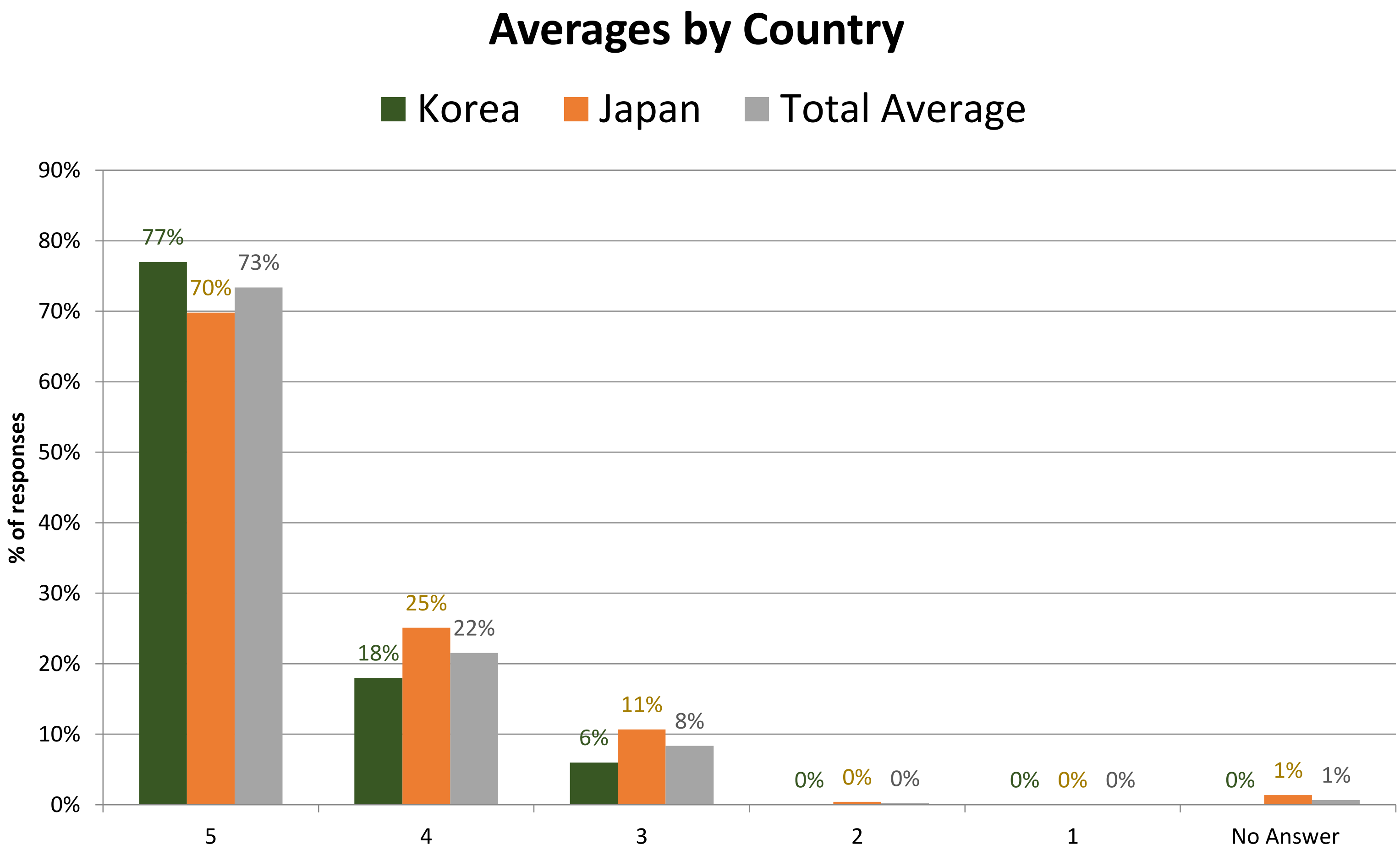
Q3. Recipes and Products



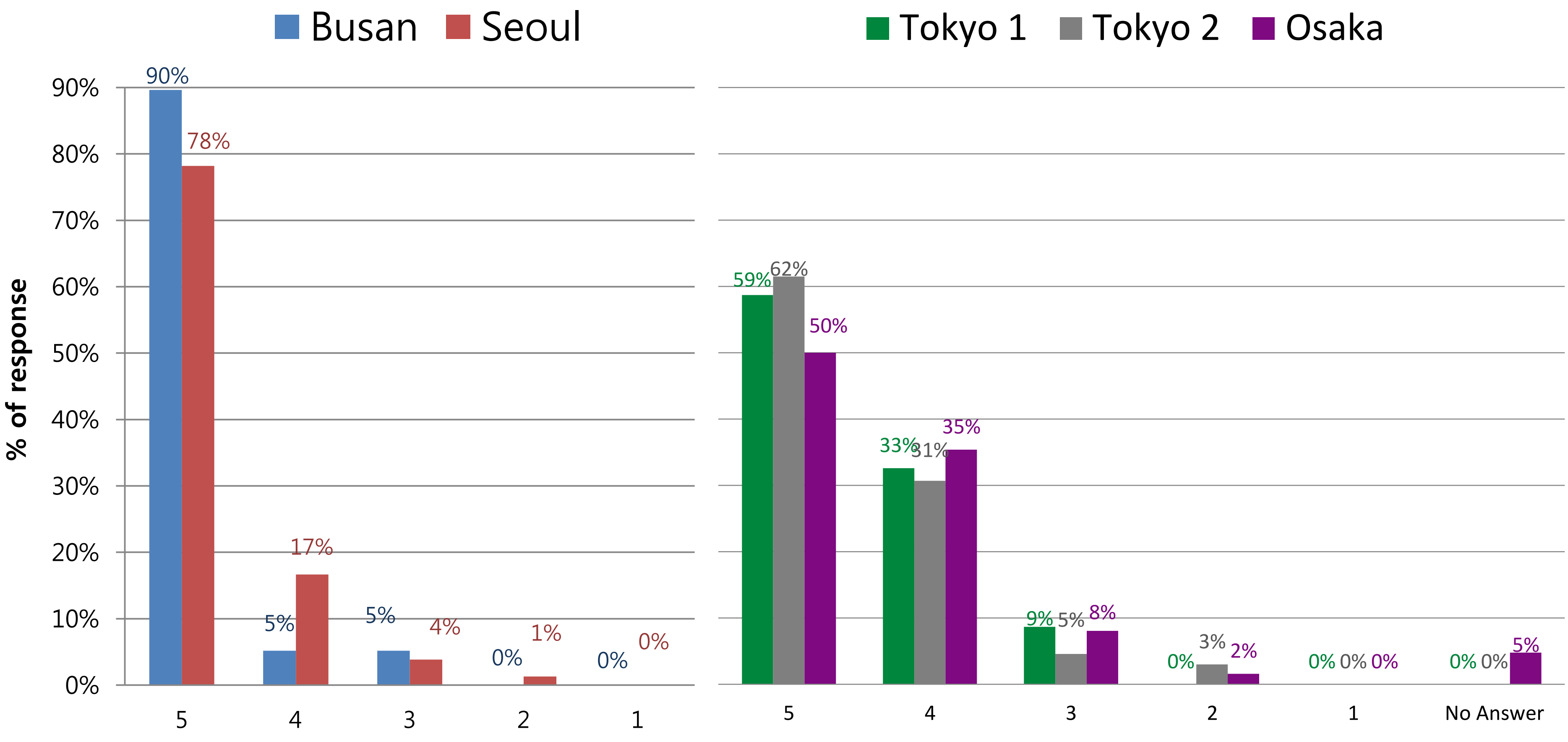
Q4. Quality and Expertise of Chef and Assistants



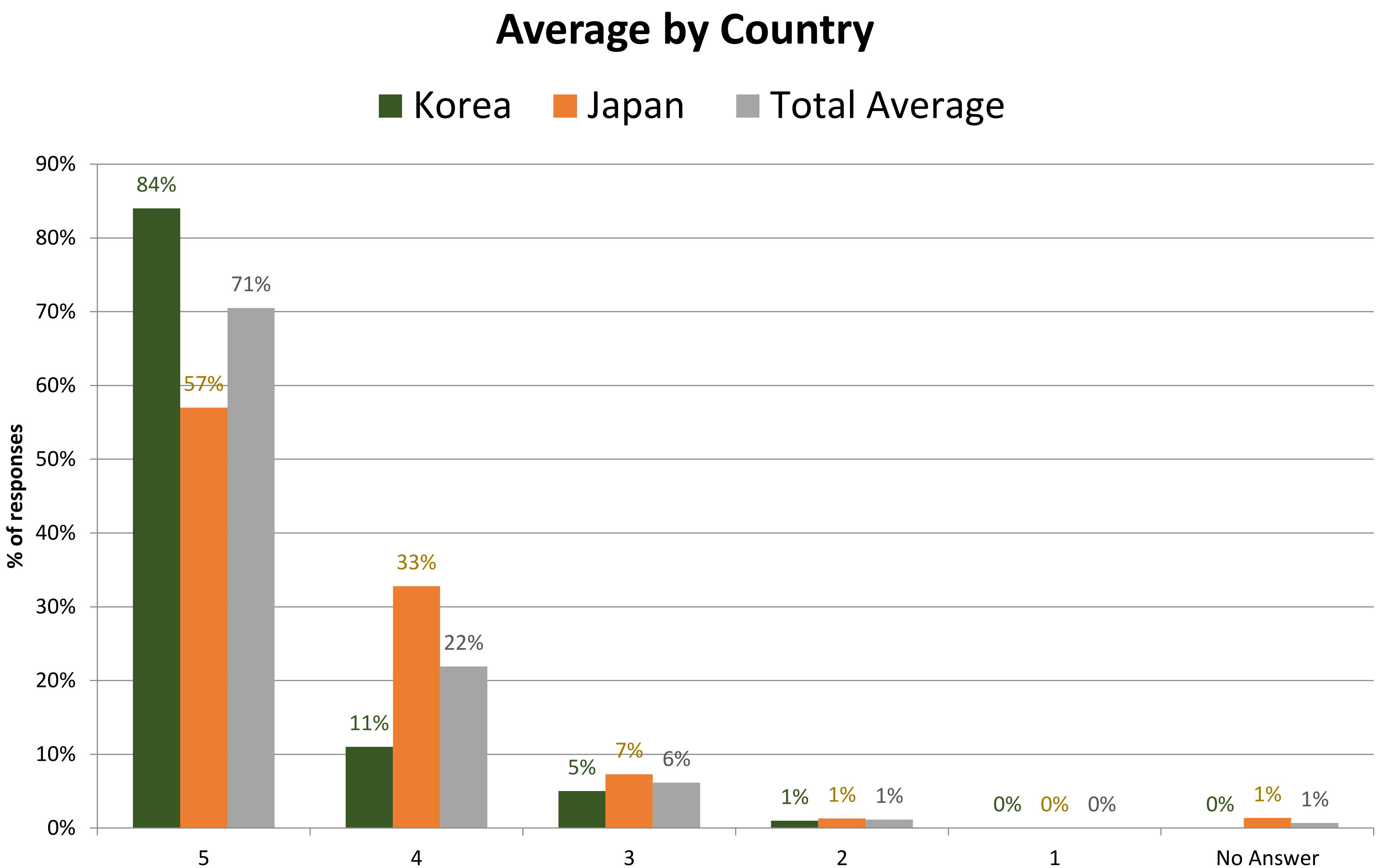
Q4. Quality and Expertise of Chef and Assistants



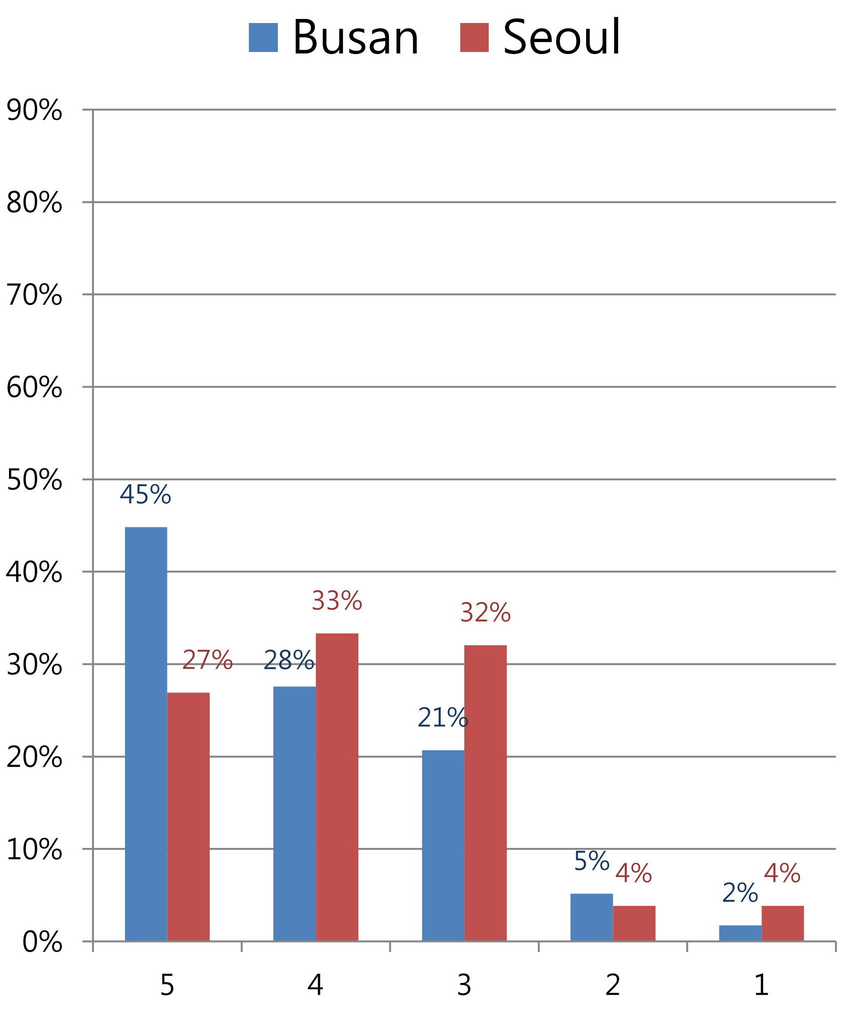
Q5. Recipe Binder and Handouts

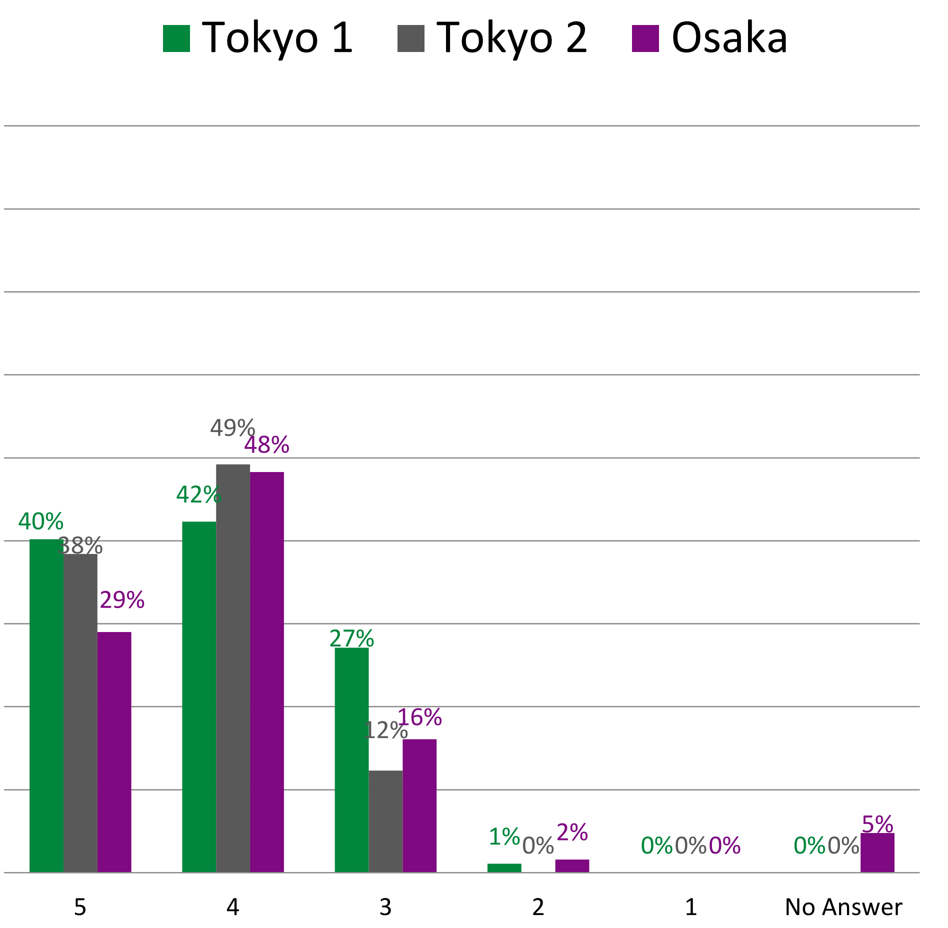


Q5. Recipe Binder and Handouts

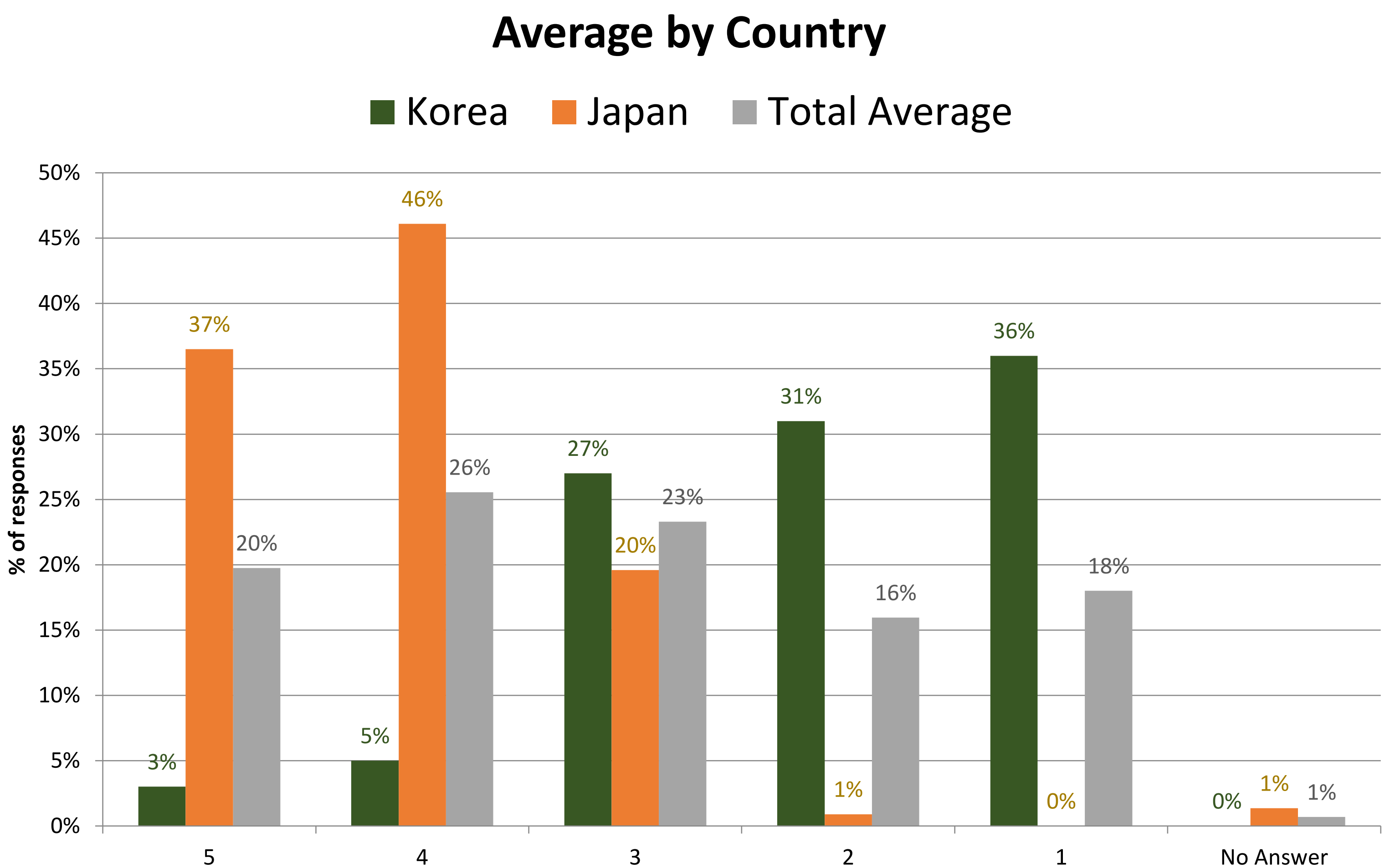


Q6. Recipe Innovativeness

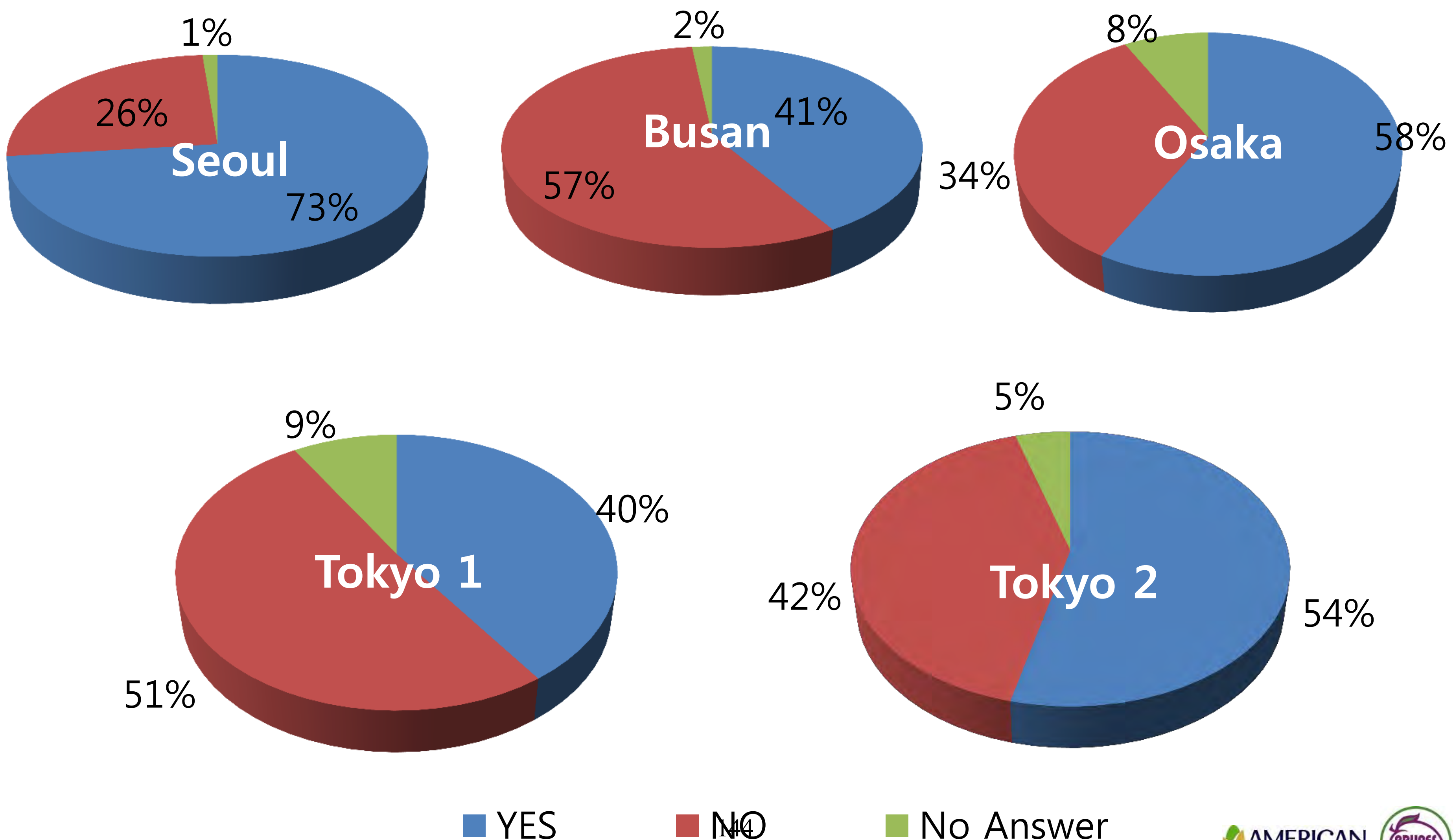




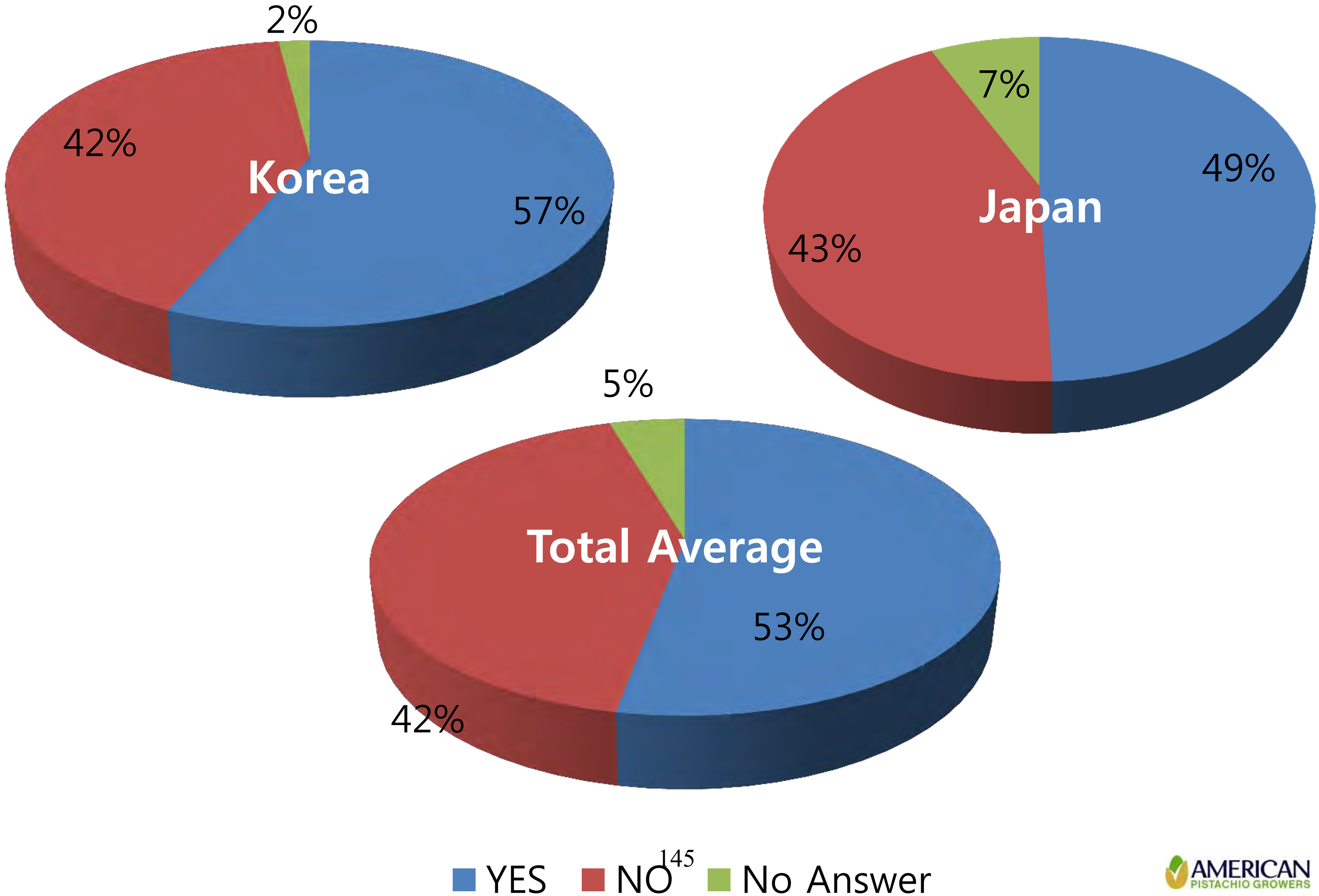
Q6. Recipe Innovativeness



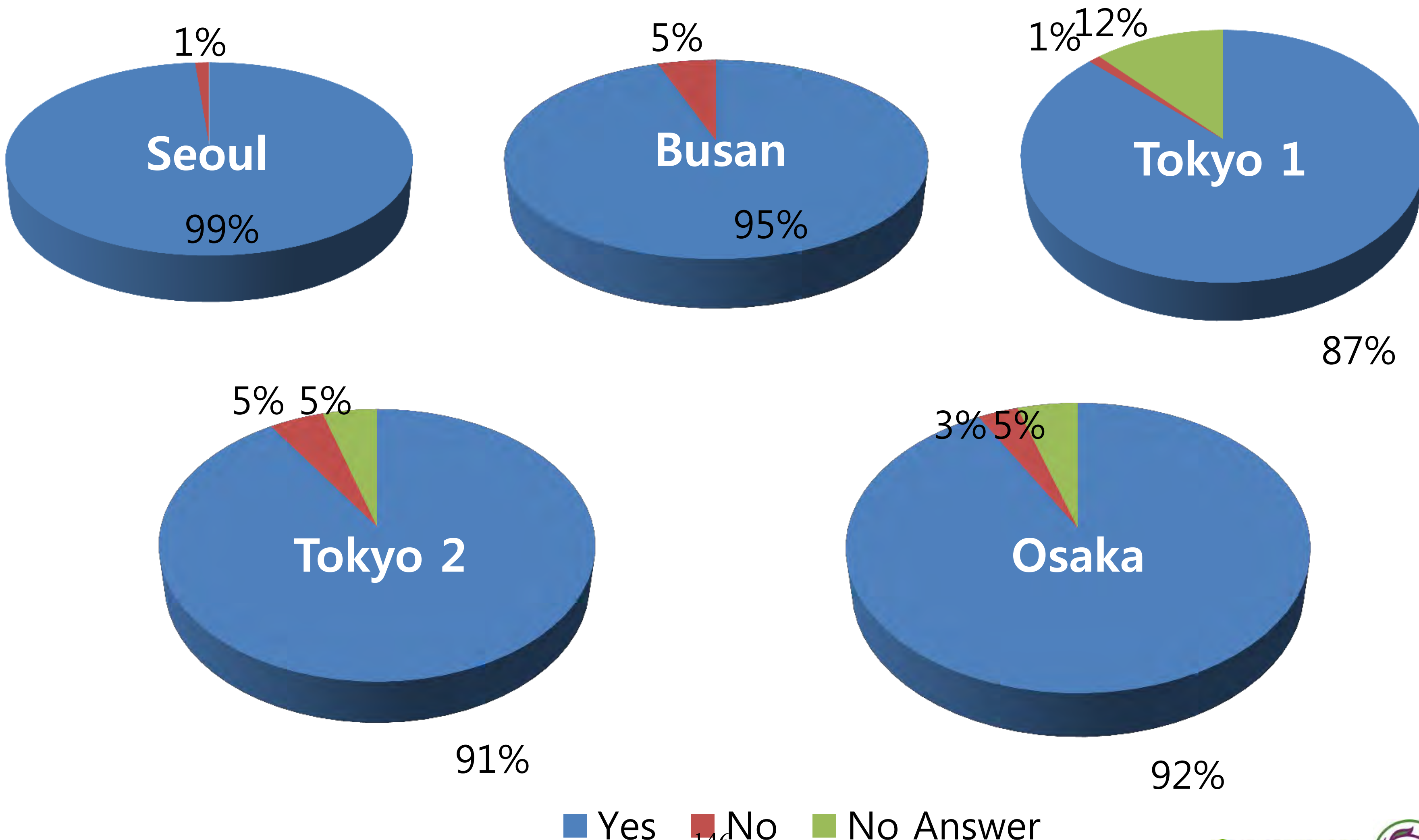
Q7. Are you already using CA prunes or pistachios in your business?



Q7. Are you already using CA prunes or pistachios in your business?



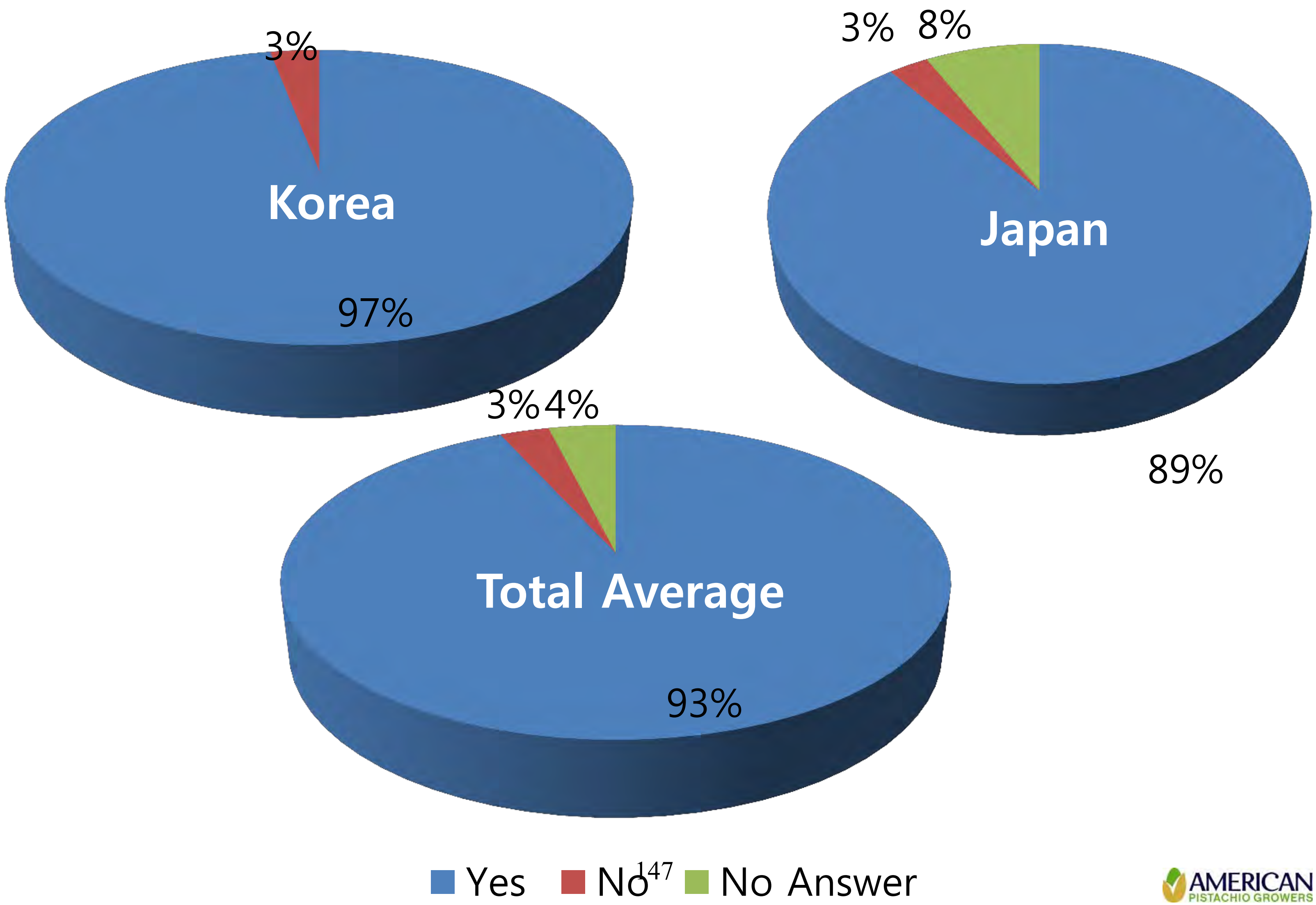
Q8. As a result of this seminar, will you use or recommend using CA prunes or pistachios in your business?



AMERICAN PISTACHIO GROWERS

PRUNES FROM CALIFORNIA

Q8. As a result of this seminar, will you use or recommend using CA prunes or pistachios in your business?



Q9. Busan Seminar

Suggestions:

- Koreans prefer to eat soft bread. Please show such recipes as well.
- The products were very good but some of them are not practically suitable in Busan bakery industry.
- I want to know more details about price and information about the demonstrated products. Also samples of the products would be helpful so that I could test them.
- The recipe of Prune Pithiviers was the most interesting. Pistachio and Prune Newton Bar was good too but prune was not sufficient to taste. Instead, orange was too strong.
- It was a grateful time!
- I would like to know more about details of the demonstrated products: the method of storage & chef's suggestions of beverages going well with the products & appropriate time to eat (as a meal or dessert).

Positive Comments:

- It was a grateful time!

Q9. Seoul Seminar

Suggestions:

- It would be great if you can show us well-being recipe with good ingredients.
- The place was somewhat limited but I hope there is a demonstration seminar that show cooking and baking together.
- The products taste nice over all, but they hardly taste of pistachios. If I could taste pistachio more, it would be better.
- Here is my opinion on tasting the demonstrated products.
  - Pistachio, Camembert and Mushroom Empanada: mealy
  - Pistachio Macaroons with Brandied Cherry Ganache Filling: a little bit hard and over-baked
  - Laminated Pistachio and Ham Brioche: a bit salty but good
  - Prune and Pistachio Frangipane Tart with Pistachio Crust: too sweet for Koreans
- Please show us more various applications of pistachios and prunes.
- I would also like to attend seminar demonstrated by French or Japanese chefs.
- I wanted to see the recipe of cake or sponge cake, and mousse or western-style cookies. Also, ideas of unique design of food should have been included because the bakery industry is competitive in Korea that we need to keep displaying the exclusive design of food. Please inspire us with a bit more unique design next time.

Q9. Seoul Seminar

Suggestions (cont.):

- The venue was limited.
- The demonstration of meal substitution bread using the pistachio or prune would be exciting.
- I could not observe the demonstration very well because of the distance between my seat and the front.
- If pistachios and prunes get cheaper than now I would like to use more. It is likely to be needed more promotions to spread out the usage of prunes and pistachios.
- I would like to see more this kind of seminars.
- I wish I could see the demonstration more closely. If mirror was suspended from the ceiling, I could see well.
- I could not observe well from various angles.
- The ganache in macaroons was too sticky.
- I want more details about the recipe in the binder. Some of them are out of order.
- Although it took a time to set a computer.
- Fried Prune Custard Pouch is unique. Application is exotic but complicated to make.
- It took so long to get prepared at the beginning. The recipes should be more detailed and organized so that people can see the recipe clearly.
- However, if I could see the recipe and the picture together at the same time (for example, the picture on the left side and the recipe on the right side) instead of checking front and back sides, I would have enjoyed the seminar more easily.

Q9. Seoul Seminar

Positive Comments:

- It was very helpful.
- the products and the demonstration were great. I hope you have more seminars.
- Great seminar!
- The seminar was very well-prepared. Thank you.
- I appreciate for the great seminar.
- I was very satisfied with the overall quality of seminar. Thank you.
- I personally think the Laminated Pistachio and Ham Brioche and Pistachio Macaroons with Brandied Cherry Ganache Filling were the best
- The overall seminar was excellent.
- I want to give 120 out of 100 points to Pistachio and Ham Brioche. It was beyond perfect. Pistachios also go well with cheese and ham! Prune, Rosemary and Balsamic Scone is easy to make. I loved the rosemary scent.
- I did not like pistachios and prunes before but the products were very good. It was much better than I expected.
- I like the recipe binder very much. The baked products taste so good! It was interesting to see the recipes using unfamiliar ingredients. Thank you.

Q9. Tokyo 1 Seminar

Suggestions:

- As an overall experience, it was very long and I wanted to know the time table. I like to get m ore details about pistachios and prunes on paper. It was difficult to watch the screen from the back seat. Demonstrations could be much shorter, especially for people who attended de spite their busy schedule. I needed to have more thorough explanations and less demonstrati on items.
- They (pistachios) need to be popularized in Japan and priced more reasonably (Nuts in Jap an is too expensive)
- It did not exceed my expectations, even though I was very interested in American culture.
- I felt that there were too few bread recipes were too little. It would have been good if there were recipes for baguette, pain de Campagne or sweetened buns using pistachio and prune .
- Shorter seminar would be much better.

Neutral Comments/Questions:

- How would you keep the price and quantity after passing the trace positive list?
- I was just wondering if I also could use the fantastic facilities.
- Do you support schools and families?“
- How would you keep the price and quantity after passing the trace positive list?

Q9. Tokyo 1 Seminar

Positive Comments:

- Having a break with the Nespresso coffee tasting was great. I would like to create a menu usin g prune puree with greater functionality.
- I would like to use the recipe for Macrobiotic specification. Thank you.
- The combination of the ingredients was very interesting. I would like to use the idea in my produ ct development in the near future. Thank you
- The seminar was very interesting. Thank you very much.
- The Seminar was wonderful. I learned much from it.
- It was a wonderful seminar.
- It was good that I attended and I learned much from the seminar. Thank you very much.
- "I personally eat pistachio every day and really like it. I would like to promote pistachios and p runes to schools and families like this seminar.
- I learned very much from the seminar.
- "Pistachio has high nutritional value even amongst the nut category and is good for diabetes an d heart disease. I understood the quality and safety attributed toward Californian pistachios. Thank you very much."
- Chef`s demonstration was very easy to understand. I learned much from his recipes which we hardly to find it in Japan. Thank you very much.
- I would like to participate in Prune contest next time. It would be great to send me a sampl e of pistachio and prune.

Q9. Tokyo 1 Seminar

Positive Comments (cont.):

- I would like to use the pistachio powder which I have never used before and I also would like to pa rticipate in the prune contest.
- All items were delicious. My own store has not been built up yet but I would like to use this recip e at our own store.
- I learned much from the seminar. I would like to do my best for new product development on this o ccasion.
- "It is a new idea for me to use prunes and pistachios which are not familiar in Japan. I hope the b oth pistachios and prunes become more familiar products in the near future. They are still consider ed as very expensive products in Japan."
- I learned much from the interesting demonstration that I have never experienced before. And the B read was tasty.
- I learned much from the seminar that is pretty much focused on pistachios and prunes.
- The combination of ingredients which I never thought of was very interesting and tasty.
- It was great that I learned the recipes to best use with pistachios and prunes in such a short time in the seminar. I am willing to attend next time too.
- Interpreter was intelligible.
- Thank you very much for such a valuable experience.
- It was tastier than I expected. I would like to use it in my menu.
- Bread was tasty and I learned much from the chef`s culinary skill.

Q9. Tokyo 2 Seminar

Suggestions:

- I would like to learn more simple recipes with more variety.
- It would have been good if there were recipes which is simple but sensational.
- It was a shame that smell of perfume from the service staff was too strong. Sorry.
- It would be great if the seminar was held often and regularly.
- It would have been much more interesting if there was a talk about the pastry trend in America.
- I wanted to know more about the combination of other ingredients.
- I wanted to know more about the combination of other ingredients. The seminar should be held on a regular basis and be doing awareness building the understanding of pistachio and prune for food industry.
- It would be great if we could get more information about purchasing the pistachio and prune.

Neutral Comments/Questions:

- Would bad weather cause sharp fluctuations in material price? Is it possible to get stable harvesting?
- I thought it would be fun to bake.

Q9. Tokyo 2 Seminar

Positive Comments:

- I learned much from the seminar.
- I learned much from the seminar. Exhibition was great too. I look forward to attending the semi nar and others next time. Thank you very much.
- I did not know how to use pistachio and prune but I learned new things from the seminar and I would like to develop new recipe using new ideas. If I have a chance next time, I would like t o attended again. Thank you very much. I attended the exhibition holding at Shoei before and I'm impressed with Shoei`s facility every time.
- Wonderful.
- Thank you very much.
- The seminar was very interesting.
- I did not use pistachio so often because I thought pistachio is too expensive and premiu m ingredients to use. It became more familiar products after the seminar. I would like to use pistachio powder in the near future.
- Thank you very much. I learned much from the seminar.
- I really enjoyed the seminar and variety of recipes
- The seminar was very substantial and was very useful. I look forward to the next seminar.
- Thank you so very much. I learned much from the seminar.
- I learned so much from the seminar and thank you very much for suggesting us new idea of u sing pistachio and prune.

Q9. Tokyo 2 Seminar

Positive Comments (cont.):

- It was good that I learned the ingredients which I was interested in. Thank you very much.
- I learned much about pistachio from the seminar. Thank you very much.
- I would like to make the best use of the information and culinary skill for product develo pment from now on. Thank you very much.
- Demonstration that are fusion of Europe and American skills is very influential. I hope to get p istachio and prune for the food industry much easier. Thank you.
- Fantastic!
- I just started working at the Bakery and learned so much from the seminar. I was very surpri sed that there are lots of variety of recipes using pistachios and prune.

Q9. Osaka Seminar

Suggestions:

- I thought it would be easy to understand to standardize the writing method either pound or kg? a nd also emphasis the number.
- There were some pastry recipe in the seminar but I would like to take a standard bakery semin ar next time
- Event entry fee was free, it took too much time (60 minutes) before the demonstration. It should b e 20-30 min for the greetings and others.
- I wanted to see chef was baking more bread.

Neutral Comments/Questions:

- It was very important to know the ingredients we used for pastry are made particularly and safely . How do people use the pistachio and prune at home in California? It was good to get new recipes today but are there any classic recipes that people love from long time ago in America? I am ver y interested in food culture. How does the taste differ depending on production areas?
- It was my first time to attend the pistachio seminar. (I have heard the benefit of Almond and Nuts at the other seminar.) I would like to eat 10 pieces of pistachio but not more than 10 pieces (it'd be t oo much).

Q9. Osaka Seminar

Positive Comments:

- I enjoyed the seminar very much.
- Demonstration was great and easy to understand. Thank you very much and looking forwa rd to the next seminar.
- I tasted the pistachio powder for the first time. It tastes like Kinako and very good. I would like t o try bread recipes. Newton bar was outstanding.
- Thank you!!!!
- I learned so much from the seminar.
- I would love to attend the seminar next time if it focuses on the bakery.
- Thank you very much for the recipe book. I will make the best use of this experience for the futur e.
- The seminar, ingredients and method were very useful. And Presentation of pistachio was very easy to understand and good reference information.
- New recipe were very interesting and useful.
- The seminar was very useful.
- Very interesting and easy to understand. Thank you very much.
- The seminar was very useful. Thank you very much.
- Keep holding these kind of seminar for professional baker for future too.
- Thank you very much.
- I will make the best use of this experience bakery and pastry.
- I will participate in the contest and do my best to be able to go to CIA! I was very glad to see K anako san after 14 years.

-The End-

2014 Baking Recipe Contest Summary Report

American Pistachio Growers & California Prune Board

Sohn's Market Makers

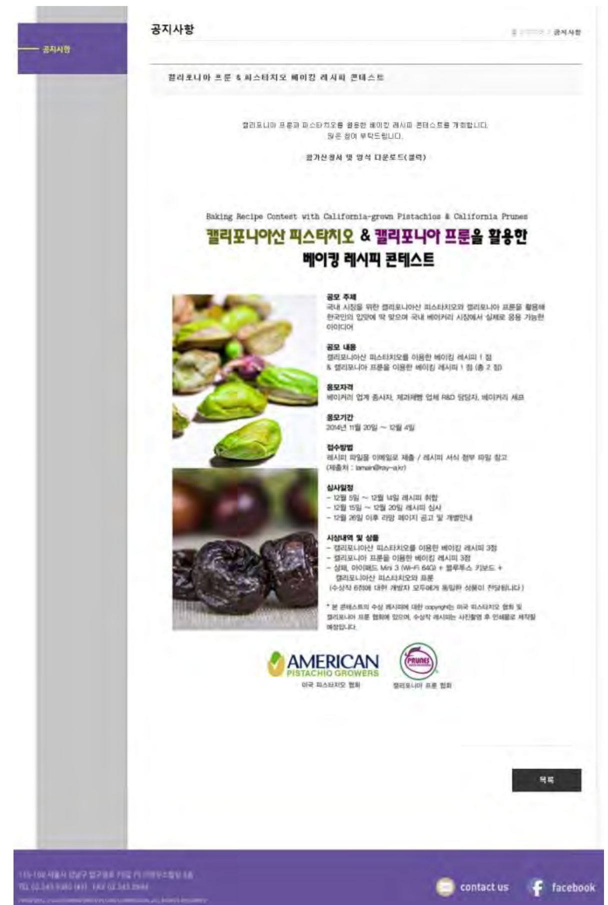
Time-line

Activity	Date
Recruitment	November 20th – December 17th, 2014
Judging & Screening	December 18th – 20th, 2014
Translating & Revising the winning recipes	December 22th, 2014 – January 6th, 2015
Photo Shooting & Retouching	January 7th – 9th, 2015
Production of New Recipe Sheets	January 12th – 23rd, 2015
Preparing & Sending the Printed New Recipes / Prize	January 26th – 30th, 2015

Recruitment

November 20th – December 17th, 2014

- Recruited through facebook, email, telephone and CPB Korean website
- Total 102 entries were collected, including 48 prune and 54 pistachio recipes



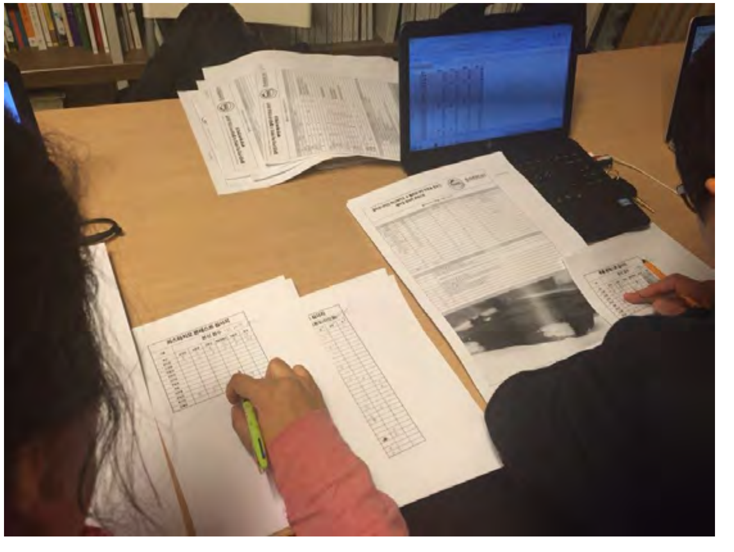
Judging & Screening

- Judged by
  - **Eun-shil Jang**

    Chief editor of food magazine "La main"
  - **Min-cheol Lee**

    Bakery instructor for SPC which is a leading food company operating bakery affiliates such as Paris Croissant, Paris Baguette, Dunkin Donuts and Shany
  - **Hye-jun Kim**

    Author of a famous book on small bakeries and organizer of window bakery



Final List

6 winners, 3 each for pistachios and prunes were chosen under a set of strict criteria including accuracy, marketability and creativity.

Winning Recipes	Winners
Pistachios	
Pistachio Cranberry Bread	Il-gyun Jeong (Owner and chef of “Ciel de France”)
Pistachio Cake with Raspberry Ganache	Sang-jun Lee (Staff of “Dessertree”)
Pista-prune Macaroons	Hye-won Park (Owner and chef of “Maison de ZOE”)
Prunes	
Prune Pound Cake topped with Prune Ganache	Ah-hyeon Shin (Pastry department of Conrad Seoul Hotel)
Finger White Brownie with Prunes	Yoo-seung Ok (Catering cooking student at Woosong University)
Prune Bread with Buckwheat and Whole-wheat	Hoon Jeong (R&D department head of Shilla Bakery)

Winning Recipes (1)

Pistachios Cranberry Bread

Pistachios Cake with Raspberry Ganache

Winning Recipes (2)

Pista-prune Macaroons

Prune Pound Cake topped with Prune Ganache

Winning Recipes (3)

Finger Prune White Brownie

Prune Bread with Buckwheat and Whole-wheat

Announcement of winning recipes

Prize

- Prize for winners

Pistachio & Prune samples, plaque, recipe binder updated with winning recipes, iPad & portable keyboard

Winners with iPad & portable keyboard

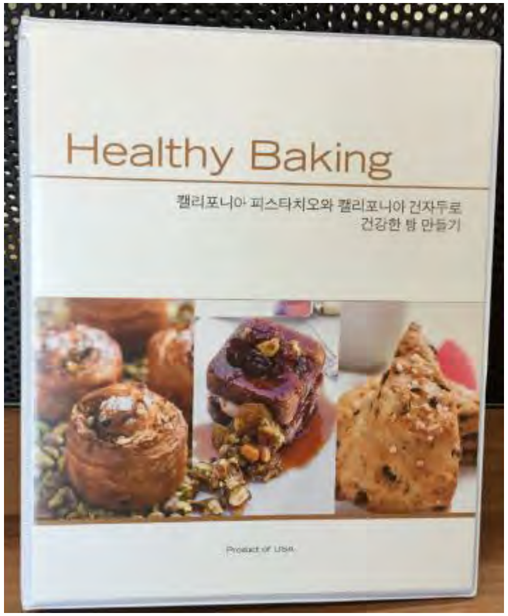
iPad & portable keyboard

Congratulation letter

Plaque

3kg of pistachio in-shell &
5kg of pitted prunes

Updated Recipe Binder



- For seminar participants

The printed new recipes for the recipe binder distributed at 2014 baking seminars were sent out with information letter to the 146 seminar participants by mail after checking the most updated address by phone call.

Media Coverage

As a result of press release about the event distributed by SMM, an article was generated in February issue of “La main”.
Circulation 5,000 / Impression 15,000 / PR Value USD 6,000


AMERICAN
PISTACHIO GROWERS
アメリカ ピスタチオ協会主催
ベーカリーコンテスト
最終審査結果発表 表彰式


AMERICAN
PISTACHIO GROWERS
メリカ ピスタチオ協会主催
ベーカリーコンテスト
終審査結果発表 表彰式


PRINCE PARLOR


P-branch
AMERICAN
PISTACHIO GROWERS
Chef
寿
アメリカ
ピスタチオ協会
American Pistachio Growers
Japan representative
Izumi Amano


AMERICAN
AMERICAN PISTACHIO GROWERS
BAKERY CONTEST
Chef
Kohei Ogata
ROUX


BRASSERIE VIRON
AMERICAN PISTACHIO GROWERS
AMERICAN PISTACHIO GROWERS BAKERY CONTEST
Pistachio Awards 2015
Mr. Kazumasa Yamazaki
貴殿は、アメリカピスタチオ協会主催の
2015年ベイカリーコンテストにご応募いただき、
厳選なる審査の結果 特別賞 を受賞されました。
よって、その栄誉を讃え、本状を送ります。
2015年1月7日
American Pistachio Growers
Japan representative


AMERICAN PISTACHIO GROWERS
AMERICAN PISTACHIO GROWERS
BAKERY CONTEST
Pistachio Awards
2015
Mr Atsushi Kobayashi
コンテストにご応募いただき、
特別賞 を受賞されました。
本状を送ります。
2015年1月7日
American Pistachio Growers
Japan representative
Izumi Amano


スタチオの恵み〜
hio blessing bread
ドール　葉山本店
AMERICAN
PISTACHIO GROWERS
AKERY CONTEST


AMERICAN
PISTACHIO GROWERS
Kohei Ogata


special:
2300

Introducing NEW Sunsweet®

Fruit & Nut Clusters

New Sunsweet Fruit & Nut Clusters are an irresistible and satisfying power snack that is filled with real fruit and premium nuts and seeds.

Try all four flavors in mouthwatering combinations of sweet, salty and savory, including Cherry Plum, Salted Caramel, Smokey BBQ and Spicy Sriracha. Each serving of Fruit & Nut Clusters contains three grams of fiber and three grams of protein to provide wholesome fuel until your next meal. Plus, they're gluten free.

Sunsweet Fruit & Nut Clusters feature dried plums, roasted almonds, cashews, pumpkin seeds, flax seed and puffed brown rice. At 120 calories per serving, this filling treat is a convenient and delicious snack choice.

You can find them in the dried fruit aisle at major retailers nationwide starting in March 2016 at a suggested retail price of $3.99 for a 3oz pouch.

Media Contact: Emma Fox – emma.fox@ketchum.com; 415-984-6176

Cherry Plum

Nutrition Facts
Serving Size 3/4 cup (28g)
Servings Per Container About 3

Amount Per Serving	
Calories 120	Calories from Fat 60
	% Daily Value*
Total Fat 7g	**10**%
Saturated Fat 1g	**5**%
Trans Fat 0g	
Cholesterol 0mg	**0**%
Sodium 70mg	**3**%
Total Carbohydrate 14g	**5**%
Dietary Fiber 3g	**12**%
Sugars 7g	
Protein 3g	
Vitamin A 0%	• Vitamin C 0%
Calcium 0%	• Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: ROASTED CASHEWS, DRIED PLUMS (DRIED PLUMS, VEGETABLE GLYCERINE), ROASTED ALMONDS, ROASTED PUMPKIN SEEDS, CANE SUGAR, BROWN RICE SYRUP, DRIED CHERRIES (CHERRIES, SUGAR), INULIN, CRISP BROWN RICE, NATURAL FLAVOR, SEA SALT, FLAXSEEDS, PUFFED BROWN RICE, RICE FLOUR.
CONTAINS NUTS.

Salted Caramel

Nutrition Facts
Serving Size 3/4 cup (28g)
Servings Per Container About 3

Amount Per Serving	
Calories 120	Calories from Fat 60
	% Daily Value*
Total Fat 7g	**11**%
Saturated Fat 1g	**6**%
Trans Fat 0g	
Cholesterol 0mg	**0**%
Sodium 70mg	**3**%
Total Carbohydrate 14g	**5**%
Dietary Fiber 3g	**12**%
Sugars 7g	
Protein 3g	
Vitamin A 0%	• Vitamin C 0%
Calcium 0%	• Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: DRIED PLUMS (DRIED PLUMS, VEGETABLE GLYCERINE), ROASTED CASHEWS, ROASTED ALMONDS, ROASTED PUMPKIN SEEDS, CANE SUGAR, BROWN RICE SYRUP, INULIN, CRISP BROWN RICE, SEA SALT, FLAXSEEDS, PUFFED BROWN RICE, NATURAL FLAVOR, RICE FLOUR.
CONTAINS NUTS.

Smokey BBQ

Nutrition Facts
Serving Size 3/4 cup (28g)
Servings Per Container About 3

Amount Per Serving	
Calories 120	Calories from Fat 60
	% Daily Value*
Total Fat 7g	**10**%
Saturated Fat 1g	**5**%
Trans Fat 0g	
Cholesterol 0mg	**0**%
Sodium 210mg	**9**%
Total Carbohydrate 14g	**5**%
Dietary Fiber 3g	**12**%
Sugars 7g	
Protein 3g	
Vitamin A 2%	• Vitamin C 0%
Calcium 2%	• Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: DRIED PLUMS (DRIED PLUMS, VEGETABLE GLYCERINE), ROASTED CASHEWS, ROASTED ALMONDS, ROASTED PUMPKIN SEEDS, CANE SUGAR, BROWN RICE SYRUP, BBQ SEASONING (SEA SALT, ONION, SPICES, SUGAR, GARLIC, BROWN SUGAR, RED AND GREEN BELL PEPPER, RICE CONCENTRATE, TOMATO POWDER, PAPRIKA FOR COLOR, NATURAL FLAVORS), INULIN, CRISP BROWN RICE, CHIPOTLE POWDER, SEA SALT, FLAXSEEDS, PUFFED BROWN RICE, RICE FLOUR.
CONTAINS NUTS.

Spicy Sriracha

Nutrition Facts
Serving Size 3/4 cup (28g)
Servings Per Container About 3

Amount Per Serving	
Calories 120	Calories from Fat 60
	% Daily Value*
Total Fat 7g	**10**%
Saturated Fat 1g	**5**%
Trans Fat 0g	
Cholesterol 0mg	**0**%
Sodium 160mg	**7**%
Total Carbohydrate 14g	**5**%
Dietary Fiber 3g	**12**%
Sugars 7g	
Protein 3g	
Vitamin A 0%	• Vitamin C 0%
Calcium 0%	• Iron 4%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat. Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: DRIED PLUMS (DRIED PLUMS, VEGETABLE GLYCERINE), ROASTED CASHEWS, ROASTED ALMONDS, ROASTED PUMPKIN SEEDS, CANE SUGAR, BROWN RICE SYRUP, INULIN, SRIRACHA POWDER (CHILI PEPPERS, VINEGAR, GARLIC, SUGAR, SALT, NATURAL FLAVORS, XANTHAN GUM, MALTODEXTRIN, SILICON DIOXIDE), CRISP BROWN RICE, SEA SALT, FLAXSEEDS, PUFFED BROWN RICE, RICE FLOUR.
CONTAINS NUTS.

SUNSWEET

FOR QUESTIONS OR COMMENTS CALL: 1-800-417-2253, 9AM - 6PM EST, MON - FRI

Snack Your Heart Out

Today, modern eating culture is marked by grabbing as you go. With more than half of the U.S. looking to improve their health, better for you snacks are essential for consumers.

With busy lifestyles and nutrition needs driving the market, snacking culture has changed rapidly over the past few years.[1]

Americans spend **$148 BILLION** on snacks annually[2]

5 in **10** consumers are eating three or more snacks per day[3]

40% of **WOMEN** say they prefer **SWEET SNACKS** while

32% of **MEN** opt for **SALTY SNACKS**[4]

1 in **3** consumers are making healthier snack choices today than in 2014[5]

Key Trends in Snacking Today

6 in **10** consumers who snack say they wish there were more healthy snack options[6]. Consumers crave fresh, less processed snacks[7] that provide sustained energy and, in turn, a healthy, convenient and inspirational snacking experience.

Look out for Sunsweet's latest power snack ...

Dried plums, roasted almonds, cashews, and flax seed are just a few of the ingredients that make up this 120 calorie-per-serving delicious snack choice.

For more information, visit www.sunsweetfruitandnutclusters.com.

SUNSWEET

1 Food and Health Survey, Greenwald Group
2 http://www.foodnavigator-usa.com/R-D/Millennials-drive-snack-growth-reshape-how-Americans-eat-Euromonitor
3 Slide 29, 2014 SNAXPO IRI Webinar
4 http://www.candyindustry.com/articles/86348-86348-snacking-gone-wild-nielsen-looks-at-snacking-trends
5 Ibid.
6 Mintel, Snacking Motivations and Attitudes, U.S., April 2015
7 http://www.hartman-group.com/hartbeat/638/as-snackification-in-food-culture-becomes-more-routine-traditional-mealtimes-get-redefined

Question	Answer Option	Ashland	P(A)	Cherryland	P(C)	Other	P(O)	Total	P(T)
1. How often do you shop for food?	Once a week	2	0.11	3	0.25	7	0.32	12	0.23
	2x per week	6	0.32	5	0.42	11	0.50	22	0.42
	3x per week	6	0.32	3	0.25	3	0.14	12	0.23
	Daily	3	0.16	1	0.08	1	0.05	5	0.09
	Less than Once per week	2	0.11		0.00		0.00	2	0.04
Total		19		12		22		53	
2. When you shop for groceries, including fresh fruits and vegetables, where do you shop? (circle all that apply)	A. Safeway	9	0.17	2	0.13	3	0.12	14	0.15
	B. Home Delivery		0.00		0.00		0.00	0	0.00
	C. Farmer Markets	2	0.04	4	0.25	2	0.08	8	0.09
	D. Pak N Save	8	0.15	1	0.06	1	0.04	10	0.11
	E. Trader Joe's		0.00		0.00	1	0.04	1	0.01
	F. Super Mercado	12	0.23	2	0.13		0.00	14	0.15
	G. Lucky's	16	0.31	5	0.31	17	0.68	38	0.41
	H. Town and Country		0.00		0.00		0.00	0	0.00
	I. Other: food max, $.99	5	0.10	2	0.13	1	0.04	8	0.09
Total		52		16		25		93	
3. Check the reasons you shop at those locations (check all that apply)	Convenient, easy to get to	23	0.29	9	0.28	16	0.25	48	0.27
	Good selection of products	17	0.22	7	0.22	12	0.18	36	0.21
	Clean	5	0.06	1	0.03	10	0.15	16	0.09
	People at the store know me	2	0.03	1	0.03	2	0.03	5	0.03
	Familiar with outlet - I know where things are loc	7	0.09	3	0.09	8	0.12	18	0.10
	always have fresh fruits and vegetable	2	0.03	2	0.06	3	0.05	7	0.04
	Affordable Prices	17	0.22	9	0.28	7	0.11	33	0.19
	Safe Location	4	0.05		0.00	7	0.11	11	0.06
	Plenty of Parking	1	0.01		0.00		0.00	1	0.01
Total		78		32		65		175	
4. List the seven (7) most important food products you would like to see available for purchase in your neighborhood:	1. Meats	24	0.22	4	0.17	7	0.12	35	0.18
	2. Grains	17	0.15	5	0.22	9	0.15	31	0.16
	3. Dairy	20	0.18	6	0.26	13	0.22	39	0.20
	4. Vegetable	24	0.22	4	0.17	15	0.25	43	0.22
	5. Fruit	24	0.22	4	0.17	14	0.23	42	0.22
	6. Snack/Junk Food		0.00		0.00	2	0.03	2	0.01
	7. Pet food/litter	1							
Total		110		23		60		193	
5. I would buy and eat more produce if it was (circle all that apply):	A. Close to home	20	0.53	5	0.38	12	0.48	37	0.49
	B. Safe	3	0.08		0.00	7	0.28	10	0.13
	C. Easy to get to by public transportation	6	0.16	3	0.23	1	0.04	10	0.13
	D. Delivered to me	7	0.18	5	0.38	2	0.08	14	0.18
	E. Other: affordable, single parent,"I like my pro	2	0.05		0.00	3	0.12	5	0.07
Total		38		13		25		76	
6. I would prefer to have fresh produce (fruits and vegetables) delivered to my home than to shop for them.	Yes	23	0.68	8	0.62	7	0.32	38	0.55
	No	5	0.15	4	0.31	6	0.27	15	0.22
	Don't care	6	0.18	1	0.08	9	0.41	16	0.23
Total		34		13		22		69	
6A. If YES to 6 above (you prefer to have fruits and vegetables delivered to your home rather than to shop personally for them) would you prefer:	A. To order on-line	6	0.24	1	0.13	2	0.25	9	0.22
	B. To order by telephone	11	0.44	5	0.63		0.00	16	0.39
	C. Receive whatever produce is in season	6	0.24	1	0.13	3	0.38	10	0.24
	D. Order what you want	2	0.08	1	0.13	3	0.38	6	0.15
Total		25		8		8		41	
7. I would prefer to shop in a store for my produce.	Yes	8	0.24	6	0.50	6	0.29	20	0.30
	No	9	0.26	4	0.33		0.00	13	0.19
	Don't Care	17	0.50	2	0.17	15	0.71	34	0.51
Total		34		12		21		67	
8. Are fresh fruits and vegetables available at the store where you shop?	Yes	31	0.94	12	1.00	20	1.00	63	0.97
	No	2	0.06		0.00		0.00	2	0.03
	Don't Care		0.00		0.00		0.00	0	0.00
Total		33		12		20		65	
9. How important is it to eat fruits and vegetables?	1. Very Important	27	0.82	8	0.67	19	1.06	54	0.84
	2. Somewhat Important	4	0.12	3	0.25		0.00	7	0.11
	3. Not Important	1	0.03	1	0.08		0.00	2	0.03
	4. Don't Know	1	0.03		0.00		0.00	1	0.02
Total		33		12		18		64	
								0	
10. How important is the "freshness" of the produce that I buy?	1. Very Important	26	0.79	9	0.75	16	0.80	51	0.78
	2. Somewhat Important	5	0.15	3	0.25	3	0.15	11	0.17
	3. Not Important	1	0.03		0.00	1	0.05	2	0.03
	4. Don't Know	1	0.03		0.00		0.00	1	0.02
Total		33		12		20		65	
11. How affordable the food that I buy?	1. Very Important	26	0.72	8	0.67	10	0.50	44	0.65
	2. Somewhat Important	7	0.19	3	0.25	8	0.40	18	0.26
	3. Not Important	2	0.06	1	0.08	2	0.10	5	0.07
	4. Don't Know	1	0.03		0.00		0.00	1	0.01
Total		36		12		20		68	
12. How far the market is from my home or workplace	1. Very Important	22	0.61	8	0.62	13	0.65	43	0.62
	2. Somewhat Important	12	0.33	4	0.31	5	0.25	21	0.30
	3. Not Important	1	0.03	1	0.08	2	0.10	4	0.06
	4. Don't Know	1	0.03		0.00		0.00	1	0.01
Total		36		13		20		69	

Date	Number	Units	Crop
6/17/2014	7	#	arugula
6/17/2014	20	bu	cilantro
6/17/2014	20	#	fava
7/1/2014	10	bu	cilantro
7/1/2014	9	#	arugula
7/15/2014	23	head	lettuce
7/15/2014	30	#	squash
7/29/2014	8.5	#	beans
7/29/2014	32	#	squash
7/29/2014	24	head	lettuce
8/5/2014	23	#	beans
8/5/2014	160	#	squash
8/5/2014	5-Jul	#	cherry toms
8/5/2014	22	bu	cilantro
8/5/2014	9	bu	basil
8/12/2014	24	#	beans
8/12/2014	11	#	cucumber
8/12/2014	11	bu	parsley
8/12/2014	11	bu	basil
8/12/2014	24	#	squash
8/26/2014	22	unit	melon
8/26/2014	22	unit	lettuce
8/26/2014	22	#	tomato
8/26/2014	22	#	cucumber
8/26/2014	9	#	squash
8/26/2014	9	#	beans
8/26/2014	11	#	beans
8/26/2014	25	#	cucmber
8/26/2014	11	#	suqash
8/26/2014	25	#	tomatoes
8/26/2014	27	unit	melons
8/26/2014	25	unit	lettuce
10/21/2014	29	head	pac choi
10/21/2014	5	bu	collard
10/21/2014	3	lb	peppers
10/21/2014	6	bu	kale
10/21/2014	10	bu	broccoli raab
10/21/2014	16	bu	basil
10/21/2014	24	unit	lemon
10/21/2014	10	bu	carrot
10/21/2014	5	bu	red beets
10/21/2014	5	bu	chiogga beets
10/21/2014	10	bu	purple top turnip
10/21/2014	15	bu	white (hakurei) turnip
10/21/2014	5	lb	arugula
10/21/2014	6	bu	parsley
10/21/2014	20	head	lettuce
10/28/2014	23	bu	cilantro
10/28/2014	7	lb	arugula
10/28/2014	10	bu	purple top turnip
10/28/2014	22	bu	hakurei turnip

10/28/2014	23	head	lettuce
10/28/2014	10	head	green choi
10/28/2014	7	bu	kale
10/28/2014	10	bu	collards
10/28/2014	23	head	tat soi
11/4/2014	17	head	tatsoi
11/4/2014	10	bu	collard
11/4/2014	10	bu	kale
11/4/2014	5	head	pac choi
11/4/2014	26	head	lettuce
11/4/2014	6	lb	beets, loose
11/4/2014	6	bu	beets
11/4/2014	6	lb	arugula
11/4/2014	15	bu	turnip
11/4/2014	6	bu	carrot
11/6/2014	10	#	salad mix
11/6/2014	5	#	spincach
11/6/2014	3	#	arugula
11/11/2014	10	bu	Broccoli Raab
11/11/2014	18	bu	Kale, bunches
11/11/2014	28		Tat Soi
11/11/2014	7	lb	Spicy Salad Mix
11/11/2014	15	bu	Carrots, bunches
11/11/2014	5	bu	Hakeuri Turnips
11/11/2014	15	lb	Purpe Turnips
11/11/2014	15	lb	Loose Beets
11/11/2014	4	head	Lettuce, each
11/11/2014	1	lb	Peppers, lbs
11/11/2014	5	bu	parsley, bunches
11/11/2014	5	lb	Arugula
11/18/2014	9	bu	kale, dino
11/18/2014	12	bu	kale, curley
11/18/2014	15	bu	collard
11/18/2014	15	unit	tat soi
11/18/2014	3	unit	pac choi
11/18/2014	12	head	lettuce
11/18/2014	5	bu	mustard
11/18/2014	5	bu	broccoli raab
11/18/2014	3	bu	chard
11/18/2014	3	bu	kale, red russian
11/18/2014	15	bu	Carrots, bunches
11/18/2014	8	lb/bu	Hakeuri Turnips
11/18/2014	20	unit	lemons
11/18/2014	1	lb	peppers
11/18/2014	18	bu	cilantro
11/18/2014	9	bu	parsley
11/18/2014	3	bags	salad mix
11/18/2014	2	spinach	spinach
11/18/2014	?	bags	arugula
12/2/2014	10	bu	Mustards
12/2/2014	10	bu	Parsley

12/2/2014	1	#	Spinach
12/2/2014	17	bu	Carrots
12/2/2014	6	#	Hakurei
12/2/2014	3	#	Arugula
12/2/2014	23	bu	Kale
12/2/2014	7	head	Lettuce
12/2/2014	0.5	#	Peppers
12/2/2014	14	bu	Collards
12/9/2014	14	#	Arugula
12/9/2014	22	unit	Lemon
12/9/2014	20	bu	Carrot
12/9/2014	14	bu	Collards
12/9/2014	20	bu	Kale
12/9/2014	6	bu	Parsley
12/9/2014	6	bu	Chard
12/9/2014	6	bu	Mustard
12/9/2014	6	bu	Radish
12/9/2014	21	head	Lettuce
12/9/2014	5.7	#	Spinach
12/9/2014	3	#	salad mix
12/16/2014	26	bu	kale
12/16/2014	1.5	#	arugula
12/16/2014	5	unit	fennel
12/16/2014	6	bu	mustard
12/16/2014	12	bu	collards
12/16/2014	2.9	#	spinach
12/16/2014	3	#	salad mix
12/16/2014	16	bu	carrot
12/16/2014	7	head	lettuce
12/16/2014	6	bu	radish
12/16/2014	0.25	#	peppers
12/16/2014	3	#	Broccoli
12/19/2014	30	bu	kale
12/19/2014	30	bu	carrots
12/23/2014	14	bu	collards
12/23/2014	6	bu	mustard
12/23/2014	22	bu	kale
12/23/2014	24	bu	chard
12/23/2014	24	bu	radish
12/23/2014	24	bu	carrot
12/23/2014	10	unit	lemon
12/23/2014	9	bu	parsley
12/23/2014	13	unit	fennel
12/29/2014	18	unit	fennel
12/29/2014	18	bu	carrots
12/29/2014	20	bu	kale
12/29/2014	20	bu	chard
12/29/2014	5	bu	mustard
12/29/2014	20	bu	radish
12/29/2014	12	unit	lemon
12/29/2014	6	bu	parsley
12/29/2014	14	bu	collard

1/1/2015	10	bu	kale
1/1/2015	10	bu	carrots
1/1/2015	7	bu	collards
1/1/2015	10	bu	Radish
1/1/2015	10	unit	fennel
1/6/2015	26	bu	chard
1/6/2015	31	bu	carrots
1/6/2015	21	bu	collards
1/6/2015	26	unit	fennel
1/6/2015	26	bu	kale
1/6/2015	6	bu	mustard
1/6/2015	6	bu	parsley
1/6/2015	16	bu	Radish
1/6/2015	21	bu	cilantro
1/13/2015	31	bu	kale
1/13/2015	20	bu	radish
1/13/2015	10	bu	collard
1/13/2015	31	bu	carrot
1/13/2015	7	unit	cabbage
1/13/2015	25	unit	lettuce
1/13/2015	10	bu	leek
1/13/2015	12	unit	lemon
1/13/2015	15	unit	fennel
1/13/2015	6	bu	cilantro
1/13/2015	5	bu	turnip
1/20/2015	30	bu	kale
1/20/2015	30	unit	lettuce
1/20/2015	12	bu	radish
1/20/2015	7	bu	collards
1/20/2015	30	bu	carrots
1/20/2015	10	bu	mustard
1/20/2015	5	bu	cilantro
1/20/2015	5	bu	parsley
1/20/2015	25	unit	lemons
1/20/2015	3	unit	fennel
1/20/2015	5	bu	turnip
1/27/2015	30	bu	carrots
1/27/2015	30	bu	kale
1/27/2015	30	unit	lettuce
1/27/2015	38	unit	lemons
1/27/2015	4	bu	mustard
1/27/2015	6	bu	collard
1/27/2015	4	bu	radish
1/27/2015	3	#	broccoli
1/27/2015	4	bu	parsley
1/27/2015	6	bu	leeks
2/2/2015	23	bu	carrots
2/2/2015	27	bu	kale
2/2/2015	25	unit	lettuce
2/2/2015	25	unit	lemons

2/2/2015	3	bu	mustard
2/2/2015	5	bu	collard
2/2/2015	5	bu	leek
2/5/2015	12	bu	carrot
2/10/2015	26	bu	carrot
2/10/2015	25	bu	kale
2/10/2015	27	unit	lettuce
2/10/2015	34	unit	lemon
2/10/2015	3	bu	mustard
2/10/2015	7	bu	collard
2/10/2015	7	bu	leeks
2/10/2015	1	unit	cabbage
2/10/2015	36	#	beets
2/10/2015	8	bu	cilantro
2/23/2015	19	bu	carrots
2/23/2015	19	bu	kale
2/23/2015	19	unit	lettuce
2/23/2015	8	bu	collards
2/23/2015	8	bu	chard
3/2/2015	30	bu	carrots
3/2/2015	30	bu	kale
3/2/2015	30	head	lettuce
3/2/2015	10	bu	collard
3/2/2015	3	bu	chard
3/2/2015	20	unit	lemon
3/9/2015	33	bu	carrot
3/9/2015	33	bu	kale
3/9/2015	27	head	lettuce
3/9/2015	14	bu	collard
3/9/2015	4	bu	chard
3/9/2015	30	unit	lemon
3/9/2015	4	unit	cabbage
3/9/2015	4	bu	cilantro
3/9/2015	8	bu	leek
3/10/2015	8	pint	strawberry
3/3/2015	8	pint	strawberry
3/16/2015	30	bu	carrot
3/16/2015	36	bu	kale
3/16/2015	4	bu	collard
3/16/2015	3	bu	chard
3/16/2015	30	unit	lemon
3/16/2015	6	bu	leek
3/16/2015	5	pint	strawberry
3/23/2015	35	bu	carrots
3/23/2015	30	bu	kale
3/23/2015	3	bu	tree collards
3/23/2015	32 or 46	unit	lemon
3/23/2015	20	bu	radish
3/25/2015	7	pint	strawberry
3/30/2015	20	bu	carrots
3/30/2015	4	bu	tree collards
3/30/2015	42	unit	lemon

3/30/2015	20	bu	radish
3/30/2015	1	#	spinach
3/30/2015	2	bu	chard
4/1/2015	6	pint	strawberry
4/6/2015	10	bu	carrots
4/6/2015	20	unit	lemon
4/6/2015	19	bu	radish
4/6/2015	30	bags	salad mix
4/6/2015	4	bu	chard
4/6/2015	19	bu	herbs
4/6/2015	10	bu	cilantro
4/6/2015	27	bags	kale rosette
4/6/2015	23	bu	kale
4/6/2015	2	bags	apples,dried
4/6/2015	4	pint	strawberry
4/20/2015	28	unit	lemon
4/20/2015	30	bu	radish
4/20/2015	20	bu	herb bunch
4/20/2015	19	bu	cilantro
4/20/2015	16	bu	kale
4/27/2015	30	unit	lemon
4/27/2015	21	bu	radish
4/27/2015	20	bu	herb bunches
4/27/2015	20	bu	cilantro
4/27/2015	7	bu	turnip
4/27/2015	3	#	salad mix
4/27/2015	4	#	lettuce mix
4/27/2015	15	bu	carrots
4/27/2015	2	bu	tree collards
5/4/2015	28	unit	lemons
5/4/2015	30	bu	radish
5/4/2015	20	bu	herb bunch
5/4/2015	48	bu	salad turnip
5/4/2015	15	bu	carrots
5/4/2015	2	bu	tree collards
5/4/2015	20	bu	beets
5/4/2015	20	bu	mint
5/4/2015	10	bu	kale
5/11/2015	20	unit	lemon
5/11/2015	31	bu	watermelon radish
5/11/2015	31	bu	herb bunch
5/11/2015	38	bu	salad turnip
5/11/2015	3	bu	carrot
5/11/2015	5	bu	mustard greens
5/11/2015	35	bu	beets
5/11/2015	20	bu	mint
5/11/2015	45	bu	kale
5/18/2015	25	unit	lemon
5/18/2015	6	bu	watermelon radish
5/18/2015	19	bu	herb bunches
5/18/2015	23	bu	salad turnip
5/18/2015	3	bu	carrots

5/18/2015	19	bu	mustard greens
5/18/2015	10	bu	beets
5/18/2015	19	bu	mint
5/18/2015	29	bu	kale
5/18/2015	7	bu	collards
5/18/2015	2	bu	chard
5/26/2015	36	unit	lemon
5/26/2015	10	bu	water radish
5/26/2015	20	bu	herb bunch
5/26/2015	37	bu	salad turniip
5/26/2015	10	bu	carrot
5/26/2015	20	bu	mustard greens
5/26/2015	20	bu	mint
5/26/2015	40	bu	kale
5/26/2015	4	bu	collards
5/26/2015	5	bu	chard
5/26/2015	20	bu	cilantro
5/26/2015	27	head	lettuce

Protected Harvest Certification Manual

2015 California Cut Flower Commission's BloomCheck® Certification Program

CERTIFIED
BloomCheck
California Standards for
Sustainable Flower Farming

2091 Park Avenue, Suite A2
Soquel CA 95073
Ph/fax: 831.477.7797
www.protectedharvest.org

Table of Contents

Introduction

Welcome to the 2015 certification season of the BloomCheck® certification program. Protected Harvest looks forward to working with the BloomCheck® program its inaugural year. Protected Harvest welcomes all of you joining the program. This manual is meant to explain how the process of certification goes.

Protected Harvest

Protected Harvest is an independent nonprofit organization with a board of leading environmental NGOs, scientists, and practitioners that approve sustainability standards, while accredited certification firms conduct annual audits and issue certification. Protected Harvest provides growers, shippers, processors, retailers and food service companies with development of sustainability certification standards and certification services for use in eco-labeling of products. More information about the program can be found on the website www.protectedharvest.org.

Contacting Protected Harvest:

To discuss routine procedural matters such as your application, payment, or how to log onto the online self-assessment website, contact:

Jane Vandine
Protected Harvest
2901 Park Ave, Suite A2
Soquel, CA 95073
e: jvandine@protectedharvest.org
ph: 831.477.7797
fax: 831.477.7790

For questions related to standards, technical questions, or more advanced procedural questions, contact:

Dr. Clifford Ohmart
Protected Harvest
1528 Olympic Dr.
Davis, CA 95616
e: cohmart@sureharvest.com
ph: 530.758.6967
fax: 831.477.7790

BloomCheck®

The BloomCheck® program is California's first sustainable cut flower production standards developed specifically for California flower farmers. They have been peer reviewed by scientists, academics and environmentalists and are being implemented on a state-wide basis.

The BloomCheck® farming practice standards were developed by the California Cut Flower Commission and SureHarvest, are based on the Self-Assessment for the Sustainable Production of Cut Flowers Workbook, and are designed to lead to measurable improvements in the environmental health of the surrounding ecosystem, society-at-large, and flower quality. Participating growers have their flower production blocks certified as producing sustainably-grown cut flowers.

The BloomCheck® Program has two components: sustainable cut flower-growing practice standards and a Pesticide Active Ingredient Do Not Use List.

To qualify for certification a flower production block has to achieve a minimum number of sustainable farming practices points based on The BloomCheck® program practice standards, and not have had applied to them during the last calendar year pesticides containing any of the active ingredients listed in the BloomCheck® Do Not Use List in Appendix C. The Protected Harvest auditing process ensures compliance and chain of custody with The BloomCheck®.

SureHarvest

SureHarvest is a company providing sustainability solutions for agriculture and food companies. SureHarvest provides administration and certification software systems to Protected Harvest. For those who are interested, SureHarvest also provides farm management software systems for subscribers to use to improve farm efficiency and document practices for certification programs. For more information, visit www.sureharvest.com or contact:

SureHarvest
2901 Park Ave., Suite A2
Soquel CA 95073
ph: 831.477.7797
e: jvandine@sureharvest.com

The Third-party Certifier

To avoid conflict of interest between the flower farmers, Protected Harvest, and SureHarvest, a third-party auditing and certification firm is utilized in the certification process. The firm is qualified to do sustainable agriculture auditing of farm records, perform site visits, and issue a "certification decision" based on applicants' compliance with the BloomCheck® standards and policies. For the past several years, the auditing has been done by FJS Consulting of Davis, CA, a firm licensed and experienced in USDA Organic and ISO inspections as well as possessing a high level of agricultural science expertise. Since 2008, this firm has made the certification decision as well.

The application, fees, online self-assessment process, and general administration of the Protected Harvest program are handled by SureHarvest staff. However, all review of records, scheduling and conducting site visits, and certification decisions are handled by FJS Consulting. Contact:

Chip Sundstrom
FJS Consulting
2744 Del Rio Place, Suite 200
Davis, CA 95618
ph: 530-304-1158
e: fjsundstrom@sbcglobal.net

The Protected Harvest Certification Process

The certification process spans the growing season and requires that you be familiar with several aspects of the program early on. The process follows. Please read through the whole process to ensure familiarity before applying.

The Standards

The Protected Harvest process begins with the BloomCheck® farming practice standards. You must read and fully understand these standards before you apply for certification, since the farming practices used throughout the year must be consistent with these in order to gain certification. A copy of the standards is available as a PDF or as a binder by request from the California Cut Flower Commission or Protected Harvest.

The standards, by Protected Harvest and California Cut Flower Commission policies, were developed in a collaborative manner with input from flower farmers, agriculture scientists, and environmental specialists, then peer reviewed by academic experts. A final review and approval was done by the Protected Harvest Board of Directors, a body of national agriculture and environmental experts. They contain approximately 200 best management practices and techniques in the areas of Production Management, Pest Management, Water Management, Energy Management, Postharvest Management, Habitat Management, Materials Handling and Social Responsibility.

The standards come in form of a Yes/No question, where a "Yes- My current practice" response is awarded a specified number of points. Farmers answering with a "No" response, which can come in several forms, receive no points. For management plan practices, a grower is required to have a management plan that must contain specific components relevant to the issue being addressed (e.g. Practice Question #18 below from on-line Production Management module). **It is critical that these plans be developed as early as possible once you have decided to apply for the program. In some cases, specific workshops or resources are available from California Cut Flower Commission related to these plans.**

Contact SureHarvest for more information before applying:

Dr. Clifford Ohmart
SureHarvest
e: cohmart@sureharvest.com
ph: 530.758.6967
fax: 831.477.7790

Practice Question #18 from Production Management – FARM module:

18	A production management plan for the flower farm has been developed and documented, and includes production goals, and elements such as crop nutrition, substrate management, erosion management, and crop residue management	◯ Yes ◯ No
	If No, click 'No' and skip #19. You have completed this module	

PLEASE NOTE: To achieve certification for a production block, you must implement enough of the practices from *each* module such that their scores add up to at least at least 70% of all points across all modules combined. A transition certification designation is available for production blocks achieving more than 50% of the practices points but less than 70%.

In the BloomCheck® Companion Document, each practice standard is accompanied by a description of what is required for the auditor to see in order to verify that the practice was done in the production block being certified.

BloomCheck® Pesticide Active Ingredient Do Not Use List

For the 2014 and 2015 flower growing seasons, the Protected Harvest Board of Directors approved for use by the BloomCheck® program the Pesticide Active Ingredient Do Not Use list developed for the Whole Foods Market Responsibly Grown Program. The list of active ingredients and some of the trade names of pesticides containing them and used on cut flowers in California appear in Appendix C.

Geographic limitation of the standards

Every Protected Harvest standard is limited in geographic scope to reflect the best management practices appropriate to the ecosystem for which the standard was developed. In the case of the BloomCheck®, the geographic region is the state of California.

Application

Once you have familiarized yourself with the farming practice standards and the BloomCheck® Pesticide Active Ingredient Do Not Use List, an application needs to be completed. The application requests information about the production blocks you wish to certify, general information about your operation, and contact information. This information will be utilized by the auditor in preparation for the audit. The application also allows you to calculate your fees.

For efficiency, the application form is provided in electronic format and it is preferred that you return it via e-mail to [email address at CCFC]. Application forms for 2015 are available from California Cut Flower Commission.

While the application may be returned electronically, payment must be received before an application is considered complete. Invoices are emailed to the applicant upon request.

Record Keeping

Documentation is critical to the process of third-party certification. During the auditing process, you will be asked to provide evidence of implementation of the practices you reported implementing in the self-assessment (see "self-assessment" below). Protected Harvest and its contracted certification firms do not provide exact specifications of the documentation required for most practices, in order to provide flexibility for growers to do what is practical for their operation. (In the case of some management plans and practices, certain items must appear in the documentation provided.) However, guidance for the type of documentation is provided in the BloomCheck® Companion Document to assist you in preparing for certification. This is an ongoing process. **Please familiarize yourself with the documentation before you apply.** In some cases, you will also have to work with your crop consultant or PCA to generate the documentation, so making sure they are "on board" is important as well.

Electronic tools for documentation are available, especially in the area of pesticide records. There are commercially available software packages to manage farming operations. For example, SureHarvest sells a comprehensive software package for efficient farm management that was designed with certification programs in mind – www.sureharvest.com. Other electronic tools from various companies are available and all may be used to provide documentation as long as the auditor is confident that the correct information is shown.

For some practices and especially technologies, paper or electronic records may not be necessary if it is visible to the auditor during a visit. Photographs (digital or on paper) may be utilized as well at the auditor's discretion.

If you have a question about the process of documenting practices, Cliff Ohmart at SureHarvest can assist you. Please take advantage of this resource, since failure to document is a common barrier to achieving certification. Additionally, many farmers have found that when they begin to document items for the first time they gain information which allows them to better manage their farms profitably.

Pesticide records will always be requested by the certification firm, to verify compliance with the BloomCheck® Pesticide Active Ingredient Do Not Use List. If the final pesticide application has not been made at the time of the audit, the records must be provided after this final application has been made. If you require a certificate to sell your product prior to this application, you may request that Protected Harvest issue you a "conditional certificate." You will have to comply with all other certification requirements to receive the conditional certification, as well as provide a record of all pesticide applications up to the time of the audit. The conditional certificate is contingent on submission of final pesticide records demonstrating compliance.

Fees

Application fees are based on a Tiered structure and paid to CCFC. Please contact California Cut Flower Commission for details.

Self-Assessment

After submitting your application and fee payment, you need to assess the BloomCheck® practices being done in each production block using the on-line self-assessment tool found at www.sustainableflowers.com. This online tool will contain a profile of your production blocks you have entered into the system and as you described them on your application. For each production block, the online tool allows you to select every practice in the standards that corresponds to that production block, generate a report of your scores for each chapter. The system includes a timesaving cloning tool for copying answers from production block to production block and from year to year. If you do not have a username and password for using the on-line self-assessment system you can click on the 'Get a Username' sign-up icon on the landing page of www.sustainableflowers.com.

Instructions for use of the tool will be provided with your user name and password, and an online webinar on how to use the tool can be arranged for flower farmers new to the program. Additional support is available when you need it by contacting Jane at SureHarvest 831-477-7797.

The self-assessment is the method by which you communicate to the auditor which of the practices you have implemented in each of your production blocks. These are then spot checked by the auditor during the certification process. A deadline for completing the self-assessment will be given when you return your application

Confidentiality

Protected Harvest and its contracted auditors agree that information collected during the certification process is to be considered confidential and proprietary to the applicant and 1) shall hold the same in confidence, 2) shall not use the individual grower information other than for the purposes of its certification business, and 3) shall disclose it only to its officers, directors, or employees with a specific need to know. SureHarvest will not disclose, publish or otherwise reveal any of the individual grower information received during certification to any other party whatsoever, except with the specific prior written authorization of the applicant.

Inspection

Once your application and payment is received, a copy will be sent to the certification firm who will be verifying your compliance with the standards. You will be contacted to schedule your audit and be told whether the audit is on site or "off site" (a records audit).

During your first year of certification, you will get an actual visit from an inspector who will spot check the production blocks and selected practices based on the information you provided in your self-assessment. In subsequent years, you will get an actual visit only once during any three year period. The year will be selected by the auditor and you will be informed only after your application and payment are received. In the years you do not receive an "on site" visit, you will be asked to provide 3 or 4 types of paper or electronic documentation via e-mail, fax, or postal mail to the auditor. The auditor will inform you which documents are needed and the specific production blocks they are to represent (unless they are relevant to the whole farm), and the date they are due. Pesticide records will be amongst the items requested; the others are at the discretion of the inspector.

You will not be informed in advance of the visit which production blocks or practices have been selected for on site auditing. The person who is responsible for implementing the program on your farm must be present during this visit (and for success, must be involved in the self-assessment and application processes as well). Failure to be at the agreed-upon location at the agreed-upon time will result in additional fees. Additionally, if a second visit is required due to a lack of sufficient documentation at the time of the first visit, further fees will be required. See Appendix A for the schedule of additional fees.

Additionally, each year approximately 10% of participating growers will receive a "surprise" audit visit. No more than 24 hours notice need be given for this visit by the inspector, and are assigned independently of whether the farm received an off or on-site audit for the year.

To maintain the integrity of the program, during the auditing process the inspector may request additional documentation or on site verification if the initial spot reveals discrepancies to the inspector or otherwise indicates that the farm may not be in compliance.

All inspectors must meet a minimum qualification level and disclose that there is no conflict of interest with the applicant. Inspectors are required to sign a confidentiality agreement annually to protect confidential information disclosed during the evaluation.

If you feel that the inspector assigned by the certification agency has a conflict of interest or any other issue that would prevent you from receiving an adequate evaluation, contact the Protected Harvest program for assistance. A different inspector will be obtained if necessary.

Please respond promptly to communication from the auditor. Extra time spent by the auditor on any one inspection takes away from the ability of Protected Harvest to keep costs low for everyone. Specifically, if the auditor does not receive response after 3 attempts it will be assumed the applicant is no longer interested in certification and his/her production blocks will be failed without refund of fees. If the applicant resumes communication and does wish to continue with certification, additional fees will be charged due to the additional auditor time required.

Inspector Qualifications

All inspectors hired by the certification firm must have one of the following credentials:

- Bachelor's degree in Agricultural Science and 2 years agricultural inspection experience
- A minimum of 5 years agricultural inspection experience
- Successful completion of training in the Protected Harvest program approved by Protected Harvest

Certification

Upon notification from the certification agency, Protected Harvest will issue certificates to all flower farmers who have achieved certification. Certificates will be issued in electronic form only. The certificate is valid for the crop produced during the season for which it was issued only.

Failure to Achieve Certification

If an applicant has failed to comply with the certification standards, pesticide Do Not Use List, or documentation requirements, he/she will be sent a letter from the certification firm informing of this status and the primary cause for the failure. The decision to grant certification is based solely on the applicant's compliance with the standard.

Suspension

Once certified, you are obliged to remain in compliance by maintaining the operational practices shown during the evaluation. If at any time Protected Harvest discovers that you have changed your procedures in such a way that you no longer can achieve a compliant score, your certification may be suspended. During suspension, you are not allowed to represent product as certified.

If the operation returns to a level of compliance, the certification may be reinstated. If no corrections are made before the end of the certificate term, the certification expires.

Revocation

If it is determined that a certified entity is not operating in manner as depicted during the certification evaluation, the certification may be revoked.

If the certification agency determines that an applicant, their consultant(s), or employee(s) willfully provide untrue information during the inspection and certification evaluation, this is grounds for revocation from the program and loss of eligibility for certification for three years.

If the operation is found to be fraudulent and not in compliance with the terms of the Grower Affidavit found in the application form, possible civil action may be taken.

Appeals and Disputes

If an applicant feels that a certification decision was made without adequate information or based on erroneous data, they are permitted to appeal the decision. The appeal must be filed with the certification agency within 30 days of the decision and must include:

- The person submitting the appeal must be identified by name. No anonymous appeals will be accepted. The name of the organization or company, address, phone number, and name and title of person submitting the appeal must be included.
- A copy of the certification decision you are appealing.
- Any information and supporting documentation that confirms your claim.
- A summary of your position in 100 words or less.

Once the appeal is received by the certification agency the decision will be re-evaluated. You will be notified of the results of the re-evaluation promptly.

If the decision is upheld and you still feel that your operation is within the compliance of the standard, you may file a dispute with Protected Harvest. The dispute should include all the information previously provided in the appeal. The certification agency will provide a copy of the dispute to SureHarvest professional staff for a recommendation. The Protected Harvest Board will review the recommendation and rule on the issue. You will be notified promptly of the decision of the Board.

Voluntary Withdrawal

At any time during the application process, an applicant may voluntarily opt to withdraw their application. A partial refund may be available to applicants that are withdrawing as follows:

1. Complete withdrawal prior to online self-assessment – full refund of payment
2. Complete withdrawal after self-assessment up to 5 business days prior to scheduled on-site inspection – refund of payment minus $500.
3. Partial withdrawal (individual production block) before or during on-site inspection - 75% of the withdrawing incremental acreage assessment is refundable.
4. Complete or partial withdrawal after on-site inspection - no refund is available.

Complaints Investigation

Any individual with credible information may file a complaint with the Protected Harvest program or the certification agency against a certified operation that is not operating within the requirements of the standard. All complaints must be signed and submitted with a return address. The complaints must clearly describe the area of non-compliance. Any support for the complaint must be provided.

Protected Harvest staff or the certification agency will investigate the compliant thoroughly. The name of the individual making the complaint will remain confidential. The investigation may include an unannounced visit to the operation. A response is sent to the individual making the complaint upon completion of the investigation.

Federal, State and Local Laws

Applicants must meet all legal requirements pertaining to their operation. These may include but are not limited to record keeping, food safety, labor management, employee safety, and nutrient management. Any legal requirement that exceeds the requirements of Protected Harvest supersedes this programs authority.

Flower Handler Certification

All flower farms utilizing the BloomCheck® label and/or other references in the certification program on their bouquets or other marketing materials must adhere to specific policies, including a minimum content of certified flowers.

Use of Certification

Once certification is granted, the certified entity may represent products that are included in the scope of the certification as certified, under the restrictions of the program.

Representation of Certified Products

Participation in the BloomCheck® certification program entitles the producer or manufacturer to make a sustainable/environmental claim about the way in which its products or the ingredients in its products are grown. Both the Protected Harvest program and the producer or manufacturer of the products may make a marketing claim to the consumer of the products or to the retail purchaser of the products. The producer or manufacturer is not authorized to make any claims beyond those that the standards to which the products or the ingredients of products are certified are designed to address.

Use of the BloomCheck® Label

Producers or manufacturers who are certified under the BloomCheck® program may affix the BloomCheck® logo to their products at the distribution or retail level. For guidelines on the use of the BloomCheck® seal, please contact Kasey Cronquist:

Kasey Cronquist
California Cut Flower Commission
(805) 696-500
Kcronquist@ccfc.org

Use of the Protected Harvest Consumer Logo

Producers or manufacturers who are certified under the BloomCheck® program may also affix the Protected Harvest Logo to their products at the distribution or retail level. For guidelines on the use of the Protected Harvest seal, please contact Jane Vandine at Protected Harvest.

Amending the Standards

To submit suggestions for revisions to Protected Harvest Standards, revisions must be in writing (electronic mail is encouraged) and may be submitted electronically, by fax, or by mail to Protected Harvest:

Dr. Clifford Ohmart
Protected Harvest
e: cohmart@protectedharvest.org
ph: 530.601-0740
fax: 831.477.7790

The person submitting proposed revisions must be identified by name. No anonymous proposals will be accepted. If submitted on behalf of an organization or company, the name of the organization or company, address, phone number, number of members, and name and title of person submitting proposed revisions must be included.

- List the standard, section number, question number, and actual text you propose to change.
- Provide the replacement language you would like to propose. New text should be in underline format, and deleted text should be indicated by strike out format.
- Provide a rationale, including the need for and intended effect of your proposed change. Supply any supporting documents or research information, including historical use.
- Include a summary of your position in 100 words or less.

Protected Harvest Process for Consideration of Revisions

It should be noted that there is a difference between a revision and a technical correction. *Revisions* represent substantive changes or additions to the standards that may affect the ability of an operation to comply. These can include additional requirements, changes to the allowance of practices, or any adjustments to the scoring of a certification audit. *Technical corrections* are changes that do not affect the intent of the standard. These include grammar and spelling corrections or terminology adjustments.

Technical corrections can be made by SureHarvest staff at any time to improve the certification documents. As these do not affect the intent of the standard, no notice or phase in period is required.

Revisions require a fully transparent procedure that allows for comment from all stakeholders. It is expected that three distinct facets of industry will provide request for revisions. They are:

- Growers and program participants
- Industry groups and consumers
- Protected Harvest Board and SureHarvest

The procedure will be equivalent no matter who submits the request. The following is a step by step method for revision:

1. Written request for revision submitted to the Protected Harvest program. Requests must be submitted at least 6 months prior to the application month (generally January). Commodities that have year round production will be assigned an application month.
2. Within 30 days, Protected Harvest staff will create a recommendation based on the information in the request. This recommendation will be forwarded to the Protected Harvest Board of Directors.
3. The staff and board will have 30 days to provide comments. Afterwards, comments will be used to create a revised recommendation.
4. The revised recommendation is posted for comment on the Protected Harvest website for 30 days. Simultaneously, the industry group is advised of the recommendation.
5. After the posting, within 30 days the recommendation is revised once again by staff to encompass comments and submitted to oversight board of Protected Harvest for approval.
6. Once approved, the recommendation is posted on the Protected Harvest website as a notice of change. Included is a date of implementation. The date of implementation is the date in which growers will be required to meet the new standard requirement. Prior to the implementation date, SureHarvest must adjust all documentation effected by the change. In the case of extreme changes, the implementation date may be held off until the following season with an exploratory period in the present season. Simultaneously, the current and expected applicants will be alerted to the eminent change.

Appendix A: Additional Fee Schedule

Applications are processed in batches so they can be assigned to an inspector based on geographic locations and size of operation. Late applications, changes to applications, changes to inspection dates, and withdrawal of production blocks cause additional scheduling and work for inspections and staff, and may result in an assessment of additional fees as detailed below.

The following schedule of fees will be billed directly to the grower for additional administrative expenses, if applicable. Your efforts to submit materials on time and provide accurate information will greatly improve the efficiency of the certification process and minimize costs.

- Inspection Cancellation (with less than 48 hours notice): $100
- Absence at scheduled inspection (without notice of cancellation): $200
- Exceptional auditor time required (eg. grower was unprepared or absent at the scheduled inspection or requires additional time after failing to respond to auditor requests for documentation): $100/hour
- Add-on production block at inspection: $50/added production block
- Add-on production block after inspection: $150/added production block, plus acreage fees
- Replacement Certificate: $15
- NSF Check: $30 each

Appendix B: Definitions

Auditor – see "inspector"

Benchmark - a measurable data point or set of points used as a reference to track progress

Bio IPM "Biointensive Integrated Pest Management" - a systems approach to pest management that is based on an understanding of pest ecology. It begins with steps to accurately diagnose the nature and source of pest problems, and then relies on a range of preventative tactics and biological controls to keep pest populations within acceptable limits. Reduced risk pesticides are used if other tactics have not been adequately effective, as a last resort and with care to minimize risks."

Broker - an entity that acts as an agent for others in negotiating a sales contract. A broker may or may not take legal title to the product.

Chain-of-Custody - documentation that links possession of a product from the origin to its final destination. For certification, this is often referred to as the "Audit Trail".

Crop Advisory Committee (CAC) - a committee that consists of 10 people representing producers, scientists, consumers, environmentalists, retailers, and also representatives of the local community. A SureHarvest professional will serve as an ex officio member of the CAC.

Distributor - an entity that receives packed or processed products, and sells or distributes those products to processors, other distributors, or retail stores.

Environmental Impact Units - numerical values assigned to each individual pesticide based on: acute mammalian toxicity, chronic mammalian toxicity, avian toxicity, aquatic toxicity, and toxicity to beneficial insects.

Goal - a data point on the continuum targeted for industry improvement.

Grower - an entity who engages in the business of growing or producing agricultural based products.

Handler - an entity (other than a retailer) that receives or otherwise acquires agricultural products and processes, packages, or stores such product with or without taking legal title to the product. This includes product that is cleaned and/or sorted.

Inspector - a person retained to conduct inspections of certification applicants or certified operations. Inspectors are also known as "auditors".

Packer - an entity that receives raw agricultural products and packs the product for shipping.

Processor - an entity that engages in the manipulation of an agricultural product to produce a new product with a different identity from that raw input.

Public Education - our on-going campaign to promote sustainable agriculture includes making point-of-purchase tools available to retailers to communicate their commitment to the environment, building strategic alliances with national environmental and consumer organizations, and promoting sustainable agriculture through educational materials, special events, and the mass media. Protected Harvest is uniquely positioned to be the gold-standard eco-label and a household name.

Quantifiable Factors - verifiable performance measures, including the adoption of sustainable agriculture practices and the reduction of pesticide use. Protected Harvest incorporates performance measures for soil and water quality, wildlife habitat, and ecosystem health. Protected Harvest certification validates the commitment of farmers and food companies to protect the environment.

Repacker - an entity that receives packed or packaged products, removes the packaging, may or may not sort the product, and repacks the product for sale in either the original packaging or different packaging.

Retailer - a business operating from an established place of business that sells food products directly to consumers.

Standard - a clear communication of the required and desired practices for a program. This also includes unambiguous information regarding the level of compliance.

Stringent – a quality of our scientifically-based production standards. The standards are divided into nine management areas: scouting, information sources, field management, general pest management, weed management, insect management, disease management, soil and water quality, and crop storage. Growers are required to implement certain Biointensive Integrated Pest Management (BioIPM) practices in order to accumulate the number of points needed for certification. In addition, pesticide use is minimized, as farmers cannot exceed a set number of "environmental impact units" established for their crop.

Transparent - our standards are available to the public, and undergo peer review by farmers, scientists, and environmentalists.

Warehouse - an entity that receives and stores products, with or without taking legal title to the product or changing the nature of the product.

Appendix C. BloomCheck® Pesticide Do Not Use List of Active Ingredients

Pesticide Active Ingredient	
acephate	fenvalerate
aldicarb	hexachlorobenzene
allethrin	lindane
amitrole	methamidophos
azinphos methyl	methomyl
carbaryl	methyl parathion
carbofuran	monocrotophos
chlorpyrifos	omethoate
chlorpyrifos methyl	oxamyl
demeton	oxydemeton methyl
diazinon	parathion ethyl
dichlorvos (DDVP)	pentachlorophenol
dicofol	phorate
dimethoate	phosmet
disulfoton	pirimiphos methyl
endosulfan	profenofos
ethoprop	propetamphos
fenamiphos	resmethrin
fenitrothion	sumithrin (phenothrin)
	thiazopyr

Appendix D. Some Trade Names of Materials Containing Do Not Use Active Ingredients

Pesticide Active Ingredient	Pesticide Trade Name
Acephate	1300 Orthene TR
Acephate	Acephate 97 UP
Acephate	Orthene TT&O
chlorpyrifos	Duraguard ME
chlorpyrifos	Dursban 50 W

BloomCheck® Companion Document:

Certification Practice Standards, Practice Points and Audit Requirements

November 2015

Certified by Protected Harvest

Table of Contents

Introduction

In 2012 & 2013 the California Cut Flower Commission (CCFC) assembled a self-assessment of best management practices for the sustainable production of cut flowers in California. The practices fell into two groups, those that pertained to the whole farming operation, in other words if used they would be done in every management unit, and those that might differ from one management unit to another. The self-assessment practices were grouped into 13 modules according to the part of flower production to which they pertained. Modules with 'FARM' in the title contain the whole farm practices and modules with 'BLOCK' in the title are those that might vary from one management unit to another. All the practices in topic areas in the last 4 modules are ones that always apply to all management units on the entire farm so there are only 'FARM' modules for them.

There are more than 420 farming practices in the self-assessment workbook. Approximately 200 of the most impactful practices were selected for CCFC's sustainable certification program and are listed in this Companion Document. These practices were submitted to Protected Harvest for accreditation. Protected Harvest had the practice standards scientifically peer reviewed and then voted to approve them on December 16, 2014.

There are two types of certification, transitional certification and full certification. To qualify for transitional certification, a flower production management unit must achieve at least 50% of the available practice points of the available practice points in all modules combined. Furthermore, pesticides containing the active ingredients listed in Appendix I as Prohibited cannot have been used on the management unit during the last cropping cycle. Those listed as restricted may be used with caution. For full certification, a flower production management unit must achieve at least 50% of the available practice points in each module as well as 70% or more of the available practices points in all modules combined. Furthermore, pesticides containing the active ingredients listed in Appendix I as Prohibited cannot have been used on the management unit during the last cropping cycle. Transitional certification is available until January 1, 2018. After that date only full certification is available.

On the following pages are tables listing the practices in each module that occur in the self-assessment workbook that were designated as certification questions. To receive the number of practice points indicated for the practice it must have been used on the flower farm and in the production block during the previous calendar year. Listed in the far right column for each practice is what the auditor must see in order to verify that the practice was used. The Question Number in each module table refers to the question number assigned to the practice in the self-assessment workbook. Since not all of the practices were selected for certification, many of these numbers are not consecutive.

1. Production Management - FARM

In order to be competitive in the marketplace, California flower farmers need to produce high quality flowers and greens that are in demand, while maintaining profitability. Therefore one of the primary goals of the self-assessment workbook is to provide a roadmap for producing quality flowers and greens at competitive pricing. The practices in the Production Management module focus on the management of soil/ planting substrate, flower nutrition, application of nutrients, and quality control. Nitrogen management on California farms is a major concern due to the high levels of nitrates found in the ground water under many agriculture areas[1]. As a result, Regional Water Quality Control Boards have developed regulatory requirements for nitrogen management. Consequently, another goal of this chapter is to include practices that optimize nutrient management, particularly nitrogen, on the flower farm, and those that minimize the offsite movement of nutrients and other water quality impediments, such as sediments. The practices included in this module are those that are used throughout the flower farm and therefore only need to be assessed once each year for the entire farm. Other practices may differ from one management unit to another and are therefore assessed for each management unit on the farm. These practices are found in the Production Management – BLOCK module.

Be sure to review both the Production Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Audit requirements
	1. Production Management - Whole Farm		
1	Irrigation water was sampled for nitrates and, if present, the amount was accounted for when determining nitrogen fertilization rates and timing	3	Lab results of water sample from past year; fertilization plan
	Fertilization: Equipment Calibration		
2	Solid fertilizer application equipment was calibrated	1	Equipment maintenance record
3	Fertilizer injectors were calibrated at least every 6 months	1	Fertilizer injector equipment maintenance record
	Erosion		

[1] Harter, T. et al. 2013. Addressing nitrate in California Drinking Water: With a focus on Tulare Lake Basin and Salinas Valley Ground Water. Report for the State Water Resources Control Board Report to the Legislature. Univ. Calif. Davis. 92pp.

4	Water permeable mulches or planted ground covers were used in non-farmed areas to minimize erosion due to wind and water	3	Photo record or visual inspection of block
8	Ditches have been planted with grass, hardened, or lined with material such as plastic or weed matting to prevent down-cutting and other types of erosion	3	Photo record or visual inspection of block
11	Potting mixes or other substrates for growing plants were stored in a manner that minimizes their potential for offsite movement (e.g., using storage bins, tarping storage piles, or surrounding storage piles with berms). If potting mixes and/or growing substrates not stored on the farm, Answer (click on) 'N/A'	1	Photo record or visual inspection of block
	Quality Control & Customer Service		
12	Internal product quality assurance protocols have been established for flowers grown by the company (including grades and standards), and processes were in place to meet them and to respond to any identified problems. They were reviewed within the last 12 months	5	Copy of protocols and processes. Record of review dates
13	The company maintains customer service protocols and tracking system for customer complaints, returns, and comments. They were reviewed within the last 12 months	3	Copy of protocols; description of tracking system, record of review dates
	On-Farm Research		
17	The flower farm has established and continues to implement a strategic research and/or development plan with a goal to continuously improve the business	5	Copy of strategic research or development plan
	Production Management Planning		
18	A production management plan for the flower farm has been developed and documented, and includes production goals, and elements such as crop nutrition, substrate management, erosion management, and crop residue management	3	Copy of production management plan with required elements

2. Production Management - BLOCK

Practices included in this module are those that may vary from one production block to another. A production block can be defined as an area of production on the farm that is the smallest area that is managed uniquely from another area. Each production block should be assessed individually using this module.

Be sure to review both the Production Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Audit requirements
	2. Production Management - BLOCK		
	Soil Management		
1	In the management unit being assessed, flowers and/or greens are grown in in-ground soil (i.e. not in soil in pots) If No, click 'No' and skip questions 2-6	--	--
2	The soil types in the production areas have been identified (e.g., using NRCS soils maps) and soil properties including soil moisture holding capacity, cation exchange capacity (CEC), texture, and rooting depth are known and recorded for each soil type and applied to soil management planning and practices	3	soil maps of farm; list of soil properties for each soil type; soil management plan
3	The soil was sampled for organic matter content within the last two years and a program is in place to raise soil organic matter content (e.g., adding compost annually, growing and incorporating a grass-based cover crop, or incorporating crop residues annually)	1	soil test results from soils lab of organic matter content; soil management plan
4	Pick the tillage frequency for the last cropping cycle		
4.1	Not tilled	3	production block activity record
4.2	Tilled once	3	production block activity record
4.3	Tilled twice	1	production block activity record
4.4	Tilled three or more times	1	production block activity record

6	Fallow ground was planted with vegetation, and the species were chosen to enhance soil quality (e.g., nitrogen-fixing plants to increase N, or forage grasses with high carbon content to add organic matter/carbon)	1	production block activity record
	Flower Nutrition Management: Monitoring		
7	If a plant nutrient-related production problem existed, plant tissue was sampled and analyzed for important macro and micro nutrients to identify the problem and correct it by altering fertilization accordingly	1	plant tissue lab analyses results; fertilization plan
10	The soil or planting substrate was sampled pre-planting and analyzed for macro and micro nutrients, electroconductivity (EC) and pH, and the results were used to determine fertilizer makeup, rate and timing	1	soil sample lab analyses results
12	A written nutrition management plan was developed and implemented for this production block for each planting	3	Copy of nutrition management plan
16	The nutrition management program was based on a 'budget' approach, where plant demand is the primary measure of the kinds and amounts of nutrients needed, and the amounts supplied are calculated from all possible sources (e.g, irrigation water, substrate/soil, compost, or any other additives)	3	Copy of nutrition management plan
	Nutrient Application		
22	Compost was added to the soil or planting substrate	1	production block management activity records
25	Fertigation was used If No then click 'No' and skip #26	--	--
26	The frequency, timing and rate of fertigation was dictated by measured plant demand, resulting in a 'spoon feeding' of small amounts of nutrients over time	3	production block fertilization records
	Crop Residue Management		
27	Crop residues were worked back into the soil or planting substrate or composted on the farm	1	production block activity records
29	Crop residues were sent to a regional green waste recycling program	1	Records of materials sent to green waste center

3. Pest Management - FARM

Integrated pest management (IPM) is a fundamental part of any sustainable farming program. It is cost-effective, flexible, and resilient. Pest management practices being used on the flower farm are assessed using two modules. This one, Pest Management – Whole Farm, assesses IPM practices that are used throughout the entire farm on all production blocks. The other, Pest Management – Management Unit, assesses practices that may vary from one production block t to another. One important goal of the Pest Management modules is to provide a roadmap for sound pest management decision-making on the flower farm. The self-assessment questions in these modules will help identify the strengths of your IPM program and any gaps that might exist. Some will list practices not currently being used but might be worth considering for implementation next year. It focuses on pest prevention, pest monitoring, and control methods if a pest problem develops (Remedial Control).

Another important goal of the Pest Management modules is to reduce pesticide risk on the flower farm. Pesticides, whether organically approved or conventional, are an important component of most pest management programs. Because they are designed to kill pests their use involves the risk of side effects. The goal of IPM, and therefore this module, is to reduce not only economic risks from pest outbreaks, but also the potential risks to the environment and the people in it posed by pesticides. Many of the practices contained in the modules are focused on using pesticides only when necessary. If their use is required, there are practices included that ensure they are handled safely and applied in ways that minimize the amount required and maximize their efficacy.

Be sure to review both the Pest Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Audit requirements
	3. Pest Management - FARM		
2	Key employees responsible for pest management received updated IPM training by participating in on-line or in-person continuing education classes (e.g., via universities, community colleges, and/or private companies)	3	class attendance records or continuing ed certificates
	Pest Prevention: Light Brown Apple Moth (LBAM) & Other Insects		
3	The company participated in state and/or county trapping programs for invading exotic pests such as LBAM	1	CDFA certificate of participation
5	A list of shipped planting material at highest risk for harboring invasive pests, such as LBAM and/or diseases, was maintained and posted, and employees	1	List of plant materials of high risk for LBAM and

	were trained identify them and to follow documented protocols for rejecting shipments		other invasive pests infestation
7	High-risk planting material was inspected for pests upon arrival, and infested material was destroyed in an isolated area away from production sites. If LBAM-infested material was found it was destroyed per LBAM program guidelines. For more information see: www.cdfa.ca.gov/plant/lbam/rpts/LBAM_BMP-Rev_3.pdf	3	Inspection activity records
8	A plan for preventing LBAM from entering, infesting, or becoming established on the flower farm was created and employees were trained to implement the plan	3	Copy of LBAM infestation prevention plan
9	Vents, doors, and other openings in the screenhouse/greenhouse were appropriately constructed and/or operated to prevent entry of pests, such as LBAM and mites	3	Visual inspection of screenhouse/greenhouse
10	Pheromone mating disruption was used to prevent LBAM from becoming established on the flower farm	1	Photo record or visual inspection of pheromone dispensers
11	The flower farm complied with California Department of Food and Agriculture Standards of Cleanliness, Food and Agriculture Code §3060.2(b). Commercially clean is defined by Code 3060.2(b) as "pests are under effective control, are present only to a light degree, and that only a few of the plants in any lot or block of nursery stock or on the premises show any infestation or infection, and of these none show more than a few individuals of any insect, animal or weed pests or more than a few individual infestations of any plant disease." (CDFA compliance agreement required practice in LBAM quarantine zones)	3	Pest monitoring records for production block
	Pest Prevention: Viruses, Bacteria & Fungi		
15	Planting material and flowers brought onto the farm known to carry pest viruses and/or bacteria was tested for infestation and properly disposed if tests were positive	3	Plant testing activity records and/or lab test results

16	Containers, tools, and equipment that contacted contaminated plants or media were cleaned with water, treated with heat, (e.g., steam or hot water), or disinfected before reuse	5	Visual inspection of cleaning process
	Pest Monitoring: General		
18	Pest monitoring was done by in-house staff; If No then click 'No' and skip #18.1 and #18.2	--	
18.1	Documented pest monitoring protocols have been established and used to train appropriate employees	3	Copy of protocols & training records
	Pest Monitoring: Light Brown Apple Moth (LBAM)		
19	The flower farm is in a Light Brown Apple Moth (LBAM) quarantine zone If No then click 'No' and skip #20 to #25	--	--
20	The flower farm has had an infestation of LBAM If Yes then click 'Yes' and skip #21	--	--
21	An assessment of the risk of farm infestation by LBAM has been completed	5	Copy of risk assessment and results
22	An employee was designated to oversee the LBAM CDFA Best Management Practices program for the flower farm, maintain current knowledge of monitoring techniques, and train staff to recognize life stages and signs of infestation and to keep written records of activities mandated by the LBAM Program (CDFA compliance agreement required practice in LBAM quarantine zones)	3	Name of employee and list of required records and mandated activities
23	Farm supervisors and staff have been trained to recognize LBAM life stages and behavior, symptoms of damage caused by each life stage, and its preferred host plants with special attention to in-coming shipments and flower farm surroundings (CDFA compliance agreement required practice in LBAM quarantine zones)	5	Training records
24	To demonstrate the farm is free from LBAM, regular monitoring was done and written records of monitoring dates, findings, and necessary actions were kept (CDFA compliance agreement required practice in LBAM quarantine zones)	3	LBAM Monitoring results & records of actions taken if they were necessary

25	The flower farm maintains records required under the LBAM compliance and BMP agreements and retained in printed form for at least 2 years since the last confirmed LBAM occurrence on the farm. For more information see: www.cdfa.ca.gov/plant/lbam/rpts/LBAM_BMP-Rev_3.pdf (CDFA compliance agreement required practice in LBAM quarantine zones)	I	LBAM program compliance record files
	Remedial Control: Light Brown Apple Moth (LBAM)		
26	If LBAM does not exist on the flower farm skip #27 to #29	--	--
27	A sample of the LBAM infestation was sent to CDFA for proper identification, using LBAM program guidelines for shipment of specimens. Meanwhile the plants in the area of suspected infestation were defoliated to remove LBAM egg-laying sites while waiting for an official identification	I	Production block activity records for LBAM infestation control
28	A sample of the LBAM infestation was sent to CDFA for proper identification, using LBAM program guidelines for shipping specimens, and the area of suspected infestation was spot-treated with an acceptable material while waiting for an official identification	I	Production block activity records for LBAM infestation control
29	A sample of the LBAM infestation was sent to CDFA for proper identification, using LBAM program guidelines for shipping specimens. While waiting for an official identification, the entire management unit where the infestation was found was treated with an acceptable material	I	production block activity records for LBAM infestation control
	Remedial Control: Other Pests		
	Pesticide Management		
35	Pesticide use including pesticide name and application date, site, and rate was reported to the county Agriculture Commission each month	I	State Law
36	Employees who handle and use pesticides were appropriately trained, which included use of proper notification and/or signage in treated area	I	State Law
38	Sprayer calibration and spray coverage tests were done at least once a season and were based on manufacturers' recommendations and spray target characteristics (e.g., crop canopy)	I	Representative sprayer maintenance records
42	Workers who handle or apply pesticides were provided with necessary personal protective equipment (PPE) and an area to shower after applications, clean PPE clothing was stored separately from personal clothing and provided to workers each day, and employees were not allowed to take PPE home	I	State Law

43	The following information about each pesticide application was posted at a central farm location: treated area, time and date; product name, active ingredient(s), and associated adjuvants; and restricted entry interval	1	State Law
49	Pesticide resistance management was practiced by rotating pesticides with different 'modes of action' from each spray to the next	1	Pesticide use reports and copy of pesticide resistance management protocols
50	Pesticides were selected and applications were timed to minimize risks to beneficials	1	Pesticide use reports
	Pest Management Planning		
52	A pest management plan with goals for the flower farm has been developed and documented, and includes elements such as prevention, monitoring and action thresholds, and effective and safe remedial actions	3	Copy of pest management plan with specified elements

4. Pest Management – BLOCK

Be sure to review both the Pest Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Auditing requirements
	4. Pest Management - BLOCK		
	Pest Monitoring		
1	Pest monitoring of the production block (e.g., glasshouse, shadehouse, or field) was done at least once a week	3	Pest monitoring records
7	Written or electronic pest monitoring records were kept and included important data such as monitoring dates, levels of specific pests, and action decisions made	3	Pest monitoring records
10	Pest monitoring was stratified so that specific problem areas within the field could be detected and treated	1	Pest monitoring records
11	Monitoring accounted for the presence of natural enemies (parasitoids or predators).	1	Pest monitoring records
12	Soil from in-ground areas to be planted with a crop sensitive to nematodes or other soil-borne pests was sampled and treated as necessary before planting	1	Soil sample lab analyses and production block activity records if actions taken
	Pest Prevention: General		
13	Crop rotation was practiced to reduce pest problems	3	Production block activity records
	Pest Prevention: Diseases		
	Pest Prevention: Weeds		
23	Steam was used to control weeds	3	Production block activity records

24	Organic mulches were used to control weeds	3	Production block activity records
25	Plastic mulches were used to control weeds	1	Production block activity records
26	Barriers (e.g., geotextile disks) were used in pots to control weeds	3	Photo record or visual inspection
27	Soil solarization was used to control weeds	3	Production block activity records
	Remedial Control: General		
28	Economic thresholds for important pests and diseases have been established, recorded, and used for control decisions	3	Economic threshold specifications; pest control action records
29	An existing pest problem in planting substrate (e.g. soil or coir) was treated before planting with heat/steam or solarization	3	Production block activity records
31	Yellow sticky tape was used to mass trap and control pests (e.g., aphids, whiteflies, and leafhoppers)	1	Photo record of installed sticky tape or visual inspection
32	Beneficial predators and/or parasitoid wasps were released in the management unit and subsequent monitoring was done to verify efficacy	5	Production block activity records of beneficial releases
	Remedial Control: Diseases		
	Remedial Control: Weeds		
34	Hand-weeding was used	3	Production block activity records
35	Spot spraying was used to control weeds	3	Production block activity records
37	Herbicide resistance management was practiced by applying herbicides with different 'modes of action' at least every third spray	1	Pesticide use reports

39	Before spraying, buffer zones based on environmental conditions and proximity to sensitive surroundings were established to minimize non-target exposure	1	

5. Water Management - FARM

One of the reasons California is the leading agriculture state in the US is due to the availability of affordable, high quality surface and ground water for irrigation. California is also the most populace state in the US and therefore affordable, high quality water is needed to support its residents, too. Because of these demands for water, this critical resource needs to be used efficiently and effectively by California flower farmers. Therefore the Water Management module focuses on practices that optimize water quality and water use efficiency.

Be sure to review both the Water Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Audit requirements
	5. Water Management - Whole Farm		
	Water Management Training		
1	The person in charge of irrigation for the flower farm participated in the continuing education classes required by the Regional Water Quality Control Board for the Irrigated Lands Regulatory Program	3	Class attendance certificate
	Water Source		
2	Irrigation water can come from many sources. Which of the following sources are used on the flower farm for irrigation:		
2.4	Captured rain water	5	Photo record or visual inspection of rain capture system
2.5	Recycled water from source outside flower farm	5	Water procurement record
	Pumping Plant Efficiency		
3	Pumping plant efficiency is measured at least every three years and adjustments are made if efficiency is below 50%	3	Pump maintenance records
	Water Quality: Irrigation		
4	The quality of the irrigation water has been tested within the last 12 months for appropriate elements based on the water source(e.g., well water for pH, total salts, nitrates and micronutrients of regional concern like boron), and results were used to make necessary adjustments	3	Irrigation water lab analyses results; water treatment action records

5	Recirculated irrigation water from flower farm is used in irrigation	3	Water management records
	Water Quality: Postharvest		
9	Water used for hydrating flowers and greens during harvest, storage, and packing was tested within the last 12 months for total soluble salts, pH, fluorine, and chlorine, and results were used to make necessary adjustments	3	Water management records
	Water Use: Production		
11	The total amount of water used annually for the entire facility/business was recorded and tracked to measure and manage water stewardship on the flower farm and measure effects of water management BMPs on water use	3	Facility water use records or water bill recording amount used
12	The total amount of water applied annually for irrigation for the entire facility/business was recorded and tracked to measure and manage water stewardship on the flower farm and measure effects of water management BMPs on water use	5	Water meter records/water management records
	Water Use: Postharvest		See Post Harvest Module
	Offsite Water Movement: Storm Water		
16	Drainage systems were built for major roads associated with the farm to capture storm water runoff	5	Photo record or visual inspection of drainage system
19	Storm water is collected in a tailwater pond	5	Photo record or visual inspection of tailwater pond
	Water Management Planning		
21	A water management plan for the flower farm has been developed and documented, and includes elements such water management goals, irrigation scheduling, irrigation system maintenance and performance, water use efficiency, and runoff prevention and management	3	Copy of water management plan with specified elements

6. Water Management – BLOCK

Be sure to review both the Water Management FARM and BLOCK modules before making conclusions on the comprehensiveness of the production management practices.

Question No.	Practice	Certification Points	Auditing requirements
	6. Water Management - BLOCK		
	Water Quality		
1	Irrigation water for this production block required filtering If No then click 'No' and skip #2, #4, #6, #8 & #9	--	--
2	The flower farm filtered the irrigation water with sand filter	0	Photo record or visual inspection of sand filter
4	A schedule was in place and employees were trained to manually check filter status and flushing system; the frequency was at least twice during the cropping cycle, the status was documented, and corrections are made if necessary	1	Filter maintenance records
6	The irrigation for this management unit was filtered with reverse osmosis filters/membrane filters	0	Photo record or visual inspection of reverse osmosis filters
8	The reverse osmosis filtering system is driven by a variable speed pump	1	Photo record or visual inspection of variable speed pump
9	A schedule was in place and employees were trained to service the reverse osmosis filtering system and it was serviced at least 3 times during the past 12 months, to maintain optimum efficiency, or a private contractor serviced the system at least 3 times during the past year	1	Filter maintenance records
	Water Use		
10	The total amount of water applied annually for irrigation was recorded and tracked for this production block in order to improve water stewardship and measure effects of water management BMPs on water use	5	Production block irrigation records
	Water Use Efficiency		

14	Various practices can be used to determine when to start irrigation and how much water to apply. Often, the same practices are used for both purposes. Which of the following practices were used to initiate irrigation? Answer #14.1 to #14.6		
14.1	Visual plant cues	1	Block monitoring records & irrigation scheduling records
14.2	Seasonal weather patterns	1	Irrigation scheduling records
14.3	Measurements from a weather station (e.g. rainfall, temperature, radiation, humidity)	1	Photo record or visual inspection of weather station
14.4	Soil/substrate moisture depletion measured directly using weight measures for potted plants, tensiometers for in-ground plants or other soil-based devices	3	Irrigation scheduling records
14.5	Direct measure of plant stress (e.g. pressure bomb)	3	Irrigation scheduling records
14.6	Radiation measurements	1	Irrigation scheduling records
15	Which of following practices were used to determine how much irrigation water to apply? Answer #15.1 to #15.6		
15.1	Visual plant cues	1	Block monitoring records & irrigation scheduling records
15.2	Seasonal weather patterns	1	Irrigation scheduling records
15.3	Measurements from a weather station (e.g. rainfall, temperature, radiation, humidity)	1	Weather station records
15.4	Soil/substrate moisture depletion measured directly using weight measures for potted plants, tensiometers for in-ground plants or other soi- based devices	3	Irrigation scheduling records
15.5	Direct measure of plant stress (e.g. pressure bomb)	3	Irrigation scheduling records
15.6	Radiation measurements	1	Irrigation scheduling records
16	Which type of irrigation system is used on this production block: Drip, sprinkler, flood or ebb and flow, other?	—	No points awarded, this is an information gathering question
17	A pressure regulator was installed and the system pressure was balanced	1	Photo record or visual inspection of pressure regulators

18	A documented schedule and process was in place and employees were trained to check for and make necessary adjustments to ensure distribution uniformity at least once every season	3	Copy of irrigation maintenance records
19	A documented schedule and process was in place and employees were trained to check lines for leaks, breaks, and clogs and make necessary repairs at least every other irrigation	3	Copy of irrigation maintenance records
22	A backflow prevention device was installed to prevent contamination of the water source if the pump stops	1	State Law
23	If production is on a slope, system pressure differences at the top and bottom of the slope were compensated for by running the mainline vertical to the slope with pressure controllers at each horizontal sub-line junction, and by running each sub-line horizontal to the slope with a pressure control valve in place	3	Physical Inspection
24	The production block is irrigated with a sprinkler system? If No then click 'No' and skip #24.1 to #24.5		
24.1	Employees were trained not to irrigate outdoor blocks in windy conditions (e.g., > 5mph)	1	
24.2	A documented schedule and process was in place and employees were trained to check for head rotation and nozzle clogging and make necessary repairs at least every other irrigation	3	Copy of irrigation maintenance records
24.3	A documented schedule and process was in place and employees were trained to check nozzle diameters for wear and replace worn heads as necessary every two years to ensure uniform irrigation rate and distribution uniformity	3	Copy of irrigation maintenance records
24.4	A small backflow device was installed on each sprinkler line to ensure water does not drain from some sprinklers between irrigation sets and to improve distribution uniformity	1	Photo record or visual inspection of backflow prevention device
24.5	If pots were used, they were spaced closely together to minimize water losses	1	Photo record or visual inspection of pot layouts
25	The production block is irrigated with a drip system? If No then click 'No' and skip #25.1 to #25.2	--	--
25.1	Pressure compensating emitters were used if block is drip irrigated	1	Photo record or visual inspection of emitters

	Offsite Water Movement		
27	Many practices can be used to prevent, minimize or mitigate the effects of runoff from irrigation. Which of the following practices are used on the production block? Answer questions #27.1 to #27.7		
27.1	A wetting agent like polyacrylimide (PAM) was added to irrigation water to increase water infiltration and reduce runoff	1	Water treatment records
27.2	Organic amendments were added to the soil to increase water infiltration	1	Production block management activity records
27.3	Engineered barriers or buffer strips were established between production areas, and between production areas and creeks, ponds and other surface waters to reduce and filter runoff	3	Photo record or visual inspection of buffer strips
27.4	Fabric was in place under container beds to slow runoff and increase water infiltration	1	Photo record or visual inspection of container beds
27.5	Runoff occurring during irrigation is captured in a tailwater pond or by other means of storage	3	Photo record or visual inspection of tailwater pond
27.7	Captured runoff is reused	5	Water management records

7. Energy Management – FARM

Energy is essential for flower production and it comes in several forms; as sunlight to power photosynthesis, as fuel to power internal combustion motorized vehicles and pump motors, and as electricity to power electric motors, shop and office lights and electronic equipment. Tracking energy is very important because it is getting more and more expensive all the time, increasing the cost of production. Burning of fuel produces greenhouse gases (GHG's) affecting air quality and contributing to the atmosphere's greenhouse affects. Minimizing energy consumption saves money and reduces GHG production. Therefore, the Energy Management – Whole Farm module focuses on energy use and energy use efficiency practices that are used throughout the entire business.

Question No.	Practice	Certification Points	Auditing requirements
	7. Energy Management - FARM		
1	The total amount of energy used annually was documented and tracked by source (e.g., electricity, diesel) to measure production performance and is used to assess effects of energy BMPs on energy use	5	Fuel use records, electrical use records
	Energy Generation		
5	Energy was generated on site for the flower farm; If No then click 'No' and skip #6 and #7	3	Photo record or visual inspection of power generation equipment
6	How is the energy generated? Answer #6.1 to #6.5		
6.1	Wind	0	
6.2	Solar	0	
6.3	Biodiesel production	0	
6.4	Hydrogen fuel cell	0	
6.5	Cogeneration	0	

8	The following alternative fuels were used on the flower farm: Answer #8.1 to #8.4		
8.1	Biodiesel	1	Fuel use records
8.2	Propane	1	Fuel use records
8.3	Natural gas	1	Fuel use records
8.4	Ethanol/gasoline mixtures	1	Fuel use records
	Energy-use Efficiency: Vehicles		
9	A documented schedule and process was in place and employees were trained to inspect and maintain engines for optimal operating efficiency	1	Copy of engine maintenance schedule and training records
14	Flower and/or greens shipments were consolidated before shipping so that trucks were as full as possible before leaving facility	3	Photo record or visual inspection or shipping policy and/or truck packing activity records
	Energy-use Efficiency: Stationary Motors		
15	Variable-speed drives have been installed on motors that experience variable loads	5	Photo record or visual inspection of variable speed pumps
16	Electrical pump efficiencies were measured and necessary adjustments to improve efficiencies were completed within the last two years	3	Pump efficiency test results; pump maintenance records
	Energy Use Efficiency: Postharvest & Cold Storage		
18	A documented schedule (at least twice a year) and process is in place and employees are trained to check the seams between doors and walls in cold storage rooms for air leaks and reseal them if necessary	1	Cooling system maintenance records
19	High-traffic doors to rooms that are heated or cooled (e.g. cold storage, greenhouses) were equipped with strip/energy curtains	1	Photo record or visual inspection of high traffic doors

21	The operational efficiency of the storage and cooling system was ensured by cleaning and maintaining equipment at least once a year, and by measuring its efficiency at least every two years and making necessary cost-effective upgrades/replacements	1	Cooling system maintenance records
23	Total energy used in cooling and storage was determined annually and tracked over time	5	Energy consumption records and calculations for cooling and storage
	Energy Use Efficiency: Shop & Offices		
	Energy Audit		
28	An energy audit of the flower farm was completed during the last five years	5	Copy of energy audit
29	Audit findings were used to develop, or refine and implement an energy management plan designed to optimize energy-use efficiency	5	Copy of energy management plan
	Energy Management Planning		
30	An energy management plan for the flower farm has been developed and documented, and includes goals (e.g., energy targets) and elements related to equipment, pumps, lighting, heating and cooling.	3	Copy of energy management plan with specified elements

8. Energy Management – GREENHOUSE

Energy management in a greenhouse involves many practices that differ from those used to manage energy in other types of flower production, such as outdoor and shadehouse, justifying a module devoted to practices that optimize energy use in greenhouses. The practices are grouped into the general topic areas of greenhouse covering, energy losses, and heating. Each greenhouse should be assessed as a separate production block in relation to energy use, because its energy use may differ from another greenhouse because of age, different equipment, or other factors. If you do not use greenhouses to grow flowers skip all the questions in this module and move to another one.

Question No.	Practice	Certification Points	Audit requirements
	8. Energy Management - Greenhouse		
	Greenhouse Covering		
*	The production block is inside a greenhouse (Yes/No)		
1	The greenhouse was covered with: Choose one		
1.1	Single pane glass	0	No points given for this practice
1.2	Double-pane glass	3	Photo record or visual inspection of covering
1.3	High-performance low-energy glass	3	Photo record or visual inspection of covering
1.4	2-wall polycarbonate	3	Photo record or visual inspection of covering
1.5	5-wall polycarbonate	5	Photo record or visual inspection of covering
1.6	Acrylic	1	Photo record or visual inspection of covering
1.7	Single poly film	1	Photo record or visual inspection of covering

1.8	Double poly film	3	Photo record or visual inspection of covering
	Energy Losses from Greenhouse		
4	Doors, vents, fan openings, and other openings in the greenhouse covering were weather-stripped	3	Photo record or visual inspection of doors, vents and other openings
5	A process was documented and staff were trained to check the greenhouse covering for holes or broken panes at least once a year, and repairs made if necessary	1	Photo record or visual inspection of greenhouse covering
6	The greenhouse was equipped with automatic doors, which are operational, to conserve heating and cooling	3	Photo record or visual inspection of automatic doors
9	A humidity/energy curtain was installed and used to optimize heating	5	Photo record or visual inspection of curtain
	Greenhouse Heating		
11	The greenhouse heating is derived from: Choose one		
11.1	Hot water boilers	0	No points given for this practice
11.2	Wall installed unit heaters	0	No points given for this practice
11.3	Heat pumps	1	Photo record or visual inspection of heat pump
11.4	Cogeneration	3	Photo record or visual inspection of cogeneration system
13	Horizontal air flow fans are used to get a more uniform temperature in the growing area	1	Photo record or visual inspection of fans
14	All boilers, heating pipes, and heating transfer lines were insulated	3	Photo record or visual inspection of heating pipes and/or transfer lines
16	The heating system was maintained in the last 12 months to ensure it was operating at peak efficiency and adjustments were made if necessary	3	Heating system maintenance records

17	Climate control software was used to optimize greenhouse heating and cooling	3	Photo record or visual inspection of software

9. Postharvest Management – FARM

Postharvest management of flowers entails practices that have a significant influence on flower quality and vase life. They include the use of water, water additives, energy for cooling and transportation, and packaging. All of these practices involve inputs, which cost money. Optimizing postharvest practices will reduce inputs and save money. Therefore the Postharvest Management - Whole Farm module focuses on practices used in handling the flowers once they have been harvested, placed in cold storage, packing and distribution.

Question No.	Practice	Certification Points	Audit requirements
	9. Postharvest Management - FARM		
	Harvest Operations		
1	To minimize flower handling and storage time, and optimize shipping potential, the best timing of harvest has been determined and documented for each flower species and the protocols were followed	3	Harvesting schedule and protocols
2	Employees were trained to keep harvest utensils clean, disinfected, and sharp	1	Training records or photo record or visual inspection of tools
3	Harvested plants were immediately placed in proper post-harvest solutions based on flower or greens species	5	Harvest protocols, photo record, or visual inspection of harvest operations
4	Post-harvest solutions were monitored to ensure consistency among batches	5	Post-harvest solution monitoring records
6	Harvest containers were cleaned and disinfected before use	5	Photo record or visual inspection of container cleaning station
8	Waste water from dyeing was disposed of according to local water quality control regulations	1	Waste water disposal protocols or photo record or visual inspection of disposal practices
10	Post-harvest solutions were disposed of properly, which included following storm-water runoff regulations, such as putting in a containment pond, or used to water dirt roads	1	Postharvest solution disposal protocols or photo record

			or visual inspection of disposal practices
	Cold Storage and Packing		
11	Storage and packing areas, especially benches, were cleaned daily	1	Cleaning protocols and schedule, and/or photo record or visual inspection of storage and packing areas
12	Storage and packing areas were extensively cleaned and sanitized on the following frequency schedule: Choose one (At least weekly; between weekly and biweekly, between biweekly and monthly, between monthly and semi-annually, between semi-annually and annually, less than annually)	Weekly 5 Bi-weekly 3 Monthly 1 Others 0	Cleaning protocols and schedule, or photo record or visual inspection, cleaning records
13	Flowers and greens were cooled rapidly after harvest	3	Harvest protocols, or photo record or visual inspection of packing/cooling areas
14	Coolers were run and monitored to achieve optimal temperatures and humidities based on the species of flowers and greens being stored	5	Cooler temperature records
18	Boxes were precooled prior to final distribution to ensure flower species were at optimal core temperatures during shipping	3	Packing protocols or visual inspection of packing rooms
	Packing Material		
19	The total amount of packaging material used annually in shipments from the production facility was known, recorded, and tracked to optimize use of packing material	1	Packing material use records
21	The amount of recycled packaging material used annually in shipments from the production facility was known, recorded, and tracked to optimize use of packing material	3	Packing material purchasing records; packaging records
	Transport and Distribution		
24	The optimum transportation temperature was determined for each flower and greens species and temperatures were monitored for quality assurance	3	List of temperatures by species; representative temperature monitoring records for transportation

25	Prior to loading temperatures of flower boxes, truck and truck contents were monitored and recorded to ensure optimum transportation conditions	5	Representative temperature monitoring records from trucks
26	Flower temperatures were monitored during shipment using temperature data loggers in order to ensure transportation conditions	5	Representative temperature monitoring log
	Postharvest Management Planning		
27	A harvest and postharvest management plan with goals has been developed and documented for the flower farm, and includes elements such as harvest, storage, packing, optimum storage time, and shipping operations	5	Copy of harvest and postharvest management plan with specified elements

10. Habitat Management – FARM

Each flower farm exists within a community of living organisms and their physical environment, all of which interact in very complex ways. While one of the primary goals of the flower farm is to maintain economic viability by producing quality flowers, another important goal is to do it in a manner that is environmentally sustainable as well. The Resource and Biodiversity – Whole Farm module focuses on practices that maintain habitat for plants and animals on or near the flower farm, as well as enhancing existing habitat if possible. Watershed stewardship is another important topic addressed by the module.

Question No.	Question	Certification Points (1, 3, or 5)	Audit Requirements
	10. Habitat Management - FARM		
	Habitat Preservation		
1	Unfarmed areas were maintained or enhanced to increase biodiversity, such as wildlife, pollinators, pest natural enemies, and/or other beneficial organisms (e.g., via maintaining or enhancing the health of existing vegetation)	1	Photo record or visual inspection of unfarmed areas
5	The flower farm has at least one water course on the property (e.g. creek, seasonal stream, or other natural water way); If No then click 'No' and skip #6 to #9		
6	The water course has a setback to minimize siltation and other non-point source water pollution (setback is a space between the water course and where farm production begins; roads are not setbacks): Choose one. If no setbacks skip #6, #7 and #8		
6.1	No setbacks - production area goes up to water course edge	0	
6.2	Setbacks of 1 to 10 feet	1	Photo record or visual inspection of water course
6.3	Setbacks of 10 to 25 feet	1	Photo record or visual inspection of water course

6.4	Setbacks of 25 to 50 feet	3	Photo record or visual inspection of water course
6.5	Setbacks greater than 50 feet	5	Photo record or visual inspection of water course
7	Setbacks were vegetated with annual and perennial grasses and weeds to improve its buffering capabilities	1	Photo record or visual inspection of water course
8	Setbacks were vegetated with a mix of grasses, trees and/or shrubs to improve buffering and provide shade for water courses to lower water temperatures to benefit aquatic species	1	Photo record or visual inspection of water course
	Habitat Enhancement		
12	Trees and/or shrubs have been planted and are maintained on farm property borders to provide wildlife habitat	3	Photo record or visual inspection of farm property borders
	Watershed Stewardship		
19	One (or more) member of the farm was active in regional land use planning	1	Minutes from regional land use planning meetings that includes attendance record
22	An NRCS conservation survey or other environmental survey of the farm has been done to determine and record on a map the sensitive areas (e.g., wetlands, riparian areas, creeks, swales, and habitat for endangered species) and other environmental features which affect farmable acres and practices, and was used to guide spraying, irrigation, fertilization, and other management activities	5	Copy of NRCS conservation survey or other environmental survey
	Habitat Management Planning		
23	A habitat management plan with goals has been developed and documented for the flower farm, and includes elements such as monitoring, an environmental survey(s), and habitat preservation and enhancement .	3	Copy of habitat management plan with specified elements

11. Materials Handling – FARM

Materials handling is a technical term for the storage, use, recycling, and disposal, if necessary, of hazardous materials. Hazardous materials are those that, because of its quantity, concentration, or physical or chemical characteristics, pose a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment. The Materials Handling module contains practices related to hazardous material use, storage of fertilizers and pesticides, mixing and loading of fertilizers and pesticides, fuel storage, recycling, and disposal of materials that cannot be recycled.

Question No.	Question	Certification Points (1, 3, or 5)	Audit Requirements
	11. Materials Handling Management - FARM		
1	A site map of the flower farm has been drawn that locates fuel tanks, waste oil drums, dumpsters, service/maintenance areas, hazardous material storage, storm drains, wells, surface water running through the property, tailwater ponds, leaching basins, municipal sewer lines, septic lines and tanks, green waste piles, and recycling receptacles. The map has been communicated to appropriate local agencies such as the County Agriculture Commissioner's Office and Fire Department	5	Site map of farm including specified elements; list of agencies where it is on file
	Hazardous Material Use		
2	The total amount of on-site hazardous materials, purchased and generated, was known and an inventory was kept and reviewed annually to communicate and manage performance	3	Inventory list of hazardous materials
	Fertilizer Storage		
5	Employees were trained to properly recognize, handle (including spill prevention, containment and cleanup), and dispose hazardous materials (e.g., solvents, cleaning materials, explosives, compressed gases, fuel, fertilizers, pesticides, acids, and lubricants)	1	State Law

6	Fertilizers were stored in a ventilated and locked room or area protected from rainfall (e.g., under awning) and not located near areas where surface or ground water could become contaminated (e.g. near creeks, streams, storm drains, or well heads)	I	Photo record or visual inspection of fertilizer storage area
7	In case of a spill, the fertilizer storage area had secondary containment including an impermeable floor and waterproof curbs	I	Photo record or visual inspection of fertilizer storage area
	Fertilizer Mixing & Loading		
12	Fertilizer mixing and loading area has impermeable floor	I	Photo record or visual inspection of fertilizer mixing area
	Pesticide Storage		
15	Pesticides were stored in a ventilated and locked room that can be unlocked from the inside or in an appropriate locked cabinet clearly marked with appropriate signage readable from 25 feet	I	Photo record or visual inspection of pesticide storage area
16	The following safe pesticide storage practices were used: dry products above liquids, only undamaged original or spill-proof containers with original labels were stored, products were segregated by type (e.g., insecticides, herbicides, fungicides and rodenticides), storage area was more than 100 feet from the nearest well, and storage area had an impermeable floor and sump to contain leaks	I	Photo record or visual inspection of pesticide storage area
17	A documented schedule and process was in place and employees were trained to check the storage area for leaky containers and to contain spills and dispose containers according to proper procedures and state law	I	Process for inspection and inspection schedule records
20	A bilingual emergency response plan, including emergency phone numbers, for pesticide spills and exposure was posted in an appropriate location(s), and employees were made familiar with and trained to follow the plan	I	Photo record or visual inspection of posted emergency response plan
	Pesticide Mixing & Loading		
22	The outdoor pesticide mixing and loading area was more than 100 feet from the wellhead unless a berm or other physical characteristics protected the well from contamination by surface water	I	Photo record or visual inspection of pesticide mixing and loading area
23	An eye wash station maintained in good working order was provided at the mixing and loading site	I	State Law

25	The indoor pesticide mixing and loading area was adequately ventilated	1	Photo record or visual inspection pesticide mixing and loading area
26	Either a double-check valve, reduced pressure principle backflow prevention device, or an air gap was maintained between the water source and sprayer tank	1	State Law
	Fuel Storage		
28	The fueling area had a concrete floor or other mechanism(s) to contain leaks and spills (e.g., berms and/or sump)	1	Photo record or visual inspection
	Hazardous Material Disposal & Recycling: Dumpster Area		
32	Dumpsters and recycling containers were sited to minimize environmental and visual impacts, positioned on cement pads to contain spills and leaks, and had lids or other covering (e.g., awning) to keep water out	1	Photo record or visual inspection of dumpsters
	Hazardous Material Disposal & Recycling: Tires, Batteries, Lubricants & Paints		
	Recycling of Equipment, Metals, Glass, Cardboards and Plastics		
41	The business had an established, documented recycling program for metal, cardboard, plastics, paper and glass	1	Copy of recycling program plan and photo record or visual inspection of recycling areas
	Materials Handling Management Planning		
44	A materials handling and waste management plan with goals has been developed and documented for the flower farm, and includes elements such as packaging, hazardous waste, recycling and waste water	3	Copy of plan with specified elements

12. Social Responsibility – FARM

The flower farm is an integral part of the community. It is responsible to the employees who work on it, the neighbors living around the farm, and the consumers who buy the flowers produced on the farm. Human Resource Management is the part of Social Responsibility that involves the employees of the farming enterprise. Effective human resource management involves planning, designing, implementing and evaluating practices to recruit and retain good employees as well as to improve employee satisfaction, productivity, safety, and wellness. It also includes important issues like succession planning and risk management for the company. Neighbors and Community is the part of Social Responsibility that involves the farms interaction with the people living on neighboring farms and the towns and cities in the landscape in which the farm is located.

Question No.	Practice	Certification Points	Audit Requirements
	12. Social Responsibility		
	Succession Management		
	Risk Management		
	Staying Informed & Trade Leadership		
11	One (or more) member of the flower farm regularly attended regional and/or statewide industry meetings (e.g., irrigation district, Farm Bureau or water coalition), trade shows (e.g., World Ag Expo or Nor Cal Fun N Sun), and seminars (e.g., UC, CDFA, CSU or Commodity Boards)	1	Attendance record or minutes from meeting that includes attendance record
14	One (or more) member of the flower farm had a lead role in local, regional or state industry associations (e.g., CCFC, California Flower Growers and Shippers Association, Society of American Florists, Association of Specialty Cut Flower Growers)	1	Evidence of participation such as committee meeting minutes, attendance, etc.
	Employee Recruitment, Retention, & Progression		
17	Documented job descriptions for each job type have been developed and given to employees and their supervisor	1	Job descriptions for each job and record of employee receiving it
19	The company did not discriminate in its recruiting and the workplace was free of discrimination based on race, sex, political persuasion or opinion, sexual orientation, religion, and national or social origin	1	Company statement of non-discrimination

	Training		See Appendix
22	All new employees underwent safety training	I	State Law
23	Safety training was done according to Cal OSHA regulations for when employees begin new assignments, processes, procedures or uses of a substance or equipment that involve a hazards (training topics include hazardous materials, office and shop safety, tractor safety, first aid, and personal hygiene including daily changes to clean clothing)	I	State Law
24	Employees were trained to respond to hazardous events (e.g., earthquakes or floods)	I	State Law
26	All employees have participated in sexual harassment prevention training	I	State Law
	Worker Safety		
28	Safety statistics (e.g., employee time lost to accidents) were tracked and retained for at least two years to communicate and manage performance	I	Safety statistical records
30	An employee trained in first aid was always on site during farming activities	I	State Law
31	Work accidents were investigated with the goal of reducing or eliminating them in the future	I	Accident investigation records
32	A documented process was in place and employees were trained to ensure the adequate and timely on-site treatment of injured or sick workers.	I	Process and training records
34	The company complied with state and federal laws for worker compensation and disability	I	State Law
	Employee Career Development		
38	The company paid employees' wages during training	I	Company policy statement on paying wages during training
39	The company paid or reimbursed employees for tuition for work-related continuing education	I	
	Workplace Conditions		
45	Employees were trained in basic hygiene practices and were provided with conveniently located clean toilet and hand washing facilities in the greenhouse area and in the field	I	State Law

46	Employees were provided shade when temperatures exceed 85 °F	I	State Law
47	Employees working in hot environments were provided with at least one quart of drinking water per hour at accessible locations (2 gals per 8-hour day)	I	State Law
	Employee Wellness		See Appendix
	Employee Job Performance & Grievance		
52	A documented process and timeline for evaluating job performance and determining pay increases and promotions was in place and communicated to employees	I	Copy of job performance evaluation process
54	A grievance process has been documented in the employee handbook, and grievances are recorded and processed in a timely manner	I	Copy of employee handbook & grievance records
	Employee Compensation, Benefits & Incentives		
56	The company adhered to child labor laws stipulated in the Fair Labor Standards Act	I	State Law
57	The company adhered to the California Labor Code for wages and overtime pay	I	State Law
61	The company complied with state and federal laws for unemployment compensation and social security	I	State Law
62	The company provided appropriate daily breaks for lunch and rest	I	State Law
63	Clean facilities were provided for food storage and lunch breaks	I	Photo record or visual inspection of food storage area and lunch room/break room
64	Employees were provided paid time off for sick leave	I	State Law
65	Employees were provided paid time off for vacation	I	Copy of company policy on paid vacation
66	Employees were allowed unpaid time off without reprisal for important events such as child birth, adoption or serious illness (up to 12 weeks is required by federal law)	I	State Law
	Team Building		

72	A documented employee recognition process was in place to provide peer-to-peer and management-to-employee feedback	1	Copy of recognition process
74	A team-building activity was held within the last 12 months for all employees	1	Record of team building activity
	Neighbors & Community		
77	The flower farm took proactive measures to ensure good community relations, such as holding open houses, making literature available to the public about farming practices and the company's commitment to sustainability, or presenting community members with gifts (e.g., flower arrangements)	1	Copies of literature, calendar of relevant events
79	The flower farm maintained visual aesthetics appropriate for the neighborhood	1	Photo record or visual inspection of farm property
81	One (or more) member of the flower farm was involved in initiatives, through time commitment and/or donations, that enhance the community (e.g., Chamber of Commerce, schools/education programs, churches, public health or affordable housing)	1	Record of donations or activities
84	One (or more) member of the flower farm was involved in community activities to promote careers in the cut flower industry (e.g., FFA, 4-H, career day at local schools, or as local agricultural teachers)	1	Record of participation in community activities
	Social Responsibility Planning		
85	A social responsibility management plan with goals has been developed and documented for the flower farm, and includes elements such as staffing, recruiting, retention, employee wellness and neighbors and community	3	Copy of social responsibility management plan

Appendix I – BloomCheck Do Not Use and Use with Restrictions** list of Pesticide Active Ingredients

Pesticide Active Ingredient	BloomCheck use status
acephate	Prohibited
aldicarb	Prohibited
allethrin	Prohibited
amitrole	Prohibited
azinphos methyl	Prohibited
carbaryl	Prohibited
carbofuran	Prohibited
chlorpyrifos	Restricted**
chlorpyrifos methyl	Prohibited
clothianidin	Restricted**
demeton	Prohibited
diazinon	Restricted**
dichlorvos (DDVP)	Prohibited
dicofol	Prohibited
dimethoate	Prohibited
disulfoton	Prohibited
endosulfan	Prohibited
ethoprop	Prohibited
fenamiphos	Prohibited
fenitrothion	Prohibited
fenvalerate	Prohibited
hexachlorobenzene	Prohibited
imidacloprid	Restricted**
lindane	Prohibited
methamidophos	Prohibited

methomyl	Prohibited
methyl parathion	Prohibited
monocrotophos	Prohibited
omethoate	Prohibited
oxamyl	Prohibited
oxydemeton methyl	Prohibited
parathion ethyl	Prohibited
pentachlorophenol	Prohibited
phorate	Prohibited
phosmet	Restricted**
pirimiphos methyl	Prohibited
profenofos	Prohibited
propetamphos	Prohibited
resmethrin	Prohibited
sumithrin (phenothrin)	Prohibited
thiamethoxam	Restricted**
thiazopyr	Prohibited

**Use of this pesticide will be phased out

Introduction to BloomCheck® Management Plans:

Descriptions and Guides for Developing Them

November 2015

CERTIFIED
BloomCheck
California Standards for
Sustainable Flower Farming

Table of Contents

Introduction to BloomCheck® Management Plans:

What is a BloomCheck® management plan?

A BloomCheck® management plan is a verbal description of how you approach a certain aspect of flower production, for example how you manage water, flower nutrition, and pest management. It will often contain not just one but several practices. Management plans were put in the BloomCheck® program because the CCFC Sustainability Task Force that help create it felt there were some aspects of sustainable flower production that were not adequately represented by a single practice. A written plan seemed to be a way to handle these more complex parts of flower farming.

Why do BloomCheck® management plans?

First, because if you do all of them you get 29 certification points, which is almost 10% of the points available in the BloomCheck® program. Second, because as you will find out in the next paragraphs, everyone can qualify for these points. Lastly, it is good to have a plan for important aspects of your flower farm. It is even better to have it written down. Why? A written plan is a record of what was done for a particular issue and can be referred to next year so you can compare what was done last year with what you intend to do this year. It is likely you will find by writing down the plan, rather than relying strictly on your memory to store the plan, it will help organize it better. Furthermore, during the process of writing it down, you may be inspired to try a new practice to address a particular issue on the farm.

What does the auditor check for in a BloomCheck® management plan?

The auditor checks that the management plan contains the elements that are mentioned in the BloomCheck® practice standard for that management plan. For example, the Production Management Plan calls for production management goals and plan elements (sections) on crop nutrition, substrate management, erosion management, and crop residue management. So you should have these elements in your plan. To make it obvious, you could have section headings for these elements. See the Plan Guides below for examples.

The auditor does not evaluate what is contained in each element of the plan. They also do not check to see if you are actually doing what you say you are doing in your plan. However, the auditor usually begins the audit by checking the management plans and what is in the plans will give him/her a good idea what to expect during the audit.

What should be in a management plan?

The management plan should be a verbal description of what you do for each element of the management plan. The more detail the better, but the detail is for your benefit not the auditors. Remember that the auditor does not evaluate the content of the plan. It is a record of what you have done to manage a particular part of your farming.

If you do not have a process for dealing with a particular element in the plan, be sure you list the element in your plan but simply say that you don't deal with it right now. For example, one element in the Production Management Plan is 'Erosion Management'. If you do not have any processes for addressing erosion on the farm simply write 'There is currently no Erosion Management Plan for the farm' under the heading Erosion Management.

Management Plan Guide:

The example management plan outlines are made up of the elements (sections) listed in the BloomCheck® practice standard. Under each section there is a series of questions for you to consider that may provide ideas of what to put in the plan. They are only suggestions, not requirements. You should put into the plan anything you are doing that you think is important and that you want to record for future reference.

Management plans appear in the order that they occur in the BloomCheck® Companion Document.

Practice 1.18 (Module 1 Production Management – FARM):

A production management plan for the flower farm has been developed and documented, and includes production goals, and elements such as crop nutrition, substrate management, erosion management, and crop residue management.

Production Management Plan Guide

Production Goals:
Goals are usually fairly high level things. Some examples might be:

- Maintain the high quality of cut flowers produced on the farm
- Optimize nutrient applications through use of crop residues and basing fertilization on plant nutrient demand
- Minimize offsite movement of sediments through erosion management

If you don't have any production management goals then create some that make sense to you.

Crop Nutrition:

Since one BloomCheck® practice is to have a nutrient management plan, I suggest simply stating here “See farm’s nutrient management plan’. It is acceptable for an element in one plan to refer to another plan.

<u>Substrate Management:</u>
Substrate refers to what the flowers are growing in; which can be soil in the ground or substrate in pots or greenhouses.

- For soil:
    - Do you manage the soil to improve organic matter content? If so how do you do that?
    - Do you manage the soil to improve water percolation? Of so, how?
    - Do you incorporate plant residues back into soil? If so how, do you do that?
    - If you till the soil describe your approach? Is it minimum till? Till between crops? Till multiple times during the cropping cycle?
    - Do you treat the soil between crops with steam, fumigants or drenches? If you do, why do you do it and how do you do it?
    - Other soil management approaches?

- Potting mixes:
    - Describe how you prepare potting mix for use
    - Describe how potting mixes are stored and why is it done in this way
    - Is potting mix reused? If so, how is it treated before reuse? If not, how is it disposed of/recycled?

<u>Erosion Management:</u>
If you have an erosion management program for the farm describe it. If you don’t say so.

- How do you handle storm runoff?
- How do you handle erosion within production blocks?
- If erosion is not a problem on the farm, describe why it is not
- Are drainage ditches treated in some way (e.g. grassed, hardened) to minimize erosion?
- Are farm roads managed to minimize erosion? If so how?

<u>Crop Residue Management:</u>

- Describe what is done with crop residues

Practice 2.12 (Module 2 Production Management – BLOCK):

A written nutrition management plan was developed and implemented for this production block for each planting.

Nutrient Management Plan Guide

There are no required elements for a nutrition management plan specified in the practice standard 2.12 so you can list any elements you want to or simply describe your approach to managing nutrients in this production block. Some bullet questions and comments will be provided to guide you in drafting your nutrient management plan.

- Describe how you approach managing nutrient additions to flower production blocks, both timing and rates
    - Do you rely on an historical formula/approach, if so describe it and what was the reasons for it to be developed and used in the first place.
    - Do you try and fertilize according to plant demand? If so, describe how you determine plant nutrient demand and your budget-based fertilization program? You don't need to include amounts of fertilizers used, just the reasons for applying them and the methods used to determine when and how much to apply.
    - Do you base your fertilization on tissue samples? If so, describe the sampling protocols and how the results are used to design your fertilization program.
    - Do you base part of your fertilization on soil samples? If so, describe the sampling protocols and how the results are used to determine fertilization timing and rates.
- Do you use foliar fertilizers? If so, why and how?
- Do you use other nutrient inputs besides synthetic fertilizers? If so, what are they and why do you use them? (e.g. incorporating plant residues, compost) If you use them, do you alter your synthetic fertilizer use accordingly?
- Do you use fertigation? If so, when and why?
- Do you try and ensure nutrients do not move below the plant root zone? If so, how do you do that?

Practice 3.52 (Module 3 Pest Management – FARM):

A pest management plan with goals for the flower farm has been developed and documented, and includes elements such as prevention, monitoring and action thresholds, and effective and safe remedial actions.

Pest Management Plan Guide

<u>Pest Management Goals:</u>
Goals tend to be high level things. Some examples are:

- Ensuring quality cut flowers free from defects due to pests
- Increasing the use of reduced risk pesticides
- Developing and using action thresholds for pests for which thresholds have not been developed

Pest Prevention:

Describe what is done on the farm to prevent pest problems from developing to begin with:

- Do you screen all plant material, such as planting stock, for pests? If so, how is this done?
- Do you use mulches to keep weeds down? If so, how is this done?
- If you have a greenhouse, do you have a program for keeping pests from entering? If so describe how this is done? For example, do you regularly check screens, doors, etc. for integrity?
- Do you use resistant varieties? If so, say that.
- Do you release natural enemies in a prophylactic way? (i.e. even though a pest problem is not evident) If so, why?
- Do you do pre-plant treatments of planting beds or potting mixes? If so, how and why?
- Is mating disruption used for some pests? If so, which ones?

Pest Monitoring and Action Thresholds:

- Describe in detail how pest monitoring is done and if records are kept of the monitoring. Be specific for each pest.
- If you contract with a consultant to do pest monitoring and management recommendations, describe how they do it, if you know. If you don't know, say so.
- Do you have threshold numbers for some pests that if they are exceeded then a treatment is done? If so, name the pest and threshold value.

Pest Management Remedial Actions:

- Are sprayers regularly calibrated? If so how often?
- Are sprayers checked for spray coverage? If so, how is this done and how often?
- Once a spray is done, does the block get checked for efficacy of the spray? If so, describe how it is done and if the results are recorded for later reference.
- Are pesticides selected, in part, due to their effects of pest natural enemies?
- Are natural enemies released when a pest problem is evident? If so, what pests and what natural enemies?

Practice 5.21 (Module 5 Water Management – FARM):

A water management plan for the flower farm has been developed and documented, and includes elements such water management goals, irrigation scheduling, irrigation system maintenance and performance, water use efficiency, and runoff prevention and management.

Water Management Plan Guide

Water Management Goals:

Goals tend to be relatively high level things. Here are some examples:

- Ensure irrigation water does not leave the production block or the plant root zone
- Maintain irrigation system performance at an optimum level
- Irrigate flower crops based on plant water demand

Irrigation Scheduling:

- Describe how you determine when to irrigate and how much to irrigate?
    - Do you base it on past history of crop? If so, how were the methods originally developed?
    - Do you use soil moisture meters? If so, what are they and how are they distributed in the production blocks?
    - Do you use visual plant cues? If so, what?
    - Do you use Evapotranspiration (ET) estimates? If so, where do you get them from (e.g. on farm weather station, CIMIS)?

Irrigation Maintenance and Performance:

- Do you periodically check the system for leaks and clogs? If so, how is this done and how often?
- Do you periodically check the distribution uniformity of the system? If so, what methods do you use and how often?
- Do you do a pump test efficiency? If so, how often?
- Do you periodically clean the irrigation lines? If so, how and how often?

Water Use Efficiency:

- Do you have a way of checking water use efficiency on the farm? For example, to you measure the amount of water used in a block during a cropping cycle and track this from one growing season to the next?
    - If you do not check or measure water use efficiency, then say you do not have a plan for doing this.
- Do you compare water use to yield in any way?

Water Runoff Prevention and Management:

- If you have discussed this in your Erosion Management section of the Production Management Plan, then simply say 'Refer to Erosion Management section in the Production Management Plan'

Practice 7.30 (Module 7 Energy Management – FARM):

An energy management plan for the flower farm has been developed and documented, and includes goals (e.g., energy targets) and elements related to equipment, pumps, lighting, heating and cooling.

Energy Management Plan Guide

Energy Management Goals:

Goals tend to be relatively high level things. Here are some examples:

- To have X% of energy used on the farm come from renewable sources by 2020
- To develop a system to measure energy use on a production block basis by 2017
- To reduce energy use per unit production by 5% over the next two years

Equipment:

- Do you have a regular schedule for tuning up internal combustion engines? If so, what is it?
- Do you use cleaner burning fuels in some internal combustion engines? If so, what kind of fuels? What percent of your engines use cleaner burning fuels?
- Do you ensure the most appropriate sized motor/tractor is used for a job? If so, state that.
- Do you provide bicycles for use around the farm to reduce the use of internal combustion engines? If so, state that.

Pumps:

- Are pumps periodically measured for efficiency? If so, how often?
- Are variable speed drives installed on pumps experiencing variable loads? If so, state that.
- Have any diesel pumps been converted to electrical?

Lighting:

- Are office and shop lights equipped with motion detection sensors to switch off when no one is around? If so, what percentage?
- Have incandescent light bulbs in offices and shop been replaced with more energy efficient lighting? If so, what is used? Can you estimate how much of total lighting is energy efficient?

Heating and Cooling:

- Is there a process in place to check seals, energy curtains, etc. in cold storage rooms to ensure minimize cold air leakage? If so, describe it.
- Is there a schedule and process for periodically cleaning cooling coils to reduce energy loss? If so, describe it.
- If you have a greenhouse, is there a schedule for checking for air leaks, either hot or cold, such as broken panes, caulking/weather stripping, effectiveness of energy curtains? If so, describe the schedule and process for checking.
- Other heating and cooling best management practices use?

Practice 9.27 (Module 9 Harvest & Postharvest Management – FARM):

A harvest and postharvest management plan with goals has been developed and documented for the flower farm, and includes elements such as harvest, storage, packing, optimum storage time, and shipping operations.

Harvest & Postharvest Management Plan Guide

Harvest & Postharvest Management Goals:
Goals tend to be relatively high level things. Here are some examples:

- To continuously improve upon flower handling and storage time, minimizing both
- To ensure a cold chain from growing area to client

Harvest:

- Do you have a process during harvest to ensure flowers are hydrated and properly cooled? If so, describe the process and how workers are trained to use it.
- Is there a process in place to keep harvest tools sharp and disinfected? If so, then describe it.
- Do you have a process for disposing of postharvest water and other solutions? If so, describe it.
- Do you have a process for keeping the harvest area clean? If so, describe it.

Storage:

- Do you have a protocol for rapid cooling of harvested flowers? If so, describe it.
- Do you have a protocol for storing each flower species at an optimum temperature? If so, describe them.
- Do you have a schedule and process for keeping the storage area clean? If so, describe it.
- Other storage practices? Describe them.

Packing:

- Do you keep tract of use of packing material? If so, describe how this is done.
- Do you use recycled packing material. If so, describe how this is done.
- Do you have a package recycling program? If so, describe it.
- Simply describe your packing process. For example, if you precool boxes before packing say so.
- Other packing practices?

Optimum Storage Time:

- Is storage time minimized? If so, how is this done?
- Describe you approach to storage. Why do you do it the way you do?

<u>Shipping Operations:</u>
- If you don't control the shipping operation then say so.
- Describe your approach to shipping?
- Do you monitor flower temperatures during shipping?
- Do you have a quality control process for monitoring results of shipping? If so, describe it.
- Do you get feedback on condition of flowers on arrival at retailers? If so, say so.

Practice 10.23 (Module 9 Habitat Management – FARM):

A habitat management plan with goals has been developed and documented for the flower farm, and includes elements such as monitoring, an environmental survey(s), and habitat preservation and enhancement.

Habitat Management Plan Guide

Many flower farms are located in industrial parks or are mainly a series of greenhouses on the property in and urban or suburban setting with no extra land to do habitat management. In this case, this management plan and the Habitat Management module may be not applicable to your flower farm. If this is the case, simply say so for your Habitat Management Plan. However, habitat management can even be as simple as some landscaping around the office or placing nesting boxes for owls, song birds or bats on the property or hummingbird feeders.

<u>Habitat Management Goals:</u>
Goals tend to be relatively high level things. Here are some examples:
- To increase the biodiversity on the flower farm through habitat management
- It is challenging to come up with example habitat management goals not knowing the specifics of your flower farm!

<u>Habitat Management Monitoring:</u>
- Do you have any wildlife on the property? If so, do you have a formal or informal way of making observations about it? If so, describe them.
- Do you have trees and/or shrubs on the property? If so, does someone keep an eye on their health? If so, describe this process and who is responsible.

<u>Environmental Survey:</u>
- Have you catalogued the habitat on your property? If not it is easy to do so. Simply make a verbal description of what is there. You could do a simple map noting locations

of habitat, trees, shrubs, etc. Also include sensitive areas like well heads, creeks, drainage ditches, or wetlands.
- If there are some habitats on the property that could be sensitive to farming practices list them here.

<u>Habitat Preservation and Enhancement:</u>
- Describe what you have done on the farm to preserve habitat, like maintaining shrubs and trees
- Have you added some habitat to the farm, such as planting some landscape plants? If so, that is habitat enhancement. Simply describe what you have added.

Practice 11.44 (Module 11 Materials Handling & Waste Management – FARM):

A materials handling and waste management plan with goals has been developed and documented for the flower farm, and includes elements such as packaging, hazardous waste, recycling and waste water.

Water Management Plan Guide

<u>Materials Handling & Waste Management Goals:</u>
Goals tend to be relatively high level things. Here are some examples:
- To reduce the amount of hazardous waste on the flower farm by X% by 2017
- To use X% of recycling material in packaging by 2018
- To recycle 100% of the cardboard and glass used by the flower farm by 2017

<u>Packaging:</u>
- Describe how packaging is approached, such as where material is sourced, what criteria are used for purchasing packaging.
- Do you have a program for minimizing package? If so, describe it.

<u>Hazardous Waste:</u>
- Do you have an overall approach for handling hazardous waste on the farm? If so, describe it.
- Do you keep an inventory of hazardous waste? If so, describe the process for keeping track of it.
- Do you have a goal of reducing it? If so, describe the process for achieving it.
- Describe the safety training for employee use of hazardous material
- Describe how hazardous waste containers are handled.

<u>Recycling:</u>

- Do you have an overall program/approach to recycling? If so, describe it here.
- Do you communicate the recycling program to employees? If so, describe how this is done.
- If you plan to enhance the recycling program this coming year, say so here.

Waste Water:
- Describe how waste water is handled on the flower farm

Practice 12.85 (Module 12 Social Responsibility Management – FARM):

A social responsibility management plan with goals has been developed and documented for the flower farm, and includes elements such as staffing, recruiting, retention, employee wellness and neighbors and community.

Social Responsibility Management Plan Guide

Social Responsibility Management Goals:
Goals tend to be relatively high level things. Here are some examples:
- To retain valuable employees
- To ensure that the flower farm is a desirable place to work
- To be a good neighbor in the community

Staffing and Recruiting:
- Describe the process for hiring a new employee, including how and where the job is advertised,
- Do you have written descriptions of each position/job in the company? If so, say so.
- Do you have an employee handbook? If so, say so, and when it is given to the employee.
- Describe how it is determined that a new position is needed on the flower farm.

Employee Retention:
- Do you have a grievance process for employees? If so, describe it.
- Do you recognize employees for a job well done? If so, describe how it is done.
- Do you recognize employees for years of service? If so, describe how it is done.
- Describe any financial benefits offered to employees such as 401k, health benefits, etc. used to retain good employees.
- Describe any team building efforts you do to keep morale high

Employee Wellness:
- Describe lunch and rest breaks
- If you provide break room/lunch room, describe it

- Describe how you keep employees safe on the job
    - Including heat precautions
- If you encourage employees to be physically fit and/or have a good diet, describe how this is done.

<u>Neighbors & Community:</u>

- Do you have a policy of keeping good relations with Neighbors? If so, how is this done?
- Do you have a process for dealing with complaints from neighbors? If so, describe it.
- Do you encourage employees to get involved in neighborhood and/or community activities? If so, describe how this is done.
- Does your company donate to charities? If so, describe these donations.

CERTIFIED BloomCheck
California Standards for Sustainable Flower Farming

Commonly Use Pesticides by Trade Name and their BloomCheck Do Not List classification
(in alphabetical order)

On BlooomCheck DNU List?	**Trade Name**	**Active Ingredient**
Yes	1300 Orthene TR	Acephate
No	26GT Fungicide	Iprodione
No	3336 WP	Thiophanate methyl
No	3336F	Thiophanate methyl
No	Abamectin 0.15EC	Abamectin
Yes	Acephate 97 UP	Acephate
No	Actinovate	Steptonyces lidigus
No	Adept	Diflubeneron
No	Agri-Mycin	Streptomycin sulfate
No	Akari 55C	FENPYROXIMATE
No	Aliette WDG Brand Fungicide	Aluminum Tris
No	Aria	Flonicamid
No	Astro Insecticide	Permethrin
No	Avid 0.15EC	Abamectin
No	Banner Maxx	Propiconazole
No	Banrot 40 WP	Terrazole; thiophanate methyl
Yes - Restricted	Benefit 60WP	imidachloprid
No	Bontanigard ES	Beauvaria bassiniana strain GHA
No	Boot Hill Rodenticide Pellets	bromadialone
No	Botanigard ES	Beauvaria bassiniana
No	CapSil	Adjuvent
No	Captan 50 WP	Captan
No	Captan 80 WDG	Captan
Yes	Carbaryl Cutworm Bait	carbaryl
No	Cease	Bacillus subtilus
No	Champ Formula 2FL	Copper hydroxide
No	Chipco 26 GT	Iprodione
No	Chipco 26019	Iprodione

1

On BlooomCheck DNU List?	Trade Name	Active Ingredient
No	Chipco 26020 N/G	Iprodione
No	Chlorothalonil 720 SFT	chlorothalonil
No	Citation	Cyromazine
No	Compass O	Tryfloxystrobin
No	Conserve SC	Spinosad
No	Cosavet 80DF	Sulfur
No	Credit Systemic	glyphosate
No	Cupro 5000	Copper hydroxide
No	Curalan EG	Vinclosolin
No	Cygnas	Kresmoxin - methyl
No	Daconil Ultrex	chlorothalonil
No	Daconil Weather Stik	chlorothalonil
No	Dacthal W-75	DCPA dimethly tetracloroterephthalate
No	Dazide 85WSG	Daminozide
No	Deadline M-PS Mini Pellets	metaldehyde
No	Decathlon 20 WP	cyfluthrin
No	Decree 50 WDG Fungicide	fenhexamid
Yes	Dimethoate 2.67	dimethoate
No	DiPel Pro DF	Bt
No	Diquat E Pro 2L	diquat dibromide
No	Direx 4L	diuron
Yes - Restricted	Discus	imidachloprid
No	Distance Insect Growth Regulator	Pyriproxyfen
No	Dithane 75DF Rainshield	mancozeb
Yes - Restricted	Duraguard ME	chlorpyrifos
Yes - Restricted	Dursban 50 W	chlorpyrifos
No	Eagle 20EW	myclobutanil
No	Eagle 40EW	myclobutanil
No	Echo 720	chlorothalonil
No	Endeavor	Pymetrozine
No	Endeavor 50 WG	Pymetrozine
No	Endorse WP	Pyloxin D Zinc Salt
No	Engage 10G	
No	Enstsar II	S-Kinprene
No	Envoy	Clethodim
No	E-rase Concentrate	oil of jojoba
No	Evergreen EC 60-6	Pyrethrin

On BlooomCheck DNU List?	Trade Name	Active Ingredient
No	Exponent	Piperonyl butoxide PBO
Yes - Restricted	Flagship 0.22G	Thiamethoxam
Yes - Restricted	Flagship 25WG	Thiamethoxam
No	Floral Brand Fruit Eliminatior?	ethefon
No	Floramite SC	bifenazate
No	Fosetyl - AL 80WDG	Fosetlyl-AL
No	Fungo flo	Thiophanate methyl
No	Fusilade II Turf Ornamental	fluazifop-P-butyl
No	Gallery	isoxaben
No	Gallery 75DF	isoxaben
No	Gavicide Green - Leaf Life	Mineral Oil
No	Glacier 10G	pentachloronitrobenzene
No	Gnatrol	B. thuringiensis israelensis
No	Goal 2XL	oxyfluorfen
No	Gramoxone Extra	paraquat dichloride
No	Gramoxone Max	paraquat dichloride
No	Grandslam 75WP	methiocarb
No	Heritage	azoxystrobin
No	Hexygon DF Ovicide/Miticide	hexythiozox
No	Hi-Wett	Adjuvent
No	Honcho Plus	glyphosate
Yes	Hyponex Bug Spray	resmethrin
Yes - Restricted	Imida E-Pro	imidacloprid
Yes - Restricted	Imidacloprid 2F	imidacloprid
Yes - Restricted	Imidan 70-W	Phosmet
No	Insignia	pyraclostrobin
No	Iprodione Pro 2SE	Iprodione
No	Javelin WG	Bacillus thuringiensis sub kurstaki
No	Judo	spiromesifen
No	Kaligreen	potassium bicarbonate
No	Karmex XP	diuron
No	Kelthane MF	dicofol
No	Kocide 101	Cooper Hydroxide
No	Kocide 4.5LF	Cooper Hydroxide
No	Kocide DF	Cooper Hydroxide

On BlooomCheck DNU List?	Trade Name	Active Ingredient
Yes	Lannate	Methmyl
No	LI 700	Adjuvent
No	Lorox DF	Linuron
No	Makaze	glyphosate
Yes - Restricted	Mallet 2 F T&O	imidacloprid
No	Manage	Fipronil
Yes - Restricted	Marathon 1% Granular	imidacloprid
Yes - Restricted	Marathon 60WP	imidacloprid
Yes - Restricted	Marathon II	imidacloprid
No	Mavrik Aquaflo	tau-Fluvalinate
No	Medallion WDG	fludioxonil
No	Menfenoxam 2 AQ	Menfenoxam
Yes - Restricted	Merit 75 WP	imidacloprid
No	Mesurol 75-W	methiocarb
No	Micora	Mandipropamid
No	Microthiol Special	sulfur
No	Mildew Cure	Conton seed oil, corn oil, garlic oil
No	Milstop	potassium bicarbonate
No	M-Pede	Potassium salts of fatty acids
No	M-Roots	
No	Naccosan	dioctyl, didecyl methyl and alcyl ammonium chlorides
No	Ornazin 3%EC	Azadirachtin
Yes - Restricted	Orthene TT&O	Acephate
No	Oryzalin 4 PRO	oryzalin
No	Overture 35WP	pyridalyl
No	Oxamyl 10%	Oxamyl
No	Pageant	pyraclostrobin. Boscalid
No	Pageant Intrinsic	pyraclostrobin. Boscalid
No	PCNB 10G	pentachloronitrobenzene
No	PCNB 2E	pentachloronitrobenzene
No	Pedestal	Novaluron
No	Pennant Magnum Herbicide	S-metachlor
No	Phyton 27	cooper sulfate
No	Pipron	piperalin
No	Potassium Carbonate	

On BlooomCheck DNU List?	Trade Name	Active Ingredient
No	Protect DF T&O	zinc, manganese and bisdiothiocarbonate
No	Protect DF WSB	zinc, manganese and bisdiothiocarbonate
No	Pylon	Chlorfenapyr
No	Pyrelin EC	pyrethrins and rotenone
No	Pyrenone	pyrethrins; pbo
No	Quadris	azoxystrobin
No	Quest	Adjuvent
No	Reward	diquate dibromide
No	Rhapsody AS	Bacilus subtilis
No	Ronstar Flo Herbicide	oxadiozon
No	Ronstar G	oxadiozon
No	Rootshield Drench	Trichorderm harzianum
No	Round Up	glyphosate
No	Rout Ornamental Herbicide	oxyfluorfen, oryzalin
No	Rubigan AS	fenarimol
No	Rubigan EC	fenarimol
No	Safari 20 SG Insecticide	dinotefuran
No	Sanmite	Pyridaben
No	Sanmite 75WP	Pyridaben
No	Scimitar	lambda cyalothrin
Yes	Sevin SL	carbaryl
No	Showcase	trifluralin, isoxaben, oxyflourfen
No	Shuttle 15 SC	Acequinocyl
No	Sonata	Bacilus pumilus
No	Spectro 90 WDG	Chlorothalonil; thiophanate methyl
No	Strike 50-WDG	triadimefon
No	Subdue GR	mefenoxam
No	Subdue Maxx Fungicide	mefenoxam
No	Sulfur - Dusting	sulfur
No	Sunspray oil	oil of jojoba
No	Surflan AS	oryzalin
No	Systec 1998 WDG	Thiophanate methyl
No	Talus 70 DF	Buprofezin
No	Tame 2.4EC	fenpropathrin

On BlooomCheck DNU List?	Trade Name	Active Ingredient
No	Terraclor 400	pentachloronitrobenzene
No	Terraclor 475WP01	pentachloronitrobenzene
No	TerraGuard	Trilfumizole
No	Terrazole CA	Etridiazole
No	TetraSan 5 WDG	Etoxazole
No	Thiolux	sulfur
No	Thiolux Jet	sulfur
No	T-Methyl E Pro 50 WSB	Thiophanate methyl
No	T-Methyl SPC	Thiophanate methyl
No	Tract 70	Neem oil
No	Triforine EC	Triforine
No	Trii-Star 70WP	acetamiprid
No	Tri-Star 30 SG	acetamiprid
No	Tri-Star 8.5SL	acetamiprid
No	Turflon Ester	triclopyr
No	Turfside 10G	pentachloronitrobenzene
No	UP Star SC	bifenthrin
No	Vorlan DF	Vinclosolin
No	Xentari	Bacillus thuringiensis sub aizawai
No	ZeroTol	Acetic acid

Attachment 1. Locations of FMNP only and FMNP and FVC Authorized Farmers' Markets in California

Panel A: FMNP Authorized Farmers' Markets (380)

Panel B: FMNP and FVC Authorized Farmers' Markets (36)

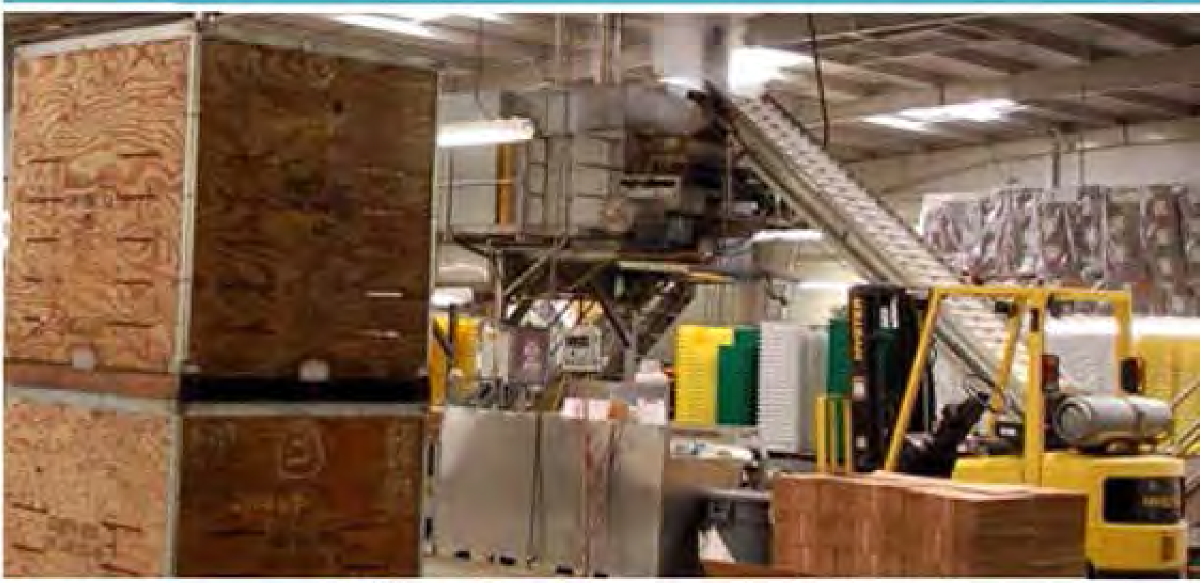
June 2016

Specialty Crop Cluster Assessment

SACRAMENTO REGION

A project of the Rural-Urban Connections Strategy (RUCS) through the Food Systems Multipliers Project

SACOG



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ABOUT THIS PROJECT

The value of specialty crops grown in the Sacramento region extends far beyond the farm, supporting further economic activity and jobs throughout the greater regional economy.

The *Food System Multipliers for Specialty Crops in the Sacramento Region* project is work conducted by SACOG in partnership with ERA Economics and BAE Urban Economics. Together, the project has developed updated data, economic modeling techniques and tools to better demonstrate the full economic value of specialty crop production in the Sacramento region. This first deliverable, the Specialty Crop Cluster Report: Sacramento Region, links specialty crop farms to a core cluster of processing, distribution and support industries. A companion Specialty Crop Multiplier Study then shows how this cluster interacts with the larger economy through a multiplier effect. The project's Executive Summary combines these two technical deliverables for an integrated approach to specialty crop economic development.

Specialty crop agriculture in the Sacramento region is not only highly productive and diverse; it is a major economic driver. However, the role of specialty crops is often overlooked due to a poor understanding of how the industry's economic impacts circulate throughout the larger regional economy. In response, the Sacramento Area Council of Governments (SACOG) has shifted the planning paradigm to more explicitly include analysis of agriculture and rural areas. Through technical work and stakeholder engagement, SACOG's RUCS program strives to bring the region's understanding of rural issues on par with those in urban settings and has demonstrated how policies and strategies impact both parts of the region.

Growing specialty crop food and fiber in our region creates jobs and income both on and off the farm. This report—the first in the *Food System Multipliers* project—combines specialty crop production with core processing, support, and distribution industries into a regional Specialty Crop cluster, and explores connections between this cluster, the full Food and Agriculture cluster, and the larger regional economy. It draws on recent employment and other data to begin to quantify the substantial economic contribution of these core industries constituting the Sacramento region's Specialty Crop cluster. Yet while this report's cluster framing helps connect specialty crop production with related industries, it does not show the ripple effect of how these Specialty Crop cluster industries then interact with the larger economy. In response, SACOG has worked with project partners ERA Economics and BAE Urban Economics to construct an updated economic model that captures the impact of the region's Specialty Crop cluster on the full regional economy. The results of the model—contained in the companion Specialty Crop Multiplier Study project deliverable —show how the economic activity documented here in this cluster assessment report circulates even further through a ripple, or multiplier, effect. Together the work of the Specialty Crop Assessment report describing the core cluster industries and the Specialty Crop Multiplier Study connecting this cluster to the larger regional economy are synthesized in the project's executive summary to highlight the full economic contribution of specialty crops in the Sacramento region.

INTRODUCTION TO THE SPECIALTY CROP CLUSTER

This report moves beyond the farm to analyze the economic contributions of the specialty crop industry cluster, a subset of the larger Food and Agriculture Cluster, in the Sacramento region. An industry cluster is a group of interdependent firms and related institutions that are linked through strong relationships and transactions. The full range of inputs and outputs in the Specialty Crop cluster include various types and scales of production, markets, and value-added processing in addition to work on specialty crop farms. Related food industries provide resources and equipment for growing or harvesting specialty crops and processing, packaging, or using specialty crops to prepare other food products. In this analysis, SACOG divided industries within the Specialty Crop cluster into the following four subsectors:

Cluster research is a widely accepted practice for developing regional prosperity strategies for sustained job creation and growth that leverage unique regional strengths. Industry clusters increase firm competiveness through shared infrastructure and a concentrated workforce; reduce operating costs with shorter supply chains; increase the flow of information regarding new business opportunities; and foster innovation with informal collaboration and heightened competition. Economic clusters often serve as the driving force of many regional economies.

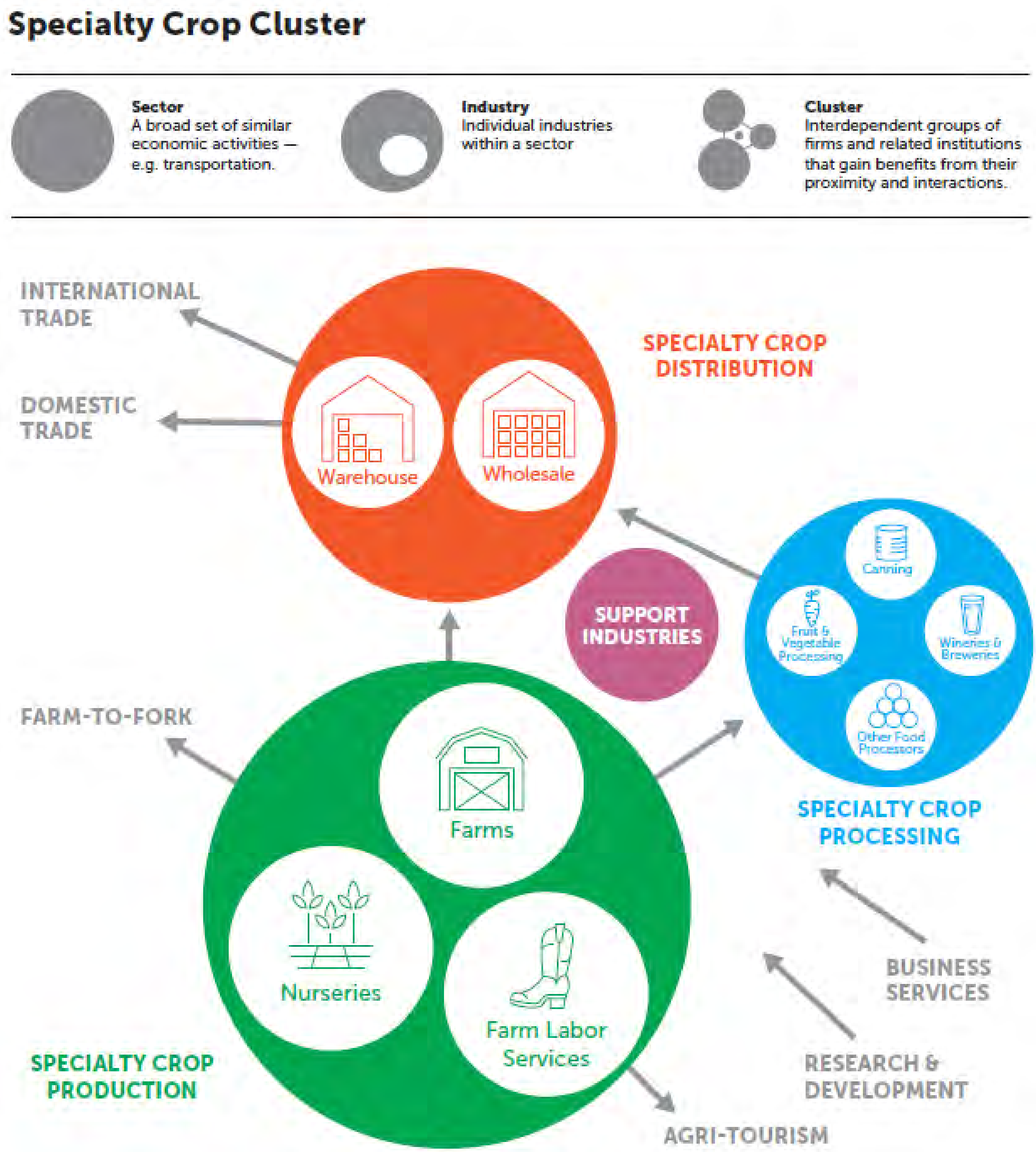
Specialty Crop Production – These firms produce, farm, and harvest specialty crops. Specialty crop production firms include nut, vegetable, and fruit farming and harvesting; pre- and post-harvest activities; nursery and floriculture production; farm labor contractors; and farm management services.

Specialty Crop Processing – Firms in this segment of the cluster process, manufacture, package, or prepare food products using specialty crops as inputs. Specialty crop processing firms include oil processing; fruit, vegetable, and other specialty canning; and the specialty crop component of various processing industries such as dried and dehydrated food manufacturing; roasted nuts and peanut butter manufacturing, prepared sauce manufacturing; and wineries.

Specialty Crop Distribution – These firms store, transport, or sell specialty crop products in bulk quantities as merchant wholesalers. Specialty crop distribution firms include the specialty crop component of grocery, fruit and vegetable, confectionary, and alcoholic beverage merchant wholesalers; refrigerated and farm product warehousing and storage; and food service contractors.

Specialty Crop Support – Firms in this segment of the cluster support specialty agricultural production by providing resources and equipment for growing and harvesting specialty crop products. Specialty crop support firms include fertilizer and pesticide manufacturing, farm and food machinery and equipment manufacturing, farm supply merchant wholesalers, and nursery and florist merchant wholesalers.

Figure 1: Specialty Crop Cluster Components



The way that food reaches our tables is complicated, yet remarkable, as fresh and processed food travels in and out of our region daily. The fuller food system encompasses multiple business sectors providing a range of services that move food products from farms, orchards, and fields to consumers. Although some products arrive "raw," most are transformed into processed or packaged goods along the way. As such, the food system extends beyond the farm to include an aggregation, distribution, and processing system that is both local and global in scale. Specialty crops—defined in this study as fruits, vegetables, tree nuts, horticulture and nursery crops—are an important part of this food system, whose production is linked to both input suppliers as well as related business industries along the full food supply chain.

In short, the Specialty Crop cluster impacts many elements of the Sacramento region's overall economy. This study quantifies employment in the cluster's core production, support, processing and distribution activities (represented by the colored circles in Figure 1 above). Employment in further related industries (such as those in greyed-out text above) are not included here because the project team could not isolate these industries' related specialty crop activity without an updated economic model. The project's companion Specialty Crop Multiplier Study deliverable performs this economic modeling to produce a broader multiplier effect of specialty crop production. So while the subsequent cluster analysis of this report does provide an updated investigation into the core activities connected to specialty crops within the food system in the Sacramento region, its data and job figures do not represent the full network of associated economic impacts and employment, which are covered in the project's executive summary.

This report delves into the regional Specialty Crop cluster, quantifying employment and other data points for its four subsectors of production, processing, distribution and support. The data analysis begins by describing ***current conditions*** in the cluster, then explores ***recent trends*** as the cluster continues to support the region's economic rebound, and concludes with a look forward to key ***challenges and opportunities*** in sustaining this recent growth. The study only includes the economic activity of specialty crop industries in the six-county SACOG region. For those cluster industries that include a blend of specialty and non-specialty economic activity, the project team used the IMPLAN base model and several data sets to estimate only the specialty crop component of the business service for analysis. This report's technical appendix (A-1) describes our methodology to estimate the specialty crop elements in cluster industries, includes the data sources analyzed (including EMSI, IMPLAN, CREE, and the ES-202 Covered Employment and Wages Program), and assumptions. As such, it is important to recognize that the reported economic indicators for the cluster are estimates, but based on a synthesis of the best available data.

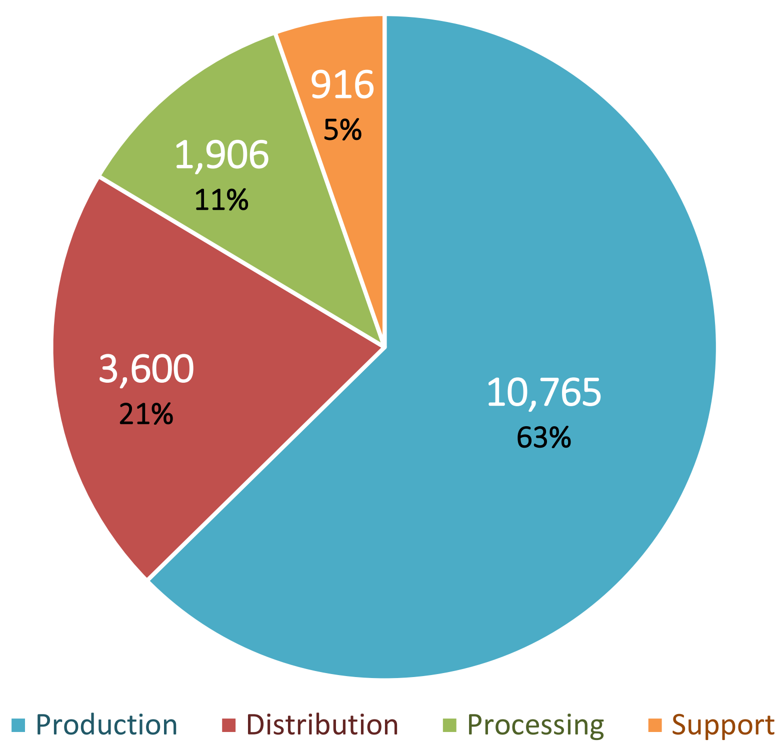
Part 1.
SPECIALTY CROP CLUSTER CURRENT CONDITIONS

EMPLOYMENT

> A survey conducted by the California Farm Bureau in 2012 found that many growers in the SACOG region experience labor shortages, and reported a statewide shortage between 10 percent and 30 percent. If unaddressed, this challenge could inhibit further growth in the cluster.

The Specialty Crop cluster is an important part of the Sacramento region's economy. In 2014, direct employment in the cluster included almost 17,200 jobs or about 1.6 percent of total employment in the six-county region. As shown in Figure 2, the largest concentration of these jobs (63 percent) were in specialty crop production, a significantly greater proportion than the Food and Agriculture cluster as a whole, calling attention to the relative labor intensity of growing specialty crops. Remaining employment fell into the Specialty Crop cluster's distribution (21 percent), processing (11 percent), and support (5 percent) subsectors respectively. Together, these "off-farm" industries make up 37 percent of employment in the Specialty Crop cluster, showcasing how food system job opportunities extend beyond the farm into other facets of the regional economy. This employment distribution among the subsectors is very similar to that of the specialty crop cluster for California as a whole. However, compared to agriculture at large in the region, the distribution subsection of the Specialty Crop cluster in particular has a lower proportion of employment.

Figure 2: 2014 Sacramento Area Specialty Crop Employment by Subsector



Source: SACOG Analysis of EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; CREE, 2013; ES-202, 2014, IMPLAN 2013 model.

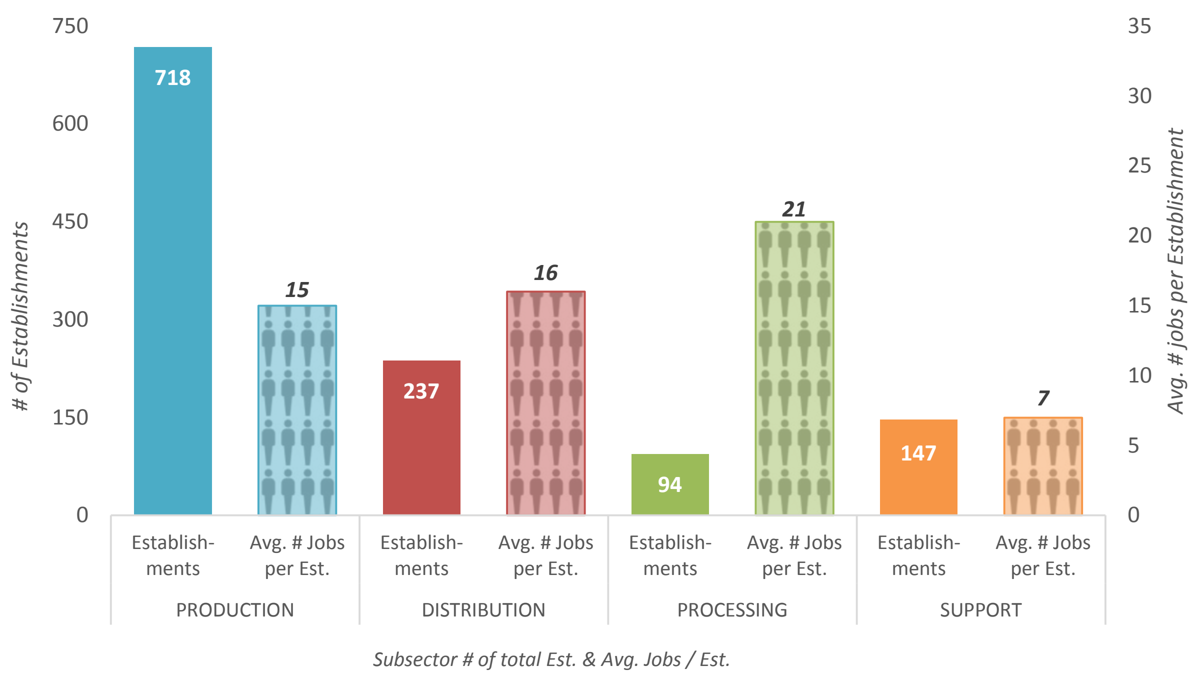
ESTABLISHMENTS

Overall there are almost 1,200 establishments in the regional Specialty Crop cluster. Figure 3 displays the total number of establishments and the average number of jobs per establishment for the four cluster subsectors. The production subsector has the most firms (over 700), yet also has a lower average number of employees per establishment (15) as compared to other subsectors in the region (the support subsector is the lowest at 7 jobs per average establishment).

An establishment is a business providing goods and/or services within an industry, generally engaging in a single type of economic activity and operating from a single physical location. Most employers have only one establishment, however, larger employers may have several.

The processing subsector has a smaller number of total establishments (100), but has the highest average number of workers per establishment (21). This total of around 100 processing establishments does not include the components of specialty crop processing that occur on farms. Though the larger processing facilities in the region — such as fruit and vegetable canning — employ a high average of workers per establishment, recent RUCS work has centered on the market opportunity to complement regional specialty crop processing activities with a focus on mid-scale facilities such as food hubs.

Figure 3: Establishments and Average Employment per Establishment by Subsector, 2014



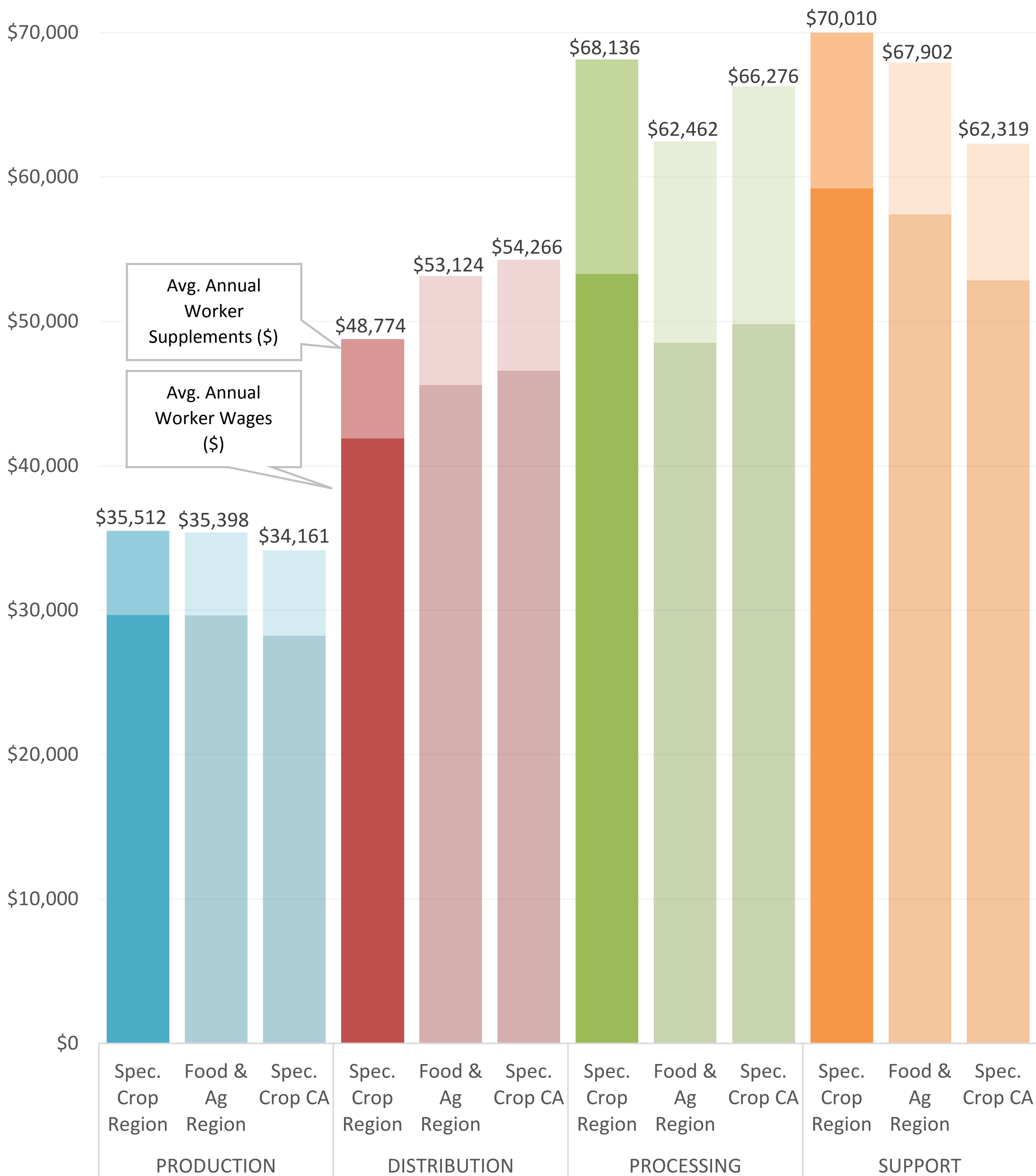
Source: SACOG Analysis of EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; CREE, 2013; ES-202, 2014, IMPLAN 2013 model.

WORKER EARNINGS

Labor can be a particular challenge in specialty crop agriculture. Thin profit margins and international competition in specialty crop agriculture can keep wages low, which, coupled with hard manual labor, can make these jobs unattractive to many people. Together, these factors affecting the competitiveness of the cluster in the labor market also have an impact the profitability of growing specialty crops on the farm and moving specialty crop products through regional supply chains.

Worker annual average earnings in this study include an average of all wages, salaries, proprietor earnings and supplemental earnings (e.g., retirement benefits, bonuses) for all industries in the Specialty Crop sector. Average annual earnings for the Specialty Crop cluster in the region total about $43,750, where roughly 17 percent is from worker supplements. This is higher than the average annual earnings of $43,250 statewide for these same specialty crop industries. However, earnings for the full Food and Agriculture cluster in the Sacramento region are higher than the regional Specialty Crop average, totaling around $48,000 per year, owing to the large proportion of specialty crop workers employed in lower wage crop production jobs. As shown in Figure 4 on the next page, the support subsector provides the best cluster earnings in the region, which are higher than both the statewide Specialty Crop cluster and the larger Food and Agriculture cluster. Conversely, production provides the lowest earnings compared to the other subsectors. The processing and distribution sectors fall in the middle of cluster earnings, however, distribution is the only sector to offer lower earnings than the statewide Specialty Crop and larger regional Food and Agriculture clusters.

Figure 4: Weighted Average Total Earnings of Regional Specialty Crop Cluster Industry Employees by Subsector, Compared to the Larger Regional Food and Agriculture Cluster and the California Specialty Crop Cluster, 2014



Source: SACOG Analysis of EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; ES-202, 2014; IMPLAN 2013 model.

CONCENTRATION OF EMPLOYMENT

Regional and Subsector Concentration

A location quotient is a ratio that compares regional employment in a particular industry to employment in that same industry at a larger geography (in this case, California). A location quotient of less than one indicates a lower proportion of employment for that industry in the Sacramento region than in the state overall. A location quotient of more than one indicates a regional industry with higher concentration of employment compared to the state average.

Location quotient (LQ) analysis provides a useful tool to identify regional economic specializations (see box at left). Compared to the full state economy, employment within the Sacramento region's Specialty Crop cluster is far less concentrated on average. As shown in Figure 5 below, the support subsector has the highest concentration of employment (0.70) within the cluster, which is still a lower concentration of employment compared to the state average in this industry. The distribution subsector has the lowest concentration within the cluster at 0.47, while production (0.52) and processing (0.56) in the Sacramento region still exhibit only about half of the average statewide employment concentration. Compared to the full Food and Agriculture cluster, the Specialty Crop cluster generally includes less concentrated employment across sectors.

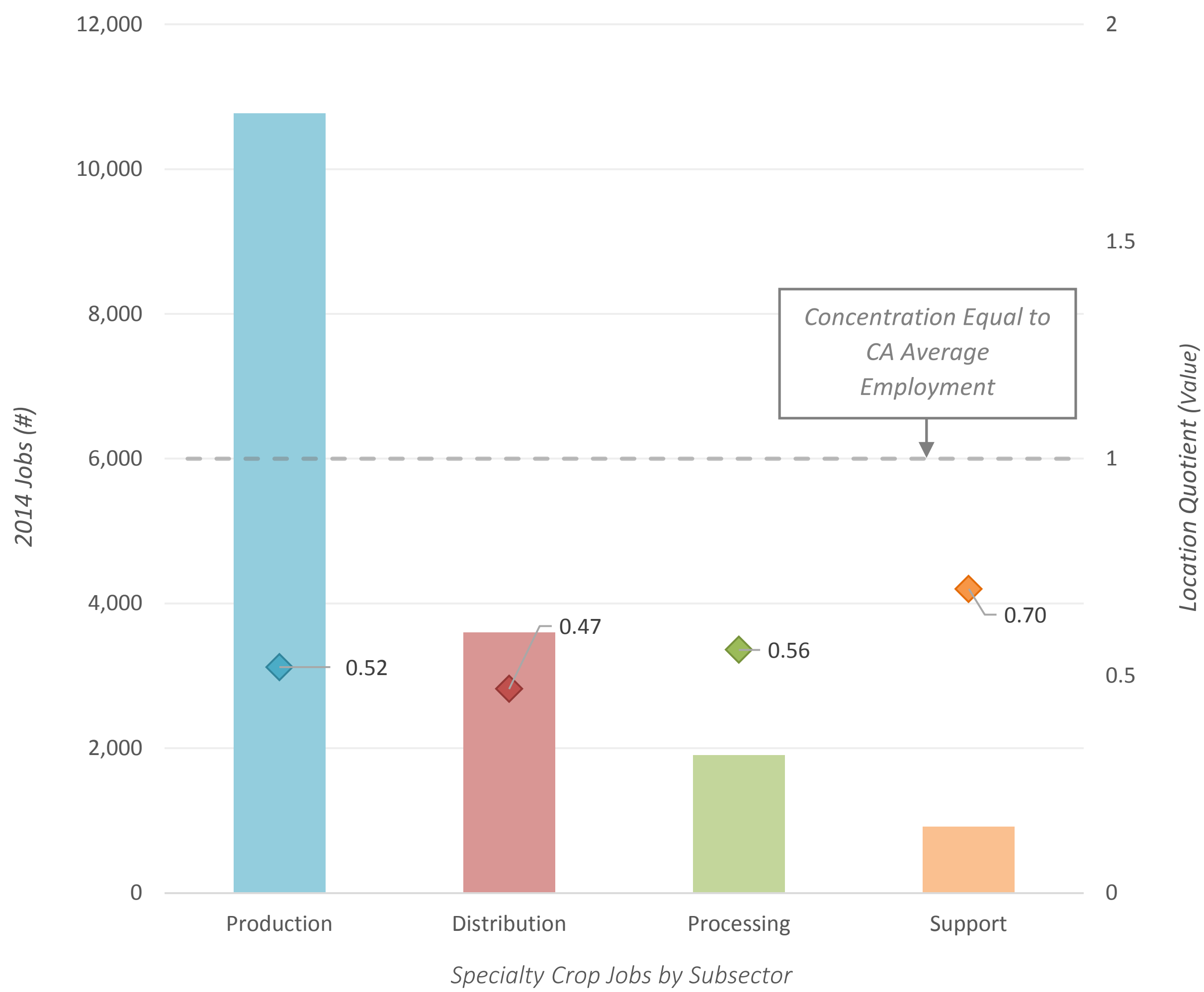
Within the cluster subsectors, there are many individual industries with regional location quotients significantly above average. Several prominent examples include:

- ***Processing*** – dried and dehydrated food manufacturing (3.19 LQ), roasted nut manufacturing (2.87 LQ), specialty canning (1.86 LQ), and oilseed processing (1.36 LQ);
- ***Distribution*** – specialty crop warehousing and storage (3.96 LQ); and
- ***Support*** – farm and garden machinery and equipment (1.18 LQ).

Subsector industries with location quotients significantly below the state average include:

- ***Distribution*** –refrigerated warehousing and storage (0.12 LQ) and wine and distilled alcoholic beverage merchants (0.24 LQ); and
- ***Production*** – farm management services (0.09 LQ) and crop harvesting primarily by machine (0.31 LQ).

Figure 5: Total Specialty Crop Employment and Location Quotient by Subsector, 2014



Source: SACOG Analysis of EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; CREE, 2013; ES-202, 2014, IMPLAN 2013 model.

Geographic Concentration

Firms in a cluster draw a productive advantage from their geographic concentration. In addition to co-location, firms in a cluster share common resources and technologies and rely on a similar labor pool and institutions. Hotspot mapping analysis measures where cluster employment is most concentrated. By design, the hotspot analysis does not visually display all areas of activity, just those with distinct co-location. As such, the following maps do not depict all the various specialty crop food system employment that occurs throughout the entire six-county Sacramento region. However, the results show how Specialty Crop cluster employment extends far beyond the farm. Figure 6a below illustrates where employees in the Specialty Crop cluster are most concentrated within the region, using SACOG's Draft 2015 Employment Inventory.[1] Overall, the largest concentration of cluster employees is located in the city of Woodland, followed by the cities West Sacramento (northeast) and Sacramento (downtown and southeast). Additionally, there is a significant grouping of employees in Yuba City and the community of Courtland in Sacramento County. Compared to the larger Food and Agriculture cluster, these Specialty Crop cluster concentrations are more substantial in Woodland and Courtland and less substantial in Marysville, Davis, Rocklin, and Galt.

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[1] SACOG's Draft 2015 Employment Inventory was developed using data from the Employment Development Department. The information is in draft form, as SACOG is currently reviewing and editing the data for final release later this year. While employment estimates may change on a smaller scale, the location and total of employees at the cluster level provides useful information about employment concentration. The employment concentration maps use the spatial analyst function in GIS to calculate "densities" of employment by standard deviation from the mean to show where employment is clustered geographically.

Employment concentrations vary when broken out by Specialty Crop cluster subsector, as shown in Figure 6b (1-4). Jobs in the production subsector are concentrated around Galt and the area of Sacramento County between the cities of Sacramento, Rancho Cordova, and Elk Grove. Areas near the communities of Ryde (Sacramento County), Norton (Yolo County), and Garden Valley (El Dorado County) also include significant concentrations of production jobs. Other lower concentrations are present throughout Sacramento, Sutter, and Yolo Counties. When compared to the larger Food and Agriculture cluster, the Garden Valley concentration is more prominent and the concentrations in Davis, Marysville, Woodland, and Yuba City are less prominent. Generally, these findings of production employment distribution stem from the inclusion of farm labor contractor firms in the production segment of the cluster. These firms may be incorporated in a single facility, but supply labor to farms across the region. Thus in Figure 6b.1 below, the mapping emphasizes the physical location of specialty crop farm labor supply firms, not necessarily how this labor spreads to farms throughout the region.

The regional nature of the Specialty Crop cluster becomes particularly apparent when paired with the RUCS crop map showing acres of specialty crop production. Figure 6c below provides a simplified version of the crop map which identifies specialty crops in the region (the full map includes crop data at the individual field and crop level). While the production component of the cluster is more dispersed in terms of employment (as shown in Figure 6b), its substantial specialty crop output supports the additional economic activity and jobs found in the other subsectors of the cluster. In other words, without specialty crop production, the rest of the cluster's contribution to the regional economy would be severely limited. The modeling and scenarios included in the *Food System Multipliers* project's companion Specialty Crop Multiplier Study help show how an increase in specialty crop production leads to further economic activity along the regional supply chain (or, how a decrease in specialty crop production would lead to economic contraction throughout the cluster, and throughout the economy as a whole).

Specialty crop distribution employment generally follows the same concentration pattern as the larger Food and Agriculture cluster. These jobs are primarily located in the cities of Yuba City and Sacramento (north, downtown, and southeast) and the community of Ryde (Sacramento County), with a less significant concentration in Rocklin. Processing is characterized by large employment concentrations in Woodland and downtown Sacramento, with eastern Sacramento city and county demonstrating less significant specialty crop concentrations than the full Food and Agriculture processing sub-cluster. Finally, the support subsector includes significant concentrations in Davis, west of Woodland and West Sacramento, and Yuba City, plus significant groupings between Rocklin and Loomis and west of Auburn. The Specialty Crop support subsector demonstrates the most variation of the subsectors when compared to the larger Food and Agriculture cluster — with greater employment concentrations near Davis, Loomis, Rocklin, and West Sacramento and lesser concentrations in Live Oak, McClellan Airfield, Sacramento, Rancho Cordova, and the community of Walnut Grove.

Figure 6a: Specialty Crop Cluster Employment Concentration

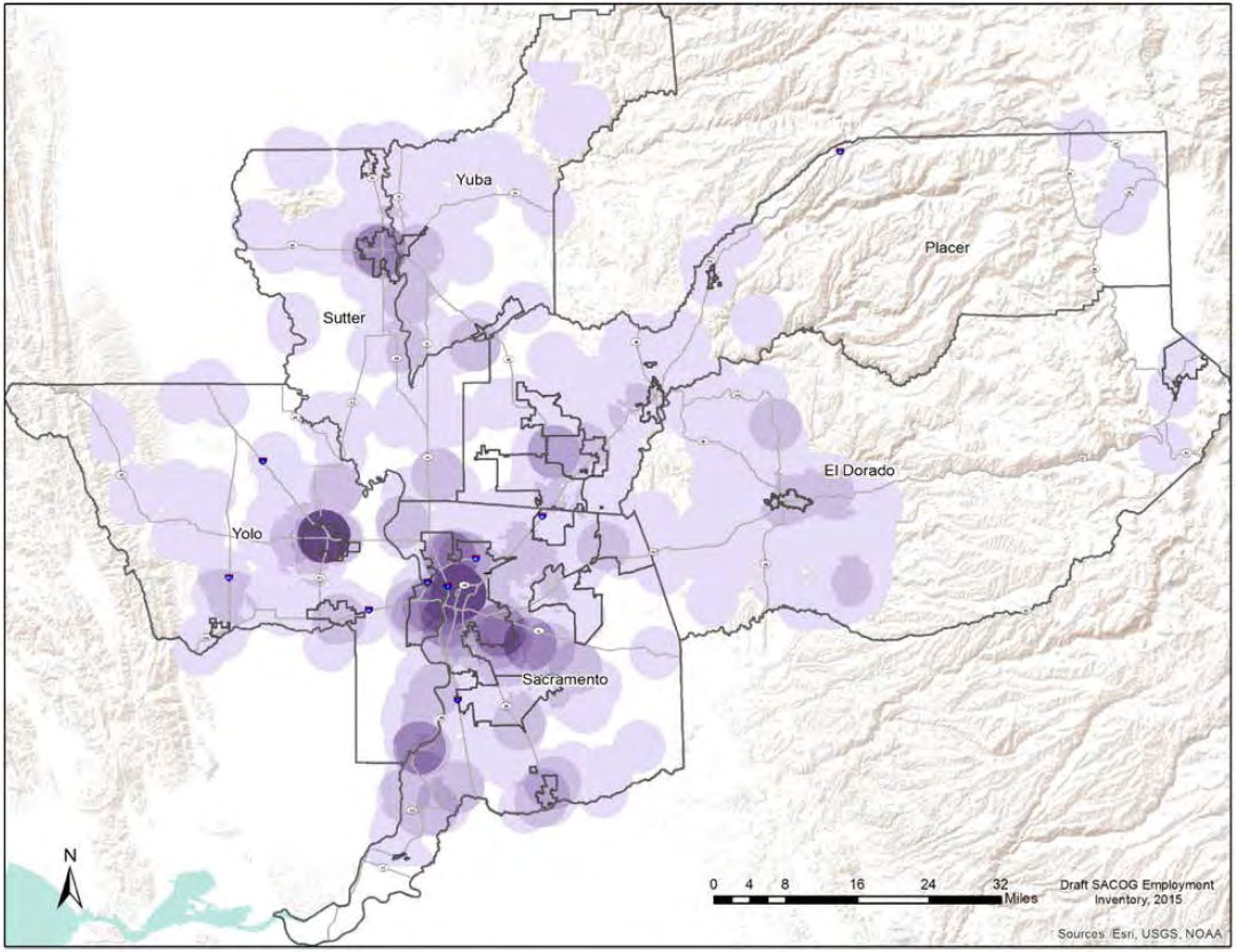


Figure 6b: Employment Concentration by Specialty Crop Cluster Subsector

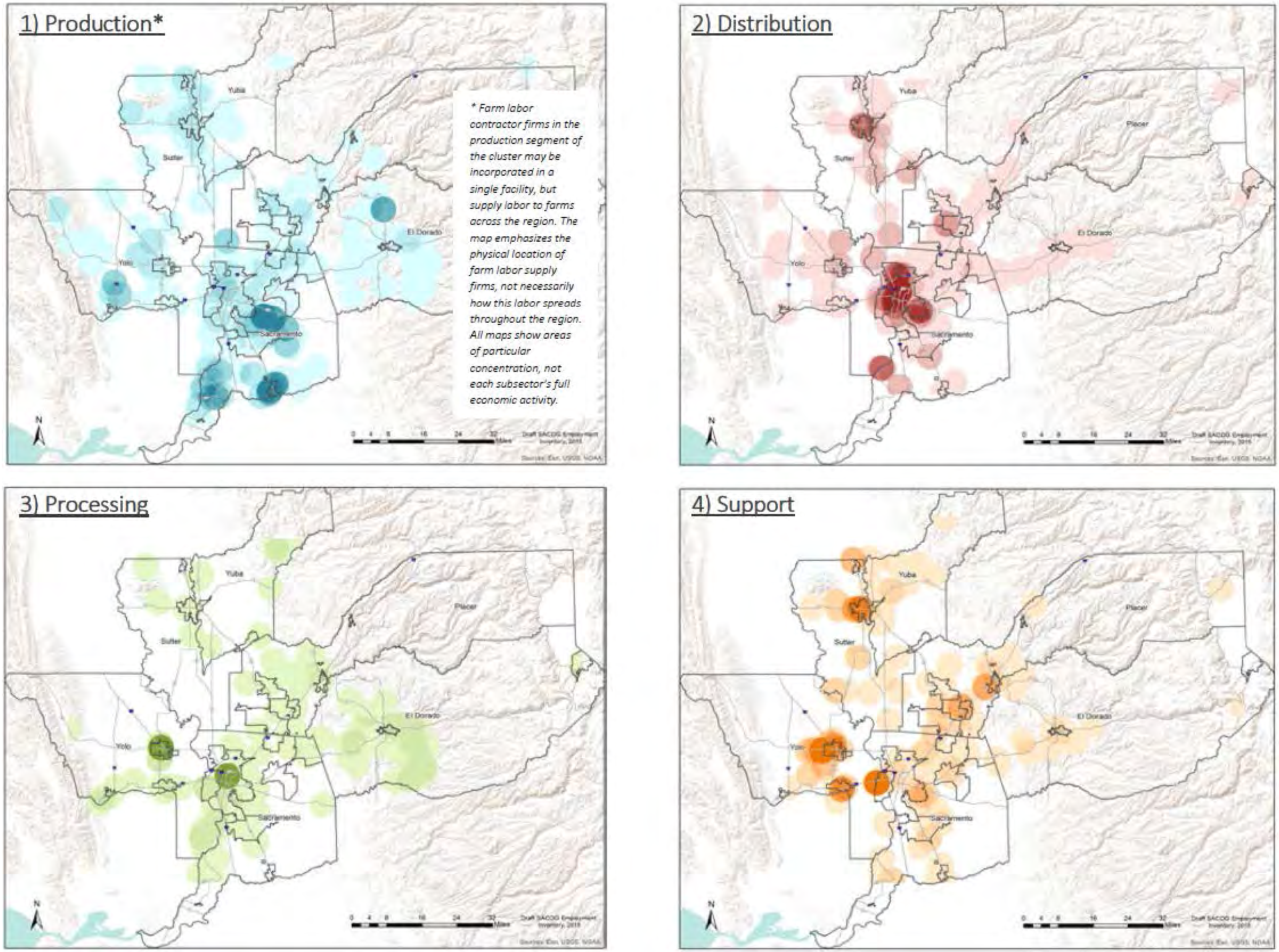
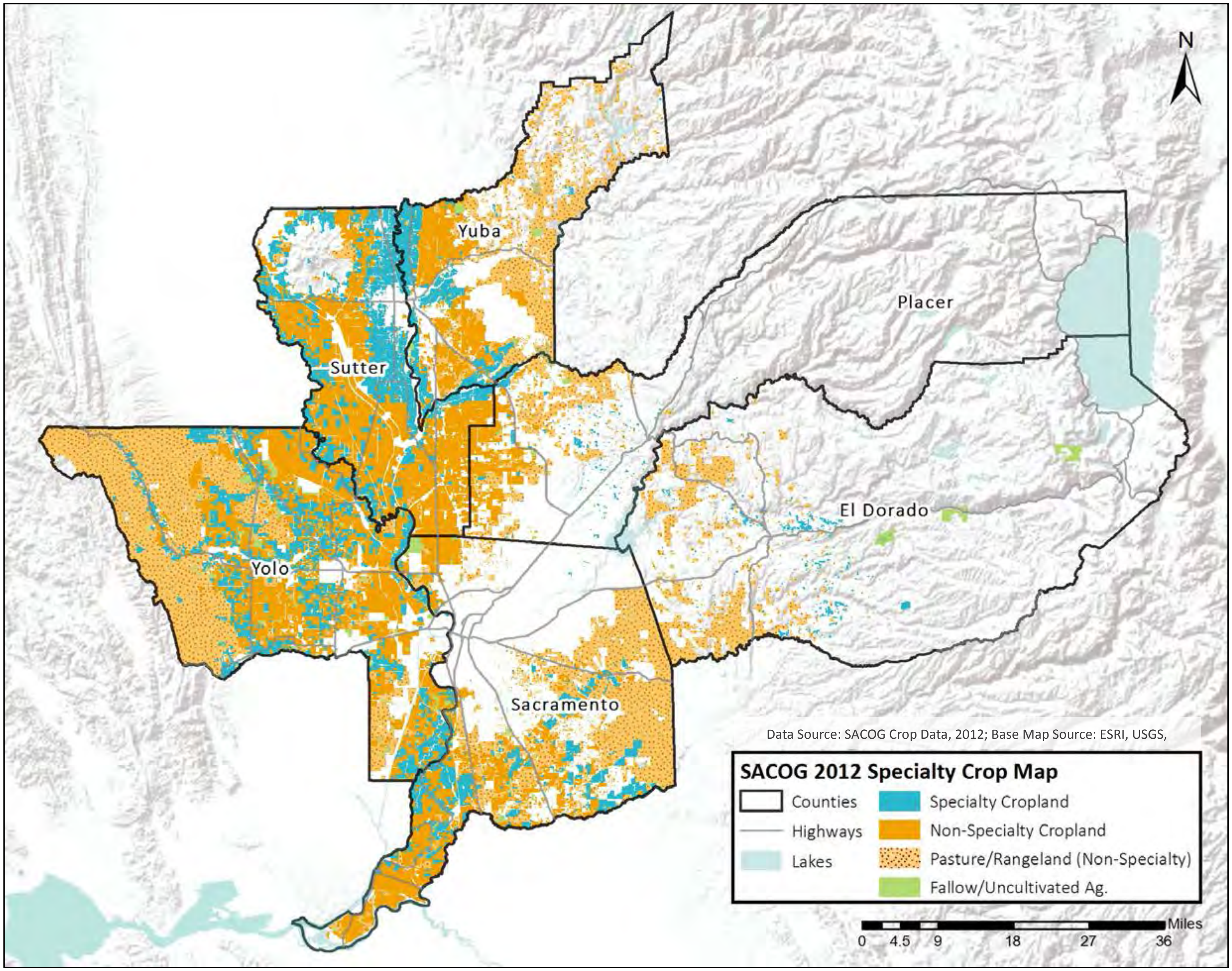


Figure 6c: RUCS 2012 Specialty Crop Map



ECONOMIC IMPACT

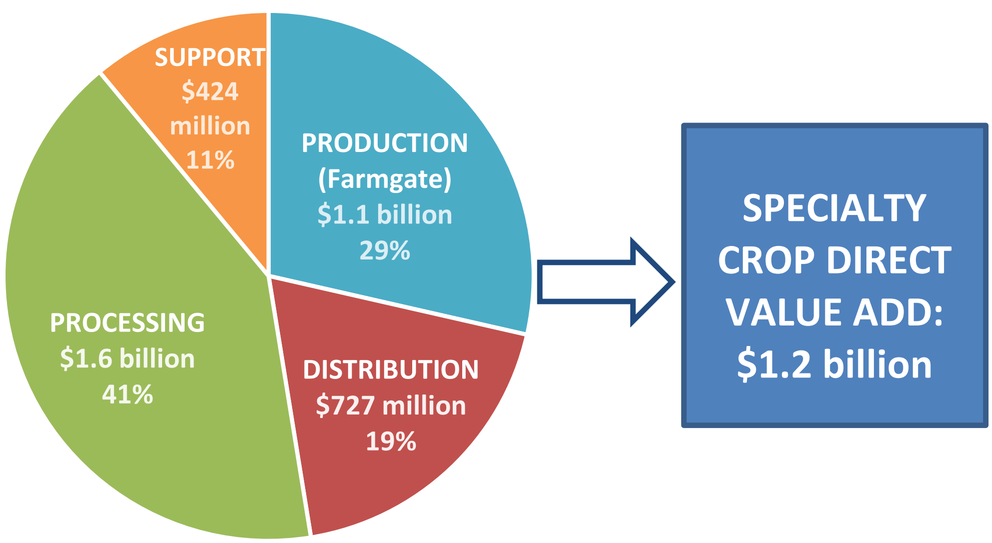
According to the 2012 Agriculture Census, the majority of the region's farms (83 percent) are less than 180 acres and 64 percent of farms earn less than $25,000 per year. Larger operations with higher revenues are seen throughout the region, yet as with the rest of the state, our region is made up of mostly small family farm operations that rely heavily on off-farm income.

In addition to providing jobs both on and off the farm, the Specialty Crop cluster also plays an important role in the region's overall economic activity. This report uses an updated IMPLAN model to measure the direct economic output of the various components of the Specialty Crop cluster.

As shown in Figure 7, output from the region's specialty crop farms and nurseries contributes over $1 billion to the regional economy each year. Specialty crop processing is also over a billion-dollar industry in greater Sacramento. The direct output of specialty crop support ($400 million) and distribution ($700 million) industries round out the annual economic impact of these main segments of the Specialty Crop cluster.[2]

Taken together, the various components of the Specialty Crop cluster add to nearly $4 billion in direct output in the Sacramento regional economy. This total counts the value of the specialty crop several times, at each point in the supply chain from production to distribution. Isolating the value add of the cluster by individual sector provides a measure of how much the value of the specialty crop is increased at each stage of the supply chain, exclusive of initial costs. This report estimates the direct total value add of the cluster at $1.2 billion a year.

Figure 7: Specialty Crop Cluster Direct Output and Value Add, 2013



Source: SACOG and ERA analysis of IMPLAN model, 2013.

[2] These findings draw on an updated IMPLAN model produced by the project team. Note that the IMPLAN analysis uses data for the year 2013 (a year earlier than the 2014 employment and firm data cited here). Due to data limitations, the economic contribution of the distribution segment is limited compared to employment. See this report's companion deliverable, Specialty Crop Multiplier Study, for an explanation of the updated IMPLAN model.

Part 2.
RECENT TRENDS

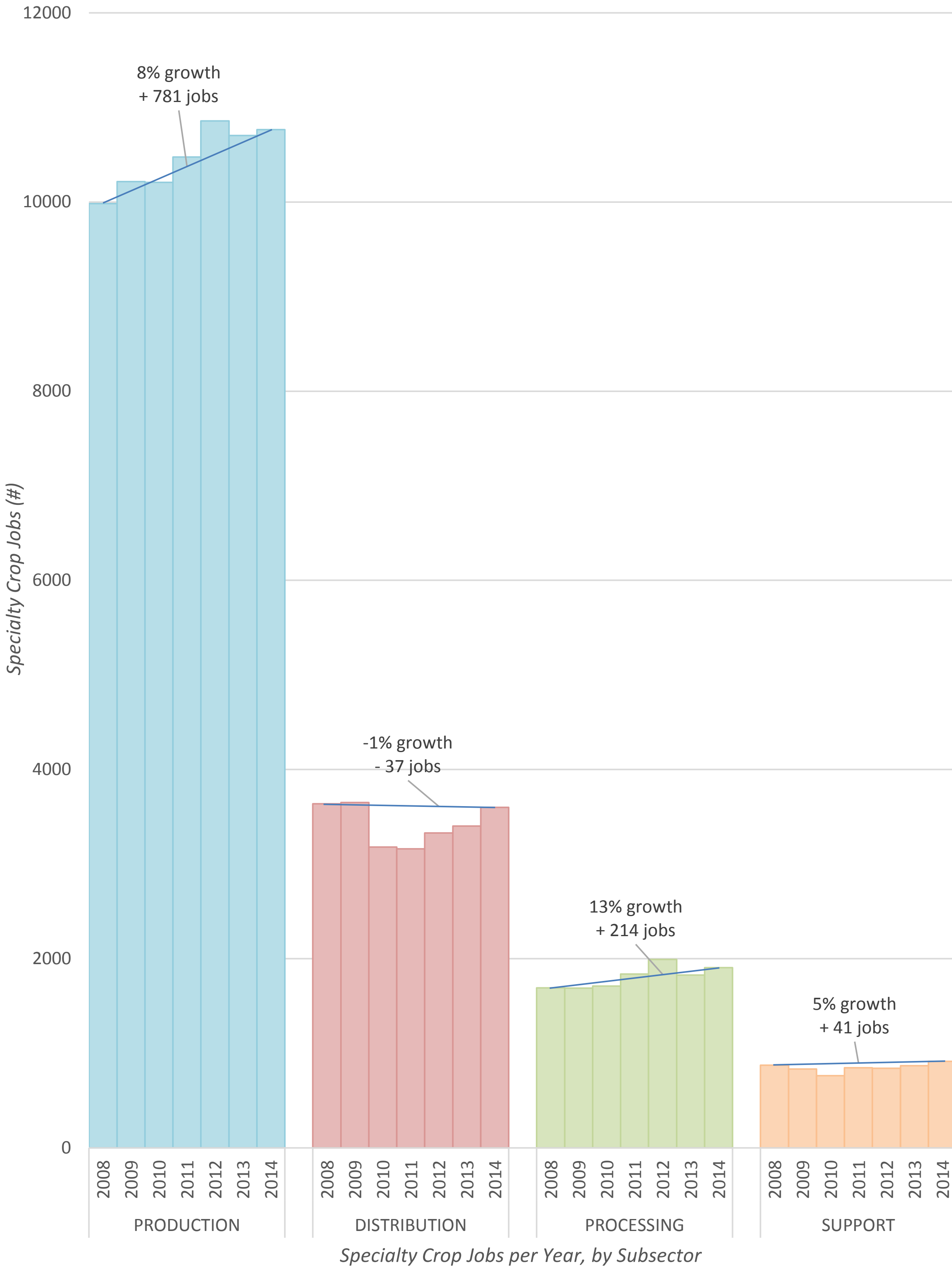
EMPLOYMENT CHANGE

The Specialty Crop cluster has outpaced the region at large in economic recovery.

Like all areas of the economy, specialty crop agriculture as a whole was influenced by the recent recession. Yet while most segments of the economy were shedding jobs, the specialty crop cluster as a whole was actually growing during the recession, and during the recovery has added jobs at a rate faster than the regional economy at large. Indeed, while the region as a whole still had not recovered all jobs lost during the recent recession by the study base year of 2014, the Specialty Crop cluster grew in employment by over 6 percent over the same period. This section of the report explores some recent trends in how the Specialty Crop cluster has rallied from recession to better compete on the local, national, and global stage.

As shown in Figure 8, with a few losses in 2010 and 2013, the specialty crop cluster has generally been adding jobs since 2008, totaling an increase of about 1,000 jobs. The production subsector of the cluster realized highest overall growth in number of new jobs (781), with the processing component of the cluster having the highest employment growth as a percentage (13%). Employment in the support subsector of the cluster grew a modest five percent over the last seven years. While the other subsectors generally follow a similar employment increase pattern to that of the cluster as a whole, the distribution pattern is actually "U"-shaped, with a decrease until 2011 before increasing again through 2014. Distribution was also the only subsector to actually lose jobs (-1%) overall between 2008 and 2014.

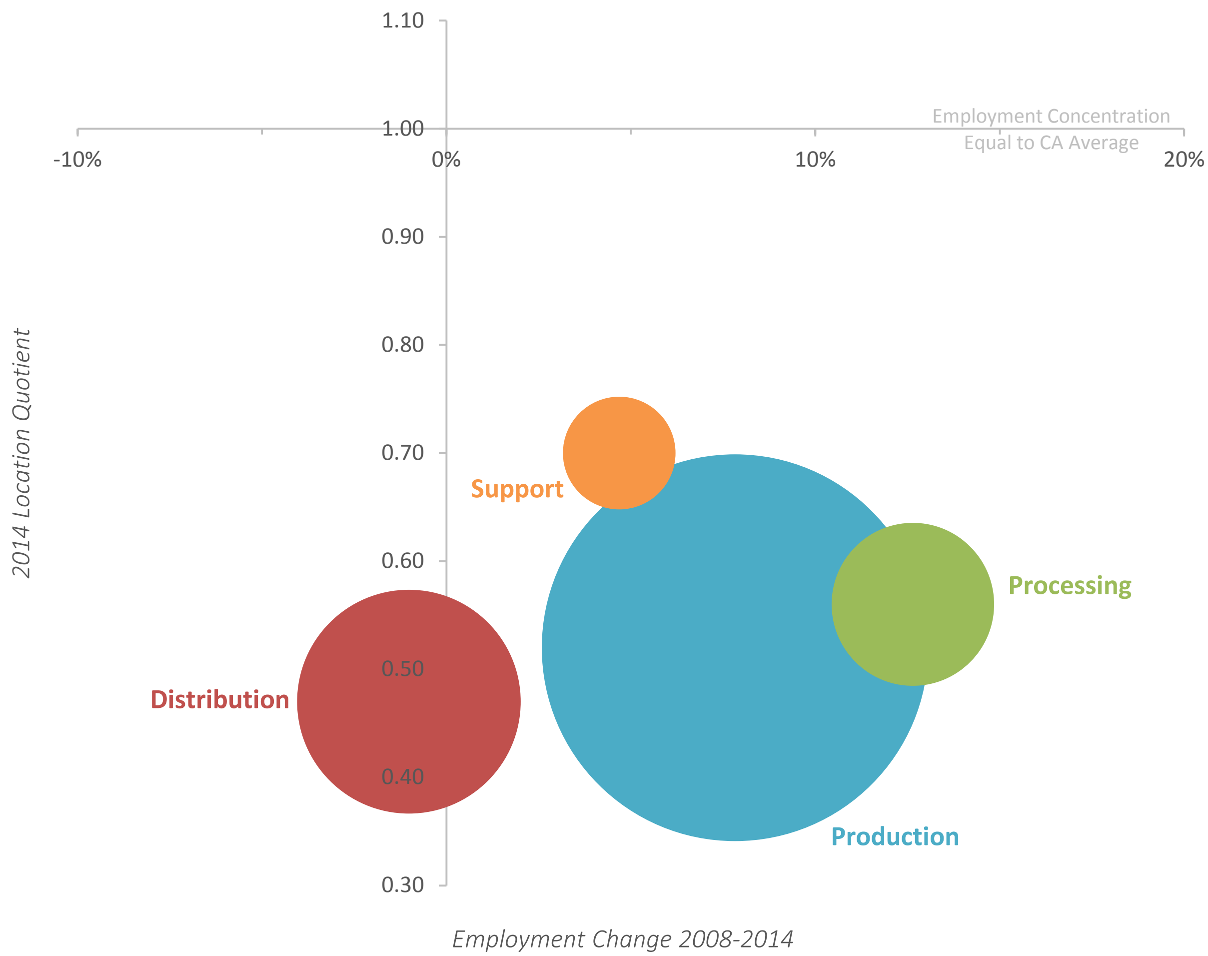
Figure 8: Specialty Crop Cluster Employment Change from 2008 to 2014



Source: SACOG analysis of EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; CREE, 2013; ES-202, 2014; IMPLAN 2013 model.

Figure 9 below incorporates current conditions and recent trends in the cluster into a single graphic. The bubble chart compares regional employment growth from 2008 to 2014 (on the x axis of graph) to the current concentration of employment in the region (y axis), with the size of the bubble indicating the current total number of jobs for each segment of the Specialty Crop cluster.[3] The graphic presents the findings of the above section: all subsectors in the Sacramento region Specialty Crop cluster have a lower concentration of employment than the statewide average. Yet regional employment in the cluster has been growing, led by the production (overall number of jobs) and processing (percentage of job growth) components of the cluster. The distribution segment seemed most susceptible to the recent recession, losing jobs up to 2011 then adding year-over-year through 2014. The support subsector of the cluster saw minor employment growth from 2008 to 2014.

Figure 9: Specialty Crop Cluster Employment Change and Concentration

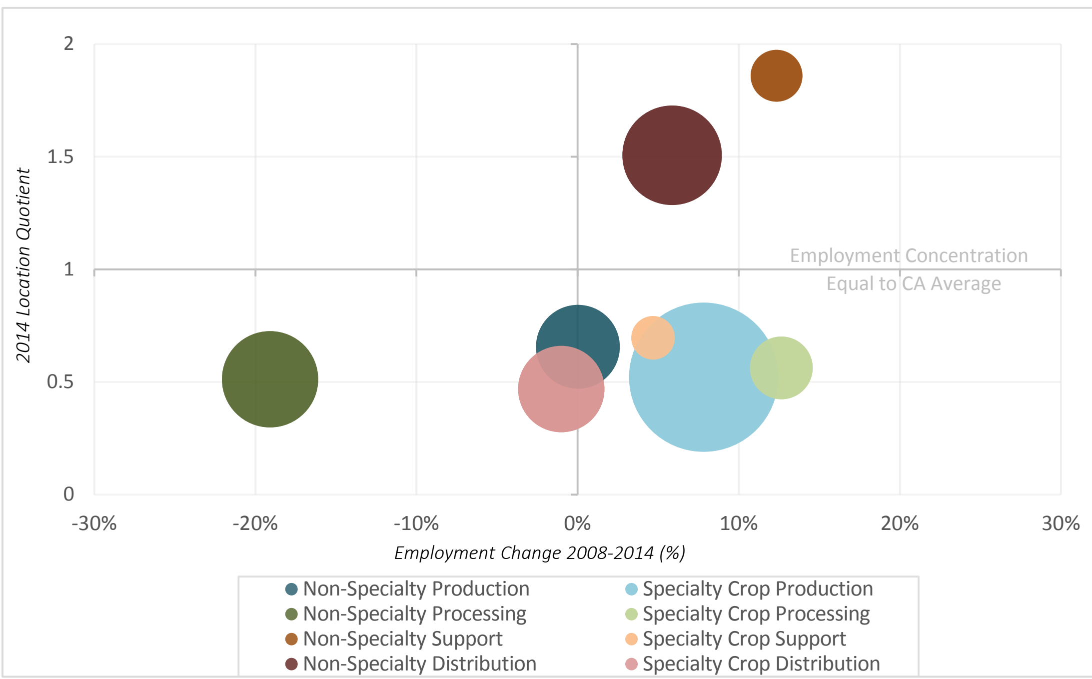


Source: EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; SACOG analysis of ES-202, 2014; SACOG analysis of IMPLAN 2013 model.

[3] Location quotient is for year 2014 compared to the California average. Likewise, total employment is for 2014.

The Specialty Crop cluster falls within a larger food and agriculture system. When the Specialty Crop cluster's contribution to the larger agriculture sector is isolated, several interesting elements emerge to better understand specialty crop developments influencing the food system, as illustrated by Figure 10 below. Specialty crop production includes far more employment than non-specialty crops in the Sacramento region, yet all the other non-specialty crop sectors (i.e., processing, support, distribution) include more employment than their specialty counterparts. While the Specialty Crop cluster has grown in employment between 2008 and 2014, the non-specialty portion of the regional food system in aggregate has actually declined in employment by four percent. This finding for the remainder of the Food and Agriculture cluster stems from a sharp decrease in processing employment while production employment was flat, so that the increases in distribution and support employment do not balance out the net loss in food jobs not associated with specialty crop agriculture.

Figure 10: Cluster Employment Change and Concentration –Specialty and Non-Specialty Elements of the Food System



Source: EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2, SACOG analysis of ES-202, 2014; SACOG analysis of IMPLAN 2013 model.

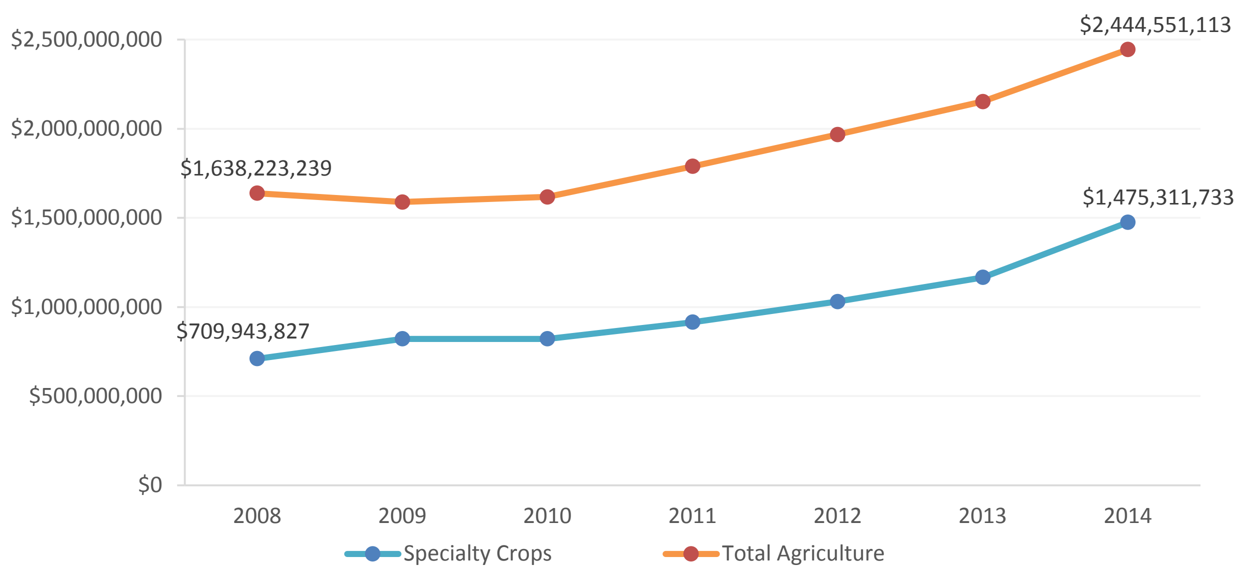
ECONOMIC IMPACT CHANGE

In the past several years, the value of regional specialty crop production has soared.

As shown in Figure 11, the total value of agriculture production in the SACOG region rose from $1.6 billion in 2008 to $2.4 billion in 2014 — an increase of 49 percent. Even when adjusted for inflation this translates to an increase of 36 percent in real dollars, far outpacing the regional economy as a whole.[4] With a substantial increase of 108 percent in total value (89 percent when adjusted for inflation), specialty crops saw an increase in value from $700 million to nearly $1.5 billion from 2008 to 2014. [5] To highlight this trend, the following section compares production of specialty vs. all agricultural crops, showing how specialty crops accounted for 95 percent of the growth in production value between 2008 and 2014.

The RUCS appendix of SACOG's MTP/SCS demonstrates that while the value of agricultural commodities in the region had declined in near parallel with the decline in agricultural acres in the past, record commodity prices today have somewhat reversed this trend, where it appears that some fallowed land has been brought back into production to take advantage of higher prices in the marketplace.

Figure 11: Economic Impact Change, 2008-2014 (in nominal dollars)*



Source: El Dorado and Alpine Counties Agricultural Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Agricultural Crop Production Report for Placer County, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sacramento County Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sutter County Crop & Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Yolo County Agricultural Crop Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; and Crop Report for Yuba County 2008, 2009, 2010, 2011, 2012, 2013, 2014.
**Nominal dollars are the value of the output in its given year and are not adjusted for inflation.*

[4] Values adjusted for inflation using the Consumer Price Index Inflation Calculator by the Bureau of Labor Statistics. http://www.bls.gov/data/inflation_calculator.htm.
[5] Note that this $1.5 billion figure is for the year 2014, one year after the study's 2013 IMPLAN estimate of $1.11 billion for the farmgate/production component of the cluster.

As shown in Figures 12a and 12b respectively, 63 percent of total farmgate value and 69 percent of specialty crop farmgate value in the region were generated by Sutter and Yolo Counties in 2014.[6] Conversely, El Dorado and Placer counties have the lowest agricultural and specialty crop values in the region, including timber. El Dorado, Sutter, Yolo, and Yuba counties all have a similar proportion of specialty crops value as compared to total agricultural value (ranging from 59 to 70 percent), while Placer County has a far lower proportion of specialty crop value at 23 percent. The proportion of total agricultural value by county was very similar from 2008 to 2014, only shifting 1 to 2 percent. This trend was similar for specialty crops, except for a more significant decrease in Sacramento County (-9 percent) and increase in Sutter County (+5 percent) over the same period.

Figure 12a: Total Agricultural Value, 2014
(in $ millions)

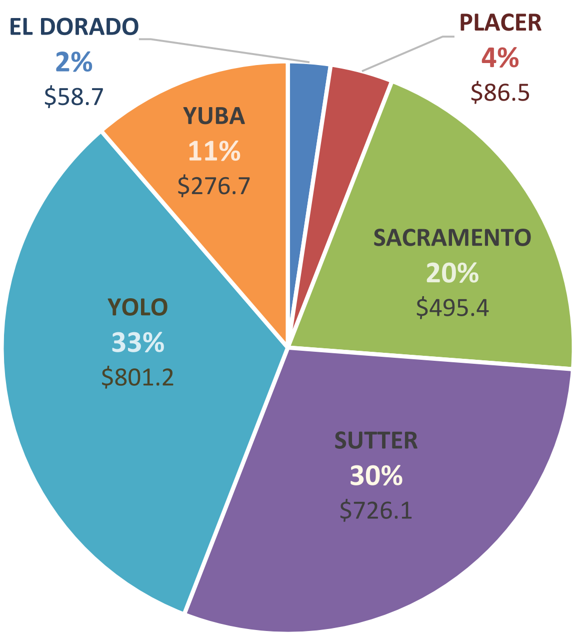
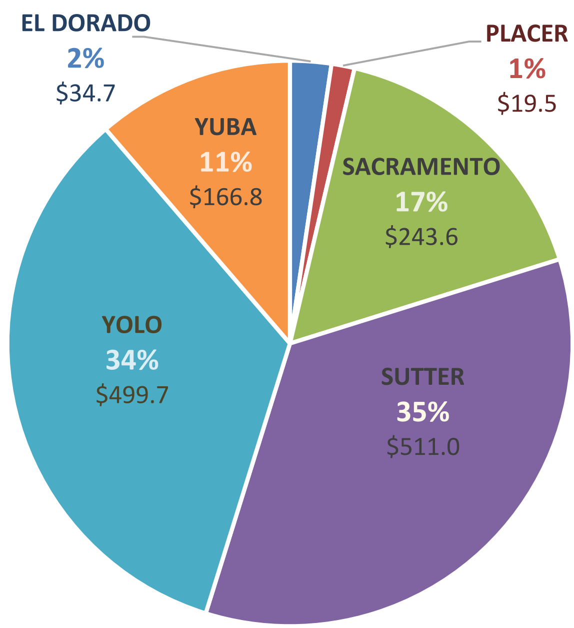


Figure 12b: Specialty Crop Value, 2014
(in $ millions)

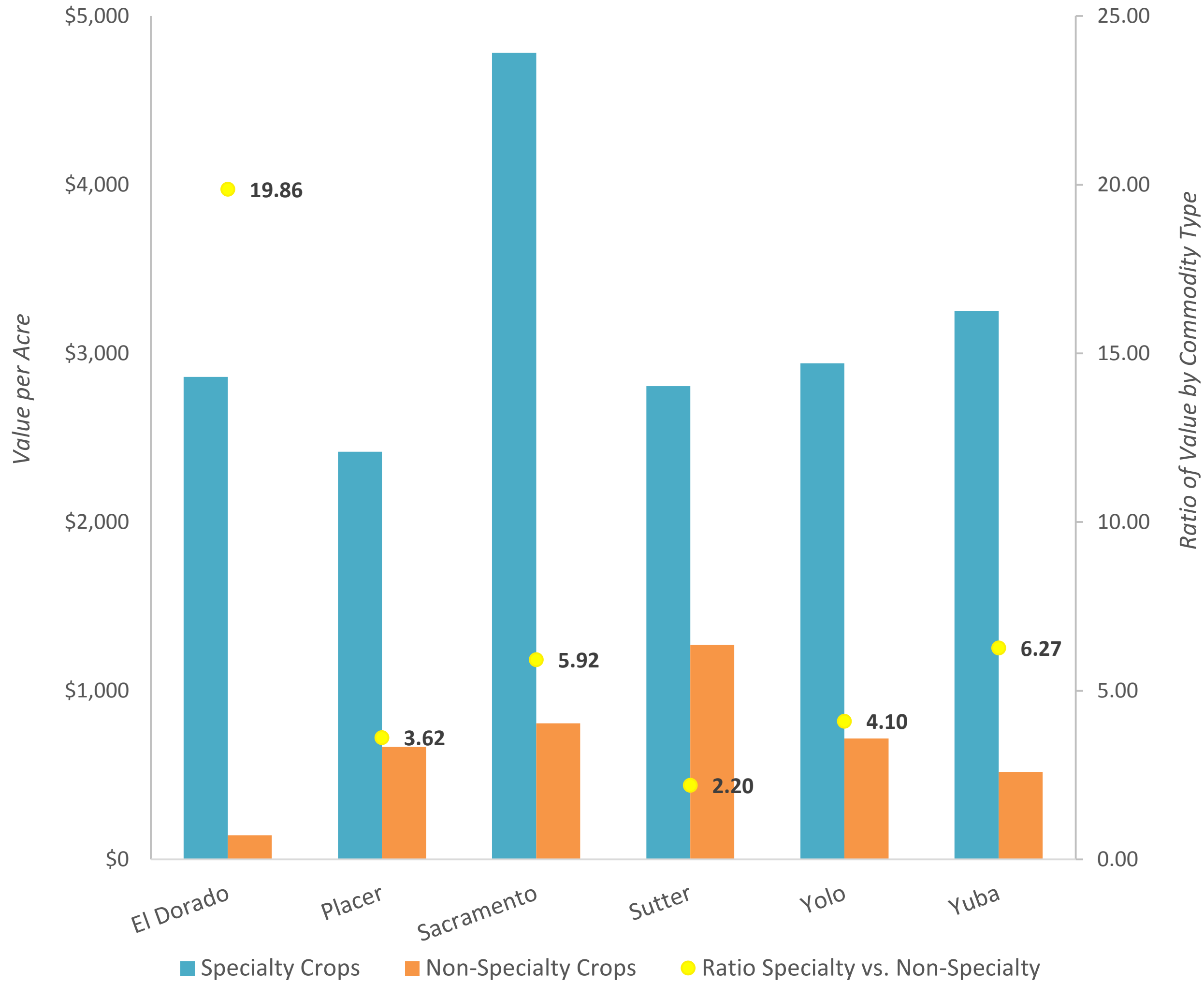


Source: El Dorado and Alpine Counties Agricultural Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Agricultural Crop Production Report for Placer County, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sacramento County Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sutter County Crop & Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Yolo County Agricultural Crop Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; and Crop Report for Yuba County 2008, 2009, 2010, 2011, 2012, 2013, 2014.

[6] While county agriculture reports generally categorize crop and livestock yields in a similar fashion, there is some variation in the type of crops rolled up into a given category which makes it difficult to truly normalize the reports for comparison across counties. Within this dataset these discrepancies occur in El Dorado County where the report includes data from Alpine County, Yolo County which includes an organic category encompassing some non-specialty crops, and Yuba County which includes some miscellaneous field crops in a vegetable crop category. However, these differences are minor overall and the data still provides useful county comparisons.

Within the region, specialty crops (including Christmas trees) generated more than three times the value per acre in 2012 than other non-specialty agricultural products (excluding timber). Specialty crops in all counties generated a higher value per acre than non-specialty crops, although the difference was most pronounced in El Dorado (factor of 19.86) and Yuba (factor of 6.27) counties and least evident in Sutter (factor of 2.2) and Placer (factor of 3.62) counties. Sacramento County had the highest specialty crop value per acre ($4,782), while Placer County had the lowest ($2,417).

Figure 13: Specialty Crop Value per Acre*



Source: SACOG 2012 Crop Map and SACOG analysis of Annual County Crop Reports- El Dorado and Alpine Counties Agricultural Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Agricultural Crop Production Report for Placer County, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sacramento County Crop and Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Sutter County Crop & Livestock Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Yolo County Agricultural Crop Report, 2008, 2009, 2010, 2011, 2012, 2013, 2014; and Crop Report for Yuba County 2008, 2009, 2010, 2011, 2012, 2013, 2014.

**Figure 13 includes the value and acreage of specialty timber (e.g. Christmas Trees), but excludes non-specialty timber, due to the difficulty in accurately differentiating acreage of timber-producing land from other forested areas within the Crop Map. The data represented in Figures 11, 12a, & 12b include both specialty and non-specialty timber values.*

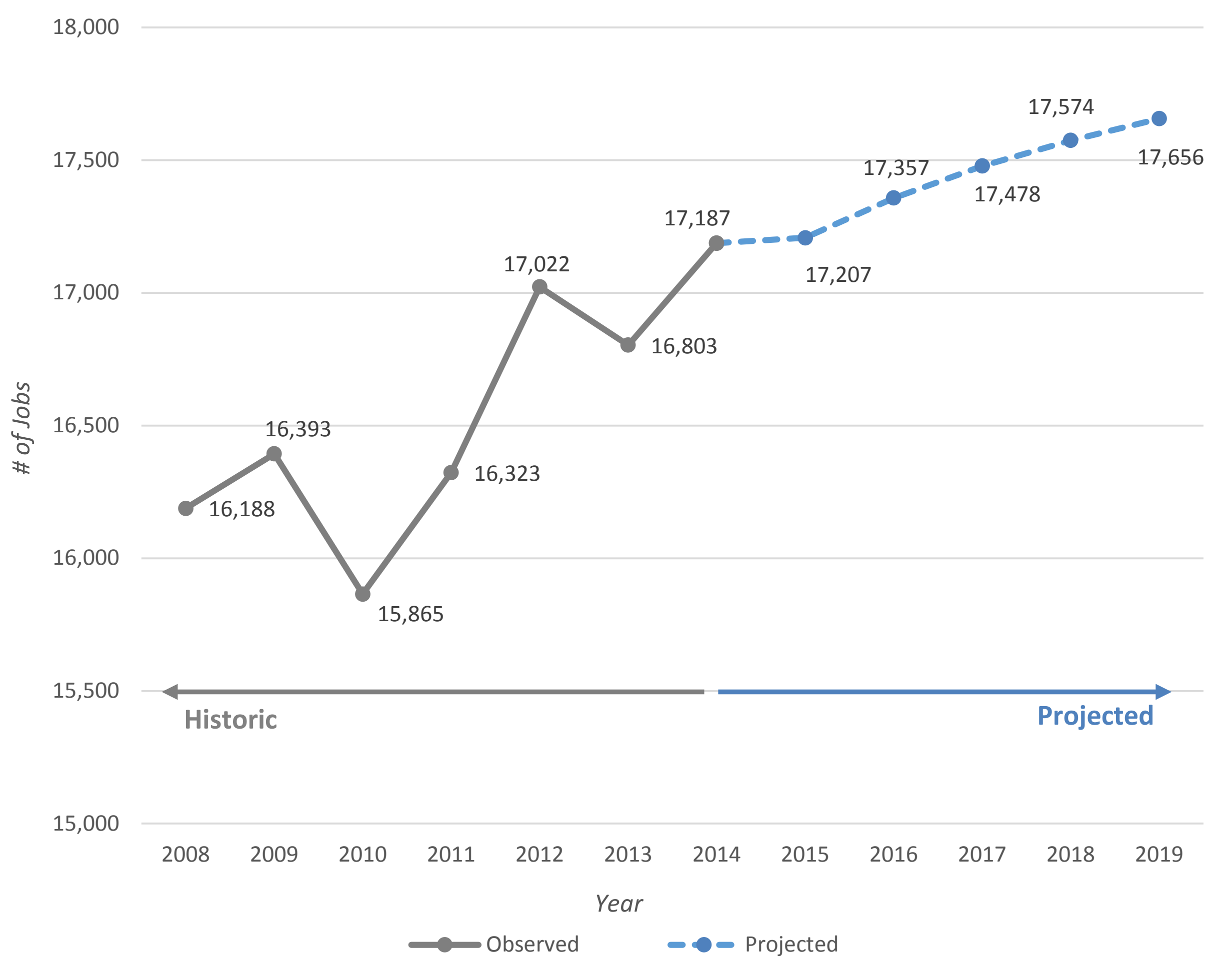
Part 3. LOOKING FORWARD

EMPLOYMENT TRENDS AND PROJECTIONS

This section uses employment projection estimates from EMSI to look out five years from the study base year of 2014. These estimates provide one possible indicator of future conditions in the Specialty Crop cluster if current trend lines continue, yet it is also important to recognize the region's potential to change this trajectory as the data and tools contained in the Food System Multipliers project translate into proactive strategies and investments. The following section illustrates some other potential future outcomes in the cluster drawing on RUCS cases studies, food hub financial analyses and other regional activities.

As shown in Figure 15, the EMSI estimates project that regional employment in the Specialty Crop cluster will continue to increase as it has since 2010, though at a slower rate. While Specialty Crop cluster employment grew about 6 percent from 2008 to 2014, the expected growth rate from 2014 to 2019 is less than 3 percent. Overall, the cluster is expected to add an additional 470 jobs by 2019.

Figure 15: Employment Trends and Projections, 2008-2019



Source: EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; SACOG analysis of ES-202, 2014; SACOG analysis of IMPLAN 2013 model; CREE, 2013; SACOG analysis of Yolo, Sacramento, Yuba, El Dorado, Sutter, & Placer County Annual Crop Reports, 2008-2014.

As shown in Table 1, the distribution subsector, which actually lost jobs between 2008 and 2014, is projected to add both the greatest number (273) and proportion (8%) of specialty crop jobs by 2019. The support subsector, which experienced a lower growth rate compared to other sectors in the past, is also expected to experience job growth by 2019 (48 jobs, 5%). After adding the highest percentage of jobs of any sector between 2008 and 2014 (13%), the processing subsector is projected to experience a lower rate of job growth by 2019 (3%). And while the production subsector experienced significant job growth from 2008 to 2014 (8%), the sector is projected to have the lowest proportional job growth by 2019 (less than 1%).

Table 1: Employment Projections by Subsector, 2014–2019

Specialty Crop Subsector	2014 Jobs	2019 Jobs	# Change	% Change
Production	10,765	10,857	92	0.9%
Distribution	3,600	3,873	273	7.6%
Processing	1,906	1,962	56	2.9%
Support	916	964	48	5.2%
Total Cluster Jobs	**17,187**	**17,656**	**469**	**2.7%**

Source: EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2; SACOG analysis of ES-202, 2014; SACOG analysis of IMPLAN 2013 model; CREE, 2013; SACOG analysis of Yolo, Sacramento, Yuba, El Dorado, Sutter, & Placer County Annual Crop Reports, 2008-2014.

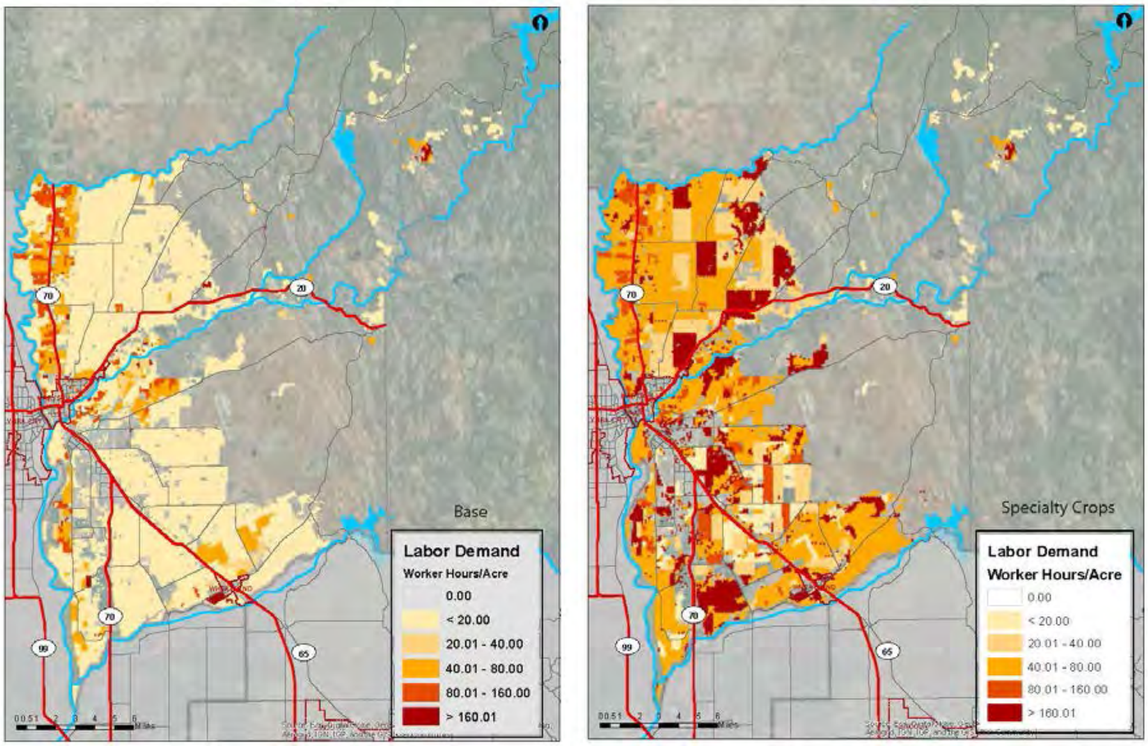
ALTERNATIVE CLUSTER TRAJECTORIES: RUCS CASE STUDY

Emerging market opportunities coupled with the data, tools, and planning contained in the *Food System Multipliers for Specialty Crops in the Sacramento Region* project (among other efforts) have the potential to dramatically change the trajectory of this vital Specialty Crop cluster into the future. Through its scenario planning efforts, RUCS has developed a suite of tools and models to test a range of changes in market demand and cost of production to illustrate alternative possible futures in the cluster that respond differently to market changes and supportive strategies. These scenarios model an increase in specialty crop and value-adding activities that meet the rapidly increasing demand for locally-grown food (including regional institutions such as schools, hospitals, or even the Sacramento Kings basketball arena) to show how emerging market opportunities can result in employment not only in the production component of the cluster, but across the full specialty crop supply chain.

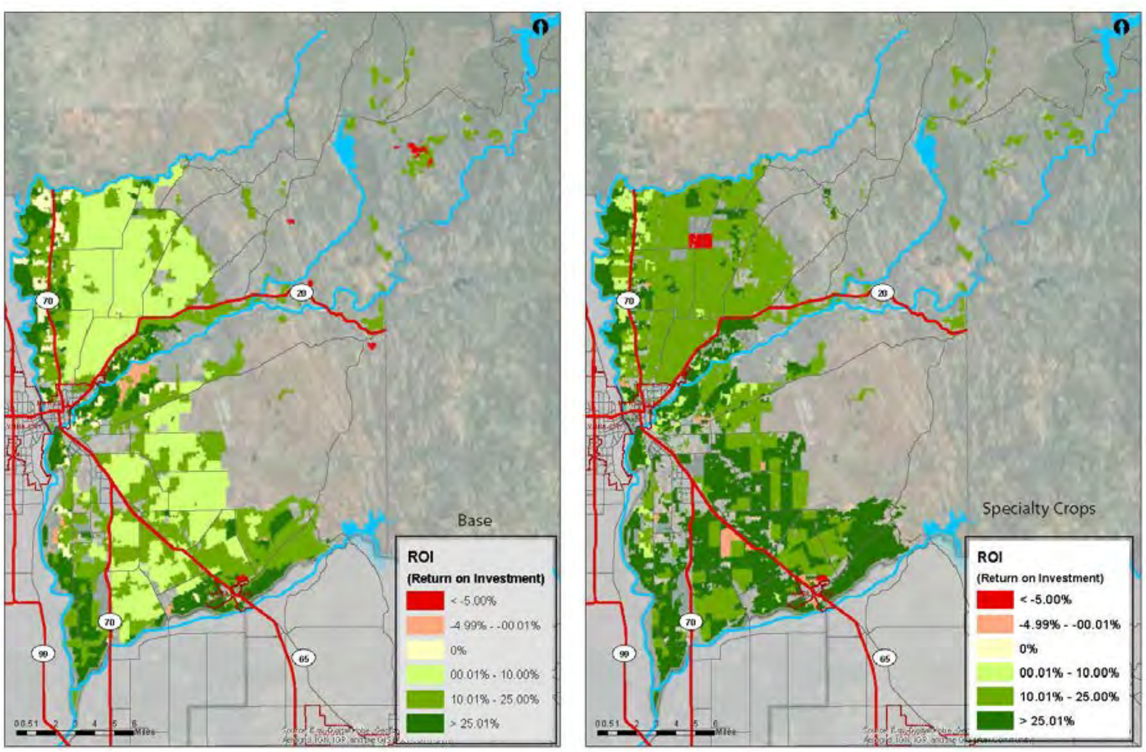
One of the various scenarios of focus for RUCS has been on ways to internalize more of our food system, in turn reducing economic leakage out of the region. This is especially true for specialty crops where there is demonstrated demand but limited supply. In particular, these scenarios test out burgeoning local market opportunities that respond to consumer demand while offering growers a means to diversify. For example, one scenario conducted in a case study for Yuba County analyzed the effects of a major cropping pattern shift to specialty crops geared to local consumption (see Figure 16 on the following page). While the scenario represents an extreme boundary-setting example of possible future change, the following maps of the results show the potential for sustained economic return and specialty crop cluster employment opportunities as smaller shifts occur in the food system. Notably, the modeled scenario quadrupled overall production value in the study area, along with an increase in labor demand (and thus job opportunities). Other scenarios—such as those conducted in RUCS' *Sacramento Regional Agricultural Infrastructure Project*[7]—exhibit the potential to capitalize on opportunities in regional processing through investments in mid-scale facilities such as food hubs.

[7] The Regional Agricultural Infrastructure Project was funded in part through the Specialty Crop Block Grant Program's 2011 cycle (project SCB11039).

Figure 16: Yuba County Case Study Scenarios



The above map measures the estimated increase in farm labor from a possible future scenario capitalizing on the increasing demand for local specialty crops, with the map below estimating grower return from the same scenario. Together these RUCS scenarios illustrate market opportunities that augment economic return and lead to more employment opportunities for specialty crop producers, and further along the specialty crop value chain.



CONCLUSION

Summary, Challenges, and Opportunities

The Specialty Crop cluster has deep roots in the region's history and will be an essential component of the region's future. California is the fourth largest agricultural economy in the world and the Sacramento region is a vital part of that economy, with some of the most productive farmland on earth. In addition to productive farmland, the Sacramento region boasts an unrivaled array of food system assets, including multi-generational knowhow, world-renowned agricultural institutions like UC Davis, food entrepreneurs, favorable climate and water supply, and engaged policymakers to name a few. Through value-added opportunities like that of the food hub, specialty crops will increase the capacity of the landscape to generate economic value and jobs, making agriculture an even more impactful economic engine.

This Specialty Crop cluster analysis in turn illustrates how these elements affect the overall regional economy: the direct components of the cluster account for over 17,000 jobs spread throughout the region and almost $4 billion in combined output value, with a direct total value add of $1.2 billion a year. While production is the largest subsector in the Specialty Crop cluster, there is also significant "off farm" employment (37 percent) in distribution, processing, and support. Recent employment and output trends suggest strong regional competitive advantages in the cluster; indeed, the cluster has outpaced the overall regional economy in its recovery from the recession. The Specialty Crop cluster analysis provides the following insight into where there are existing opportunities for benefits to the regional economy:

- The Specialty Crop cluster has helped the region rebound from recession: the cluster saw job growth from 2008 to 2014 that outpaced the regional average, led by the production and processing subsectors.
- The distribution subsector includes a significant number of jobs and is projected to add the greatest number and proportion of jobs by 2019.
- The support subsector provides the highest earnings in the region (higher than the state and larger Food and Agriculture cluster), has the highest concentration of employment as compared to the average for the California economy, and is projected to experience the job growth through 2019.
- The production subsector is more dispersed in terms of employment and includes the greatest amount of employment of the Specialty Crop cluster. Additionally, its substantial output demonstrates the regional nature of the cluster, supporting the additional economic activity and jobs found in the other subsectors.
- Specialty crops have driven the region's agriculture production sector to record levels of economic output. Specialty crops in all counties generated a higher value per acre than non-specialty crops, where Sutter County had both the greatest output in 2014 and largest value increase since 2008. The Specialty Crop cluster directly contributed over half of the larger Food and Agriculture cluster output in 2014 and accounted for 95 percent of the growth in value of the larger cluster's production component between 2008 and 2014.

In addition to highlighting regional strengths, the Specialty Crop cluster analysis provides further insight into where there are currently challenges for the regional economy:

- The distribution subsector has the lowest concentration of employment as compared to the average for the full statewide economy and experienced the lowest amount of growth of all the sectors between 2008 to 2014 (an overall loss of 1%).
- The region faces a constrained agricultural labor supply, which can inhibit future growth. Overall, worker earnings in the full Food and Agriculture cluster are higher than the Specialty Crop average, owing to the large proportion of specialty crop workers employed in lower wage crop production jobs. The production subsector provides the lowest earnings compared to the other subsectors and is projected to experience the lowest percentage of (and only slight) job growth by 2019.
- The support subsector has the lowest direct output value of the cluster. Additionally, Yolo County generates the lowest proportion of specialty crop value and Sacramento County actually saw a decrease in specialty crop value from 2008 to 2014.
- While Specialty Crop cluster employment grew almost 6 percent from 2008 to 2014, the growth rate from 2014 to 2019 is expected to be half that. However, the development of an action plan for the larger Food and Agriculture cluster and other regional initiatives speak to the Sacramento region's potential to proactively change trajectory and capitalize on promising market developments supporting further regional jobs and economic activity.

The full range of economic contributions from specialty crops and their ancillary industries, or the "multiplier effect", reflects various types and scales of production, markets and value-added processing within the SACOG region.

In short, this report demonstrates the direct contribution of Specialty Crop industries to the regional economy and begins to illustrate how growing food and fiber creates jobs and income, both on and off the farm. The full economic impact of an industry cluster spreads throughout its entire value chain. This cluster analysis includes the core cluster industries of production, processing support and distribution, but does not include related food system elements such as consumption establishments or other activity in R&D, environmental services or agri-tourism. As such, the data and analysis contained in the report constitute an important initial — though still incomplete — look into the cluster and its role in the Sacramento region's economy.

Building on the work contained in this cluster assessment, SACOG—through a partnership with ERA Economics and BAE Urban Economics—has developed an updated economic model based on primary survey and other data to capture the full ripple effect of how the Specialty Crop cluster's output circulates through the larger regional economy. In addition to describing the larger economic contribution of specialty crop production, this work in the Specialty Crop Multiplier Model deliverable also had produced a new scenario tool for stakeholders to test possible policy and investment decisions supporting specialty crop expansion.

Together these tools and research will enable SACOG and its partners to complete much needed economic analysis to illustrate the importance of specialty crop production in the region and easily and effectively communicate the economic impact of specialty crop production to a wide audience, with particular attention to local policy makers. By demonstrating the economic potential of agricultural lands and related food industries, there will be more incentive to invest in specialty crop production and food chain infrastructure and to preserve working lands. This will enhance the marketability and competiveness of specialty crops of all California producers by creating new economic opportunities through expanding markets and increasing the value of their products. It will also inform potential regulatory reform at various levels, ensuring the viability of California specialty crops for the next generation by creating a more flexible regulatory environment to start a new business and/or farm. These tools will be a valuable asset to public and private stakeholders by providing much needed data to facilitate the development of effective strategies, investments, and policies that support specialty crop agriculture.

APPENDIX A: SPECIALTY CROP CLUSTER DEFINITION AND METHODOLOGY

The North American Industry Classification System (NAICS) is the standard grouping scheme used by Federal statistical agencies to categorize business establishments and collect statistical data related to the economy. Official U.S. business economy datasets are organized by this NAICS classification scheme, and most proprietary employment datasets also align to the NAICS structure given its leading role in database management. The NAICS numbering system starts with a general classification of major economic sectors listed by a two-digit code. For example, the entire agriculture sector is grouped with forestry, fishing, and hunting in the two-digit code NAICS 11, while construction is NAICS 23 and education is NAICS 61. Each digit added to the two-digit sector code provides more detail on the industry activity, with the fullest detail at a maximum of six digits. An industry example of this organizational structure from most detailed to broadest listing is strawberry farming (NAICS 111333), which is nested within non-citrus fruit and tree nut farming at the five-digit level (11133), then fruit and tree nut farming at the four-digit level (1113), within crop production (111) at the three-digit level, and finally within NAICS sector 11—agriculture, forestry, fishing and hunting—at the broadest level.

The base economic and employment data used in this Specialty Crop Cluster Assessment: Sacramento Region report is an Economic Modeling Specialists International (EMSI) dataset on the six-county SACOG region (El Dorado, Placer, Sacramento, Sutter, Yolo and Yuba counties) covering the period of 2008 to 2014. EMSI aggregates over 90 data sources into a unified rollup of wages, employment, firms, and other indicators. The Los Rios Center of Excellence provided the EMSI data for this project; all analysis and conclusions come from SACOG. The dataset is organized by the NAICS classification scheme, providing indicators by industry at the six-digit level.

As the EMSI data reports at the six-digit NAICS level it represents a highly detailed look into business economy indicators across specific industries. Likewise, the data overcomes many disclosure limitations and gaps in coverage compared to other sources that also operate at the detailed six-digit industry coding, thus providing very specific details for individual industries in the economy. Even at the most detailed six-digit NAICS level however, project staff needed to conduct further work to isolate only specialty crop industries for analysis in this study. The first step staff took was to group those NAICS codes at the six-digit level that were exclusively specialty crop (such as NAICS 111333 Strawberry Farming or NAICS 311421 Fruit and Vegetable Canning) for further analysis. The team then excluded all NAICS codes with no specialty crop activity (any NAICS code outside of the agriculture cluster, and those agriculture industries that were non-specialty crops, such as NAICS 111140 Corn Farming or NAICS 311615 Poultry Processing) from the cluster. While these steps helped organized the vast majority of the 1,100 industries at the NAICS six-digit into the specialty crop cluster or non-specialty activity, several industries remained that due to their NAICS definition included both specialty and non-specialty crop activity (for example, the NAICS industry 115115 Farm Labor Contractors and Crew

Leaders includes business services provided to specialty crop producers, but also to other crop production).

To isolate the specialty crop component of these industries that include a blend of specialty crop and other economic activity (hereafter "proportional industries"), the project team took a series of steps based on supplemental data and modeling activities to estimate the specialty crop component of proportional industries. As such, the data and analysis contained in this cluster report only includes the economic activity generated by the specialty crop cluster. The steps to arrive at these specialty crop estimates are described in turn.

First, while the EMSI dataset provided economic data at the six-digit level for the vast majority of industries in the regional economy, the base data set actually aggregated industries within crop production to a broader industry coding. To isolate those specialty crop industries within the broader crop production category, the production team drew on the Covered Employment and Wages Program (commonly referred to as the ES-202), produced in tandem by the Bureau of Labor Statistics, the U.S. Department of Labor, and the State Employment Security Agency. Like the EMSI data, the team analyzed the 2014 ES-202 data for the same six-county geography. As the EMSI dataset includes estimates for self-employed and sole proprietor workers, the final step for the production component of the specialty crop cluster was to apply these additional worker categories to the ES-202 specialty crop production industries. The ES-202 program produces a comprehensive tabulation of employment and wage information for workers covered by State unemployment insurance (UI) laws and Federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. It is a cooperative program involving the Bureau of Labor Statistics (BLS) of the U.S. Department of Labor and the State Employment Security Agencies (SESAs). Thus, together these sources provide consistency between the production segment and the other subsectors of the cluster.

Next, the project team turned to those proportional industries in the processing, distribution, and support segments of the specialty crop cluster. Using the base IMPLAN model, the project team estimated the portion of these industries' inputs that were specialty crop related. The IMPLAN model is a widely-used tool for estimating how money from one industry flows through the larger regional economy. The model uses national industry data and county-level economic data to generate a series of multipliers, which in turn estimate the total economic implications of economic activity. The team used these model estimates to the split the proportion of economic activity in these industries related to specialty crop production as part of the cluster, and removed the remainder. Some of these proportional industries had a high degree of specialty crop activity in the region. For example, SACOG's analysis of the region's IMPLAN model suggest that about 75 percent of all economic activity in the farm labor contractors industry stems from specialty crop production, given the labor-intensity of specialty crops compared to non-specialty crops. In other industries the specialty crop contribution was quite small (such as ice cream and frozen dessert manufacturing, which does include some fruit and tree nut inputs, but is mostly non-specialty crops). Note that to generate these splits the team used the IMPLAN model for the year 2013, a year earlier than the 2014 employment data. The team conducted this IMPLAN analysis both on proportional industries within the study area (using an IMPLAN model for the six-county region) as well as all of California (with an IMPLAN model of the full state) in order to perform the project's location quotient analysis. In conjunction with the work on the production sector, this work produced the study year economic indicators for each specialty crop industry within the cluster.

Finally, the team drew on the California Regional Economies Employment (CREE) series to estimate the change in proportion of specialty crop production for each year between 2008 and 2014. The California Regional Economies Employment (CREE) Series provides non-confidential annual average employment and wage data for the United States, California, and all 58 California counties. It is an outgrowth of the California Regional Economies Project (CREP) and sponsored by the California Workforce Development Board. The team then applied these estimates to the base EMSI data to create a time series for the specialty crop cluster over the last seven years. The methodology assumed that the change in the proportion of specialty crop production over the time series applied to the other three subsectors of the cluster as well. Overall the proportion only changed by less than one percent for the time series, so this assumption has a very minor effect on the study indicators.

In short, the project team drew on multiple data sources and the IMPLAN model to isolate the specialty crop component of proportional industries given the limitations in standard industry classification. To create the full cluster, the team then included this specialty crop proportion in conjunction with industries identified as exclusively specialty crop through their industry code, while excluding all non-specialty crop industries from analysis. It is important to note that the results are estimates for economic indicators within the specialty crop cluster, but that these estimates are based on standard economic data and modeling techniques. The following page lists the specialty crop cluster by NAICS code, and indicates which industries are full specialty crop and which are proportional and derived from the study's methodology to isolate specialty crop economic activity.

The Specialty Crop cluster is comprised of the following NAICS codes:

Processing

311224	Soybean and Other Oilseed Processing*
311340	Non-chocolate Confectionery Manufacturing*
311351	Chocolate and Confectionery Manufacturing from Cacao Beans*
311352	Confectionery Manufacturing from Purchased Chocolate*
311411	Frozen Fruit, Juice, and Vegetable Manufacturing
311421	Fruit and Vegetable Canning
311422	Specialty Canning*
311423	Dried and Dehydrated Food Manufacturing*
311520	Ice Cream and Frozen Dessert Manufacturing*
311813	Frozen Cakes, Pies, and Other Pastries Manufacturing*
311911	Roasted Nuts and Peanut Butter Manufacturing*
311930	Flavoring Syrup and Concentrate Manufacturing*
311941	Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing*
311942	Spice and Extract Manufacturing*
312130	Wineries

Distribution

424410	General Line Grocery Merchant Wholesalers*
424420	Packaged Frozen Food Merchant Wholesalers*
424450	Confectionery Merchant Wholesalers*
424480	Fresh Fruit and Vegetable Merchant Wholesalers
424490	Other Grocery and Related Products Merchant Wholesalers*
424820	Wine and Distilled Alcoholic Beverage Merchant Wholesalers*
493120	Refrigerated Warehousing and Storage*
493130	Farm Product Warehousing and Storage*
722310	Food Service Contractors*

Support

325311	Nitrogenous Fertilizer Manufacturing*
325312	Phosphatic Fertilizer Manufacturing*
325314	Fertilizer (Mixing Only) Manufacturing*
325320	Pesticide and Other Agricultural Chemical Manufacturing*
333111	Farm Machinery and Equipment Manufacturing*
333241	Food Product Machinery Manufacturing*
423820	Farm and Garden Machinery and Equipment Merchant Wholesalers*
424910	Farm Supplies Merchant Wholesalers*
424930	Flower, Nursery Stock, and Florists' Supplies Merchant Wholesalers

Production

111130	Dry Pea and Bean Farming
111219	Other Vegetable (except Potato) and Melon Farming
111310	Orange Groves
111320	Citrus (except Orange) Groves
111331	Apple Orchards
111332	Grape Vineyards
111333	Strawberry Farming
111334	Berry (except Strawberry) Farming
111335	Tree Nut Farming
111336	Fruit and Tree Nut Combination Farming
111339	Other Non-Citrus Fruit Farming
111411	Mushroom Production
111419	Other Food Crops Grown Under Cover
111421	Nursery and Tree Production
111422	Floriculture Production
115112	Soil Preparation, Planting, and Cultivating*
115113	Crop Harvesting, Primarily by Machine*
115114	Postharvest Crop Activities (except Cotton Ginning)*
115115	Farm Labor Contractors and Crew Leaders*
115116	Farm Management Services*

**These industries include a blend of specialty crop and non-specialty crop activity. We applied adjustment factors to isolate solely the specialty crop component from inclusion in the cluster.*

July 2016

Food System Multipliers for Specialty Crops: Executive Summary

SACRAMENTO REGION

A project of the Rural-Urban Connections Strategy

SACOG

Food System Multipliers for Specialty Crops: Executive Summary

This project was supported by the Specialty Crop Block Grant Program at the U.S. Department of Agriculture through grant 12-25-B-1567. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

July 2016

Prepared by:

SACOG

David Shabazian
Garett Ballard-Rosa
Ally Holmqvist
Lynnea Ormiston

in partnership with:

ERA Economics
Environment • Resources • Agriculture

Duncan MacEwan
Richard Howitt
Jay Noel
Jennifer Scheer

bae urban economics

Aaron Nousaine
Matt Kowta

SACRAMENTO REGION

RURAL-URBAN CONNECTIONS STRATEGY

FINAL REPORT

ERA Economics
Environment • Resources • Agriculture

Food System Multipliers for Specialty Crops in the Sacramento Region

This project was supported by the Specialty Crop Block Grant Program at the U.S Department of Agriculture (USDA) through grant 12-25-B-1556. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

July 25, 2016

prepared by

ERA Economics, LLC
Duncan MacEwan, PhD
Jennifer Scheer
Richard Howitt, PhD
Jay Noel, PhD

in collaboration with

BAE Urban Economics, Inc.
Aaron Nousaine
Matt Kowta

Sacramento Area Council of Governments
Garett Ballard-Rosa, Project Manager
David Shabazian, RUCS Program Manager

About the Multiplier Study & Project Team

The value of specialty crops grown in the Sacramento region extends far beyond the farm, supporting further economic activity and jobs throughout the greater regional economy.

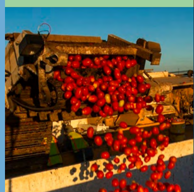
The economic benefits of specialty crops are often overlooked due to a poor understanding of how growing food and fiber creates jobs and income both on and off the farm. In response, the *Food System Multipliers for Specialty Crops in the Sacramento Region* project not only highlights the direct contribution of a fuller range of specialty crop industries, it goes even farther to illustrate the ways in which the economic impact of this specialty crop cluster ripples throughout the larger regional economy. This important work related to evaluating and enhancing the competitiveness of specialty crops is funded by the USDA Specialty Crop Block Grant Program, which is administered by the California Department of Food and Agriculture. The Sacramento Area Council of Governments (SACOG) conducted the project through the Rural- Urban Connections Strategy (RUCS) in partnership with ERA Economics and BAE Urban Economics.

The study area for the project is the SACOG six-county region, including El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties. The project draws on numerous data sources (including interviews with local specialty crop farmers, processors, and distributors), as well as an updated economic model to quantify the relationships and linkages between specialty crop production, a core specialty crop cluster, and the larger Sacramento regional economy. The work also provides stakeholders an integrated tool to test possible future economic conditions in the cluster. To capture these findings, this Executive Summary brings together the work of two technical deliverables. The first element of the project, the Sacramento Region Specialty Crop Cluster Assessment, links specialty crop farms to a core cluster of processing, distribution, and support industries. The companion Sacramento Region Specialty Crop Multiplier Study then shows how this cluster interacts with the larger economy through a multiplier effect. Each technical deliverable also contains the citations for the various data and findings referenced in this Executive Summary. While these reports synthesize the best available data, it is important to recognize that the reported economic indicators and quantified economic activity are estimates that include modeled outputs, and only cover the core specialty crop components of a much larger food system.

The tools developed as part of this project demonstrate a valuable asset to public and private stakeholders by providing much needed data to facilitate the development of effective policies and strategies that support specialty crop agriculture. By demonstrating the economic potential of agricultural lands and related food industries, there may be more incentive to invest in specialty crop production and food chain infrastructure and to preserve working lands. This will enhance the marketability and competiveness of specialty crops of all California producers by creating new economic opportunities through expanding markets and increasing the value of their products.

This multiplier study in many ways parallels urban economic development studies used to help shape policies and plans for our region's future. Recently completed RUCS case studies help identify food system opportunities and gaps to inform rural strategies and provide guidance for both public sector and private sector decision makers. Understanding how the effect of the food system ripples through the entire economy not only reinforces political and financial commitment to those industries, but also identifies potentially overlooked segments of the economy needed to support the cluster. This study provides more evidence that the agriculture and food cluster is not just a rural asset, but also one that depends on and reinforces the connection between rural producers, aggregators and urban processors, food entrepreneurs, wholesalers, retailers, marketers, and consumers. This work adds to the unprecedented data and tools that SACOG has developed to help us think about how to shape our urban *and* rural future, while balancing land use, transportation, and economic development decisions across the entire region.

Beyond the immediate benefit to SACOG's member jurisdictions, this study buttresses local efforts such as the Sacramento Convention and Visitors Bureau's Farm-to-Fork initiative, the Sacramento Metropolitan Chamber's Food and Agriculture committee, and Valley Vision's Food System Action Plan. The work also underpins AgPlus, the California Central Valley Investing in Manufacturing Communities Partnership federal designation that provides funding priority for food system-related projects in the Central Valley. RUCS is specifically identified as the technical support for this effort.

"The farm—in and of itself an important economic driver—is just one element of a larger food cluster encompassing multiple business sectors. This cluster's economic activity circulates further into the larger regional economy, including sectors outside of agriculture. Together, this is the full economic impact of specialty crops within the region."


The Economic Contribution of Specialty Crops in the Sacramento Region

Rural and urban areas are inextricably linked through the food system. Food moves from the farm to our plate through processes that we encounter every day without even realizing it. These processes illustrate a more complete picture of the agricultural economy, as growing food and fiber in our region creates jobs and income both on and off of the farm.

Specialty Crops on the Farm: Agricultural Production

A look at the full specialty crop system must begin at the foundation with an understanding of the role that specialty crop farms play in the regional economy. Approximately 60 percent of our lands in the Sacramento region are agricultural, including some of the most productive farmland in the world. We have great soil, water resources, and a Mediterranean climate that can grow almost anything, with over 70 specialty crops currently grown in the region. But specialty crop agriculture (defined in this study as fruits, vegetables, tree nuts, horticulture, and nursery crops) is not only highly productive and diverse— it is a major economic driver in the Sacramento region.

This *Food System Multipliers for the Sacramento Region* project estimates almost 11,000 jobs on specialty crop farms and nurseries throughout the region; together, this work growing specialty crops results in around $1.5 billion in regional farmgate value, helping feed both the region as well as national and international markets.

10,800

Jobs

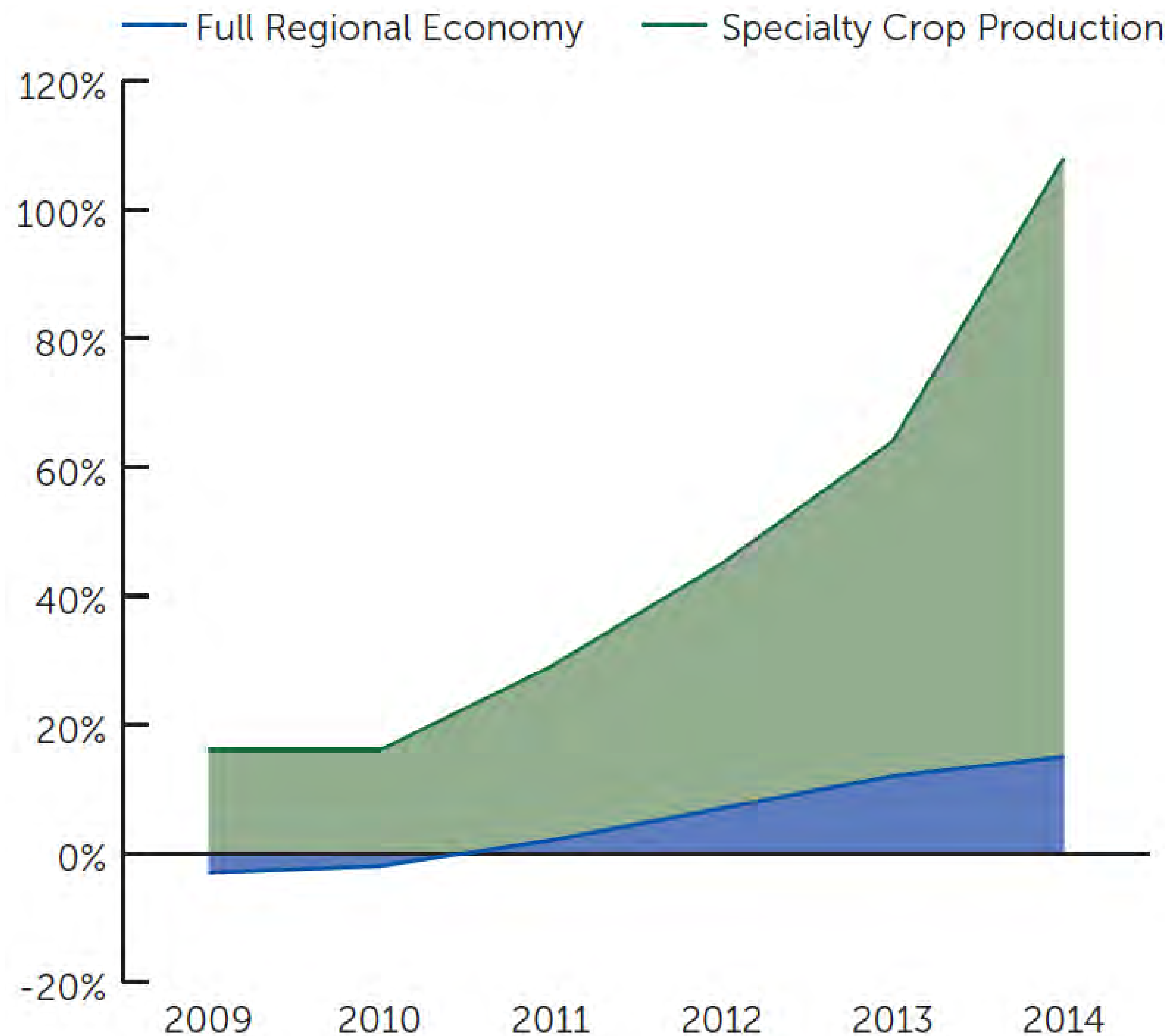
(full-time equivalent positions)

$1.5 billion

Direct Farmgate Value

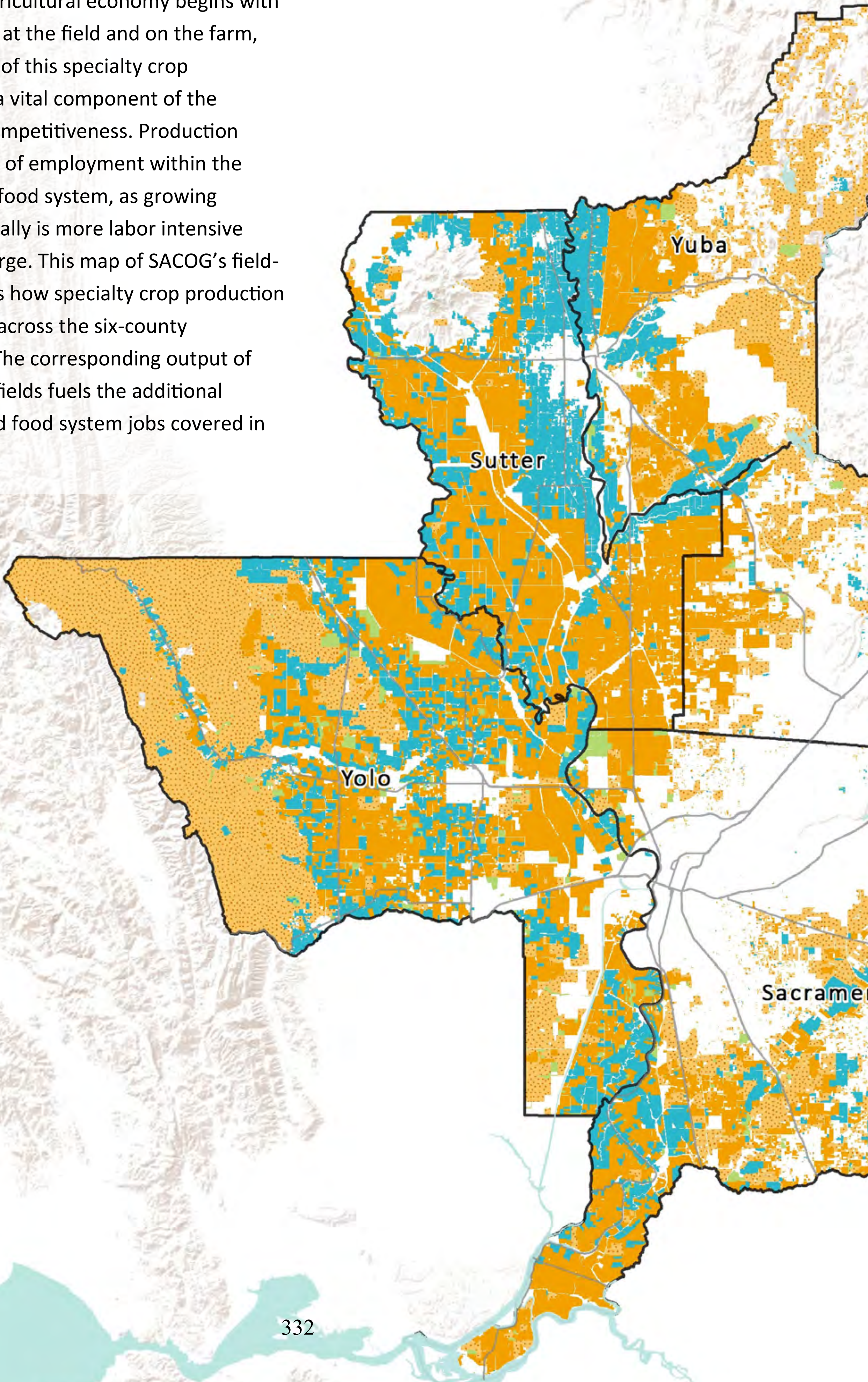
(annual gross sales of specialty crop farmers)

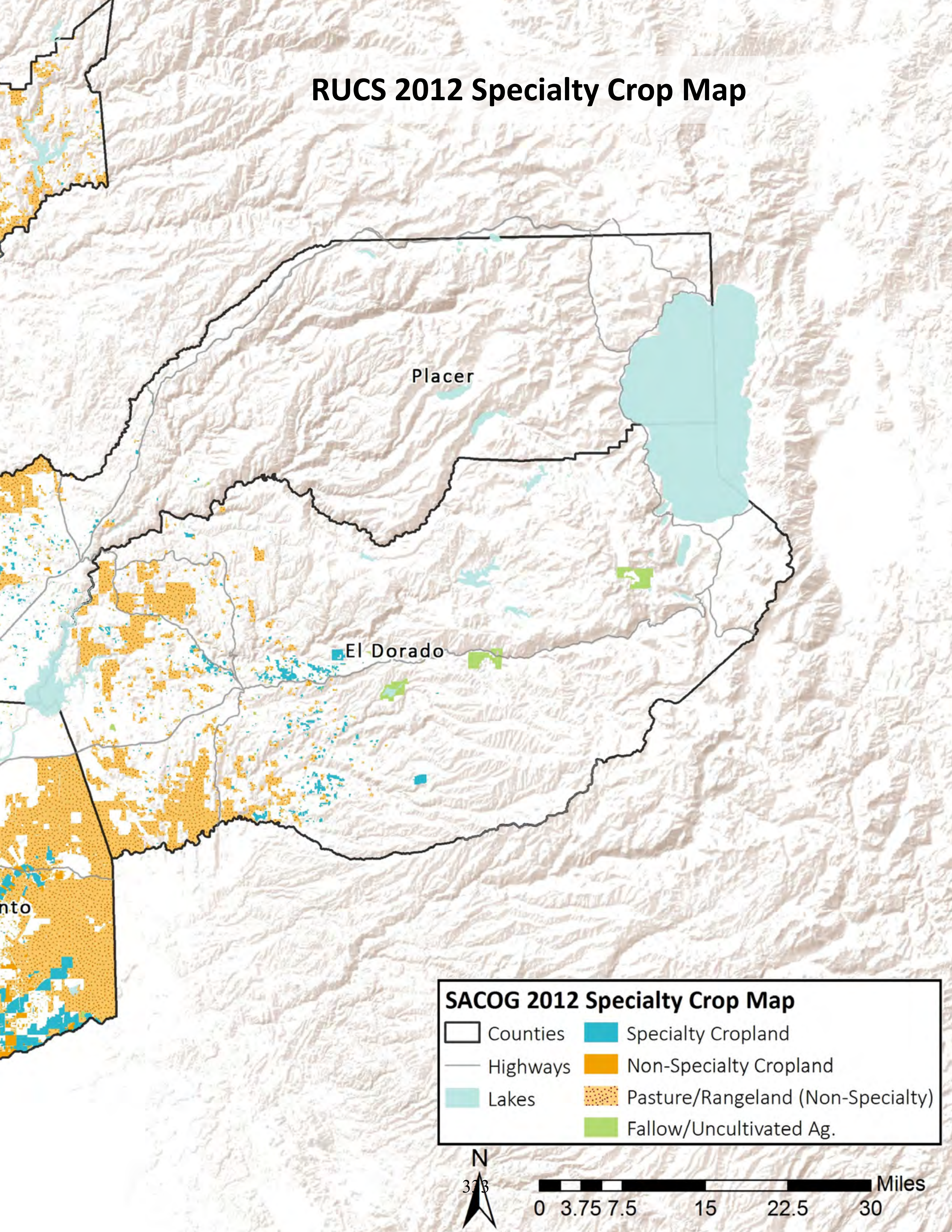
Cumulative Output Growth since 2008
(in nominal dollars)



Not only does specialty crop production support jobs and economic activity, but its impact on the regional economy has grown through time. Since 2008 specialty crop farms have added 800 jobs regionally, while most other sectors lost jobs and have yet to return their pre-recession employment levels. Notably, specialty crops have driven the region's agriculture production sector to record levels of economic output. In all, between the study years of 2008 and 2014 specialty crop output value doubled (an increase of 89 percent when adjusted for inflation), far outpacing growth in the regional economy as a whole. This direct output, derived from 21 percent of the agricultural acreage in the region, accounted for 60 percent of total agricultural value. In fact, specialty crops accounted for 95 percent of the growth in total agricultural value from 2008 to 2014. Additionally, while all agriculture contributes significant value to the regional economy, specialty crops generated around $2,700 per acre annually— more than three times the value per acre than non-specialty agricultural products.

The specialty crop agricultural economy begins with production decisions at the field and on the farm, and the contribution of this specialty crop production sector is a vital component of the region's economic competitiveness. Production includes the majority of employment within the larger specialty crop food system, as growing specialty crops generally is more labor intensive than agriculture at large. This map of SACOG's field-level crop data shows how specialty crop production is widely distributed across the six-county Sacramento region. The corresponding output of these specialty crop fields fuels the additional economic activity and food system jobs covered in this study.




RUCS 2012 Specialty Crop Map
Placer
El Dorado
nto
SACOG 2012 Specialty Crop Map
Counties
Highways
Lakes
Specialty Cropland
Non-Specialty Cropland
Pasture/Rangeland (Non-Specialty)
Fallow/Uncultivated Ag.
N
Miles
0 3.75 7.5 15 22.5 30

Specialty Crops both on and off the Farm: The Industry Cluster

Cluster research is a widely accepted practice for developing regional prosperity strategies for sustained job creation and growth that leverage unique regional strengths. Industry clusters increase firm competiveness through shared infrastructure and a concentrated workforce, reduce operating costs with shorter supply chains, increase the flow of information regarding new business opportunities, and foster innovation with informal collaboration and heightened competition. Economic clusters often serve as the driving force of many regional economies.

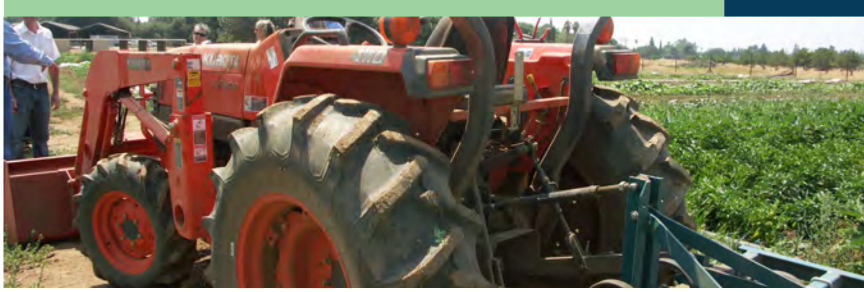
Growing specialty food and fiber in our region also creates jobs and income off the farm. The way that food reaches our tables is complicated, yet remarkable, as fresh and processed food travels in and out of our region daily. Although some products arrive "raw," most are transformed into processed or packaged goods along the way. Indeed, the fuller specialty crop food system encompasses multiple business sectors providing a range of services that refine, enhance, and move food products from farms to consumers.

Together, these industries represent the specialty crop cluster – a group of interdependent firms and related institutions linked through strong relationships and transactions. This project has divided the cluster into four core sectors: specialty crop production, processing, distribution, and support.[1]

17,200
Jobs
(full-time equivalent)

1,200
Establishments
(# of firms in the cluster)

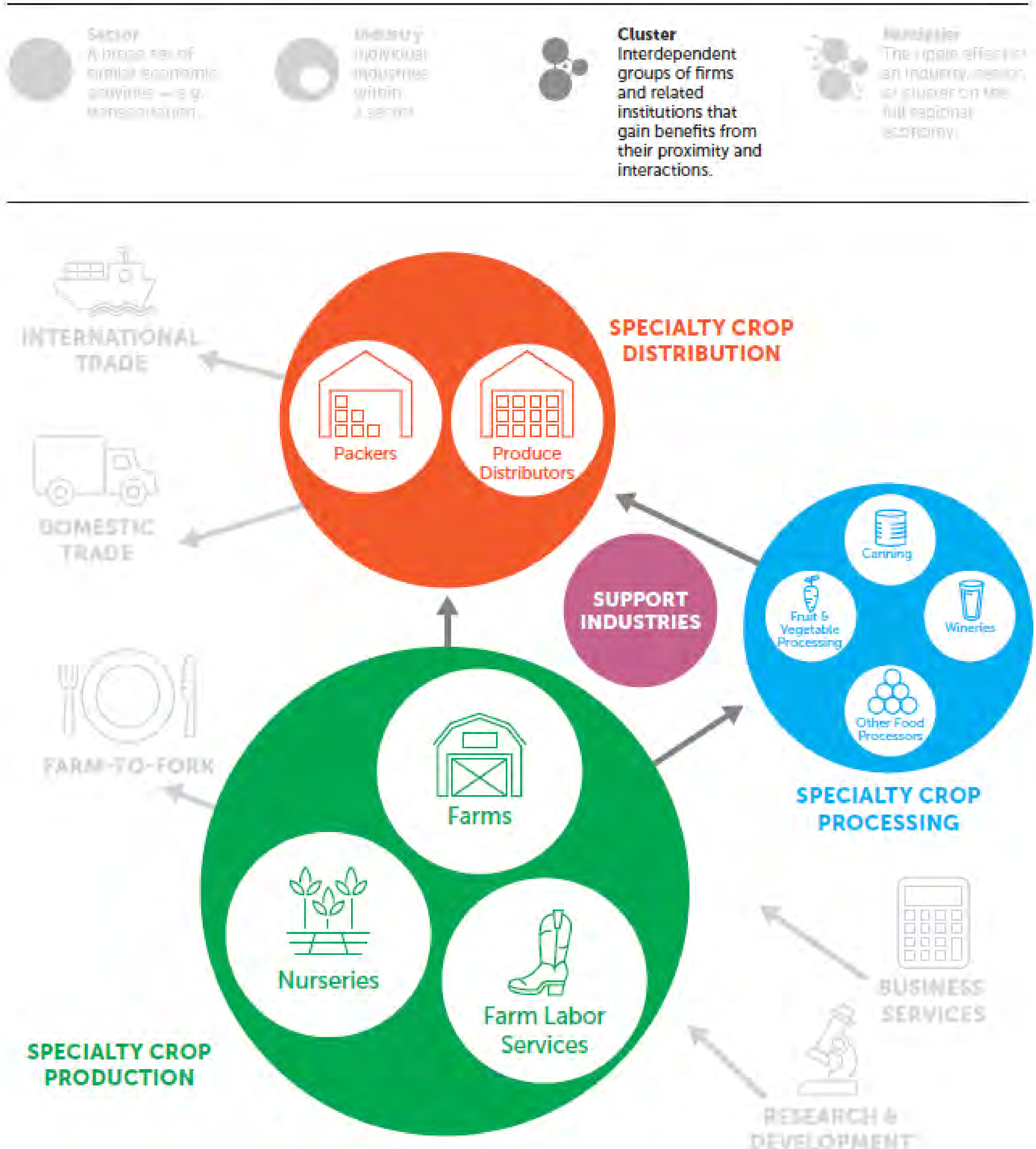
$1.2 billion
Value Added
(end sales minus value of all inputs)



$4 billion
Direct Output
(gross sales)

[1] *In keeping with other food system and cluster studies, this cluster definition incorporates the core economic linkages resulting as specialty crops are grown, processed and distributed in the Sacramento region. Note that this cluster definition does not include the (substantial) economic impact of specialty crop food at the point of consumption, be it restaurants, grocery stores, or institutions to name a few. Also, that the distribution activities included in the cluster definition are limited to a select subset of industries due to data restrictions. The cluster distribution employment data include warehousing and storage activities, while the project's multiplier analysis only includes three industries—packer shippers, produce distributors, and produce stands.*

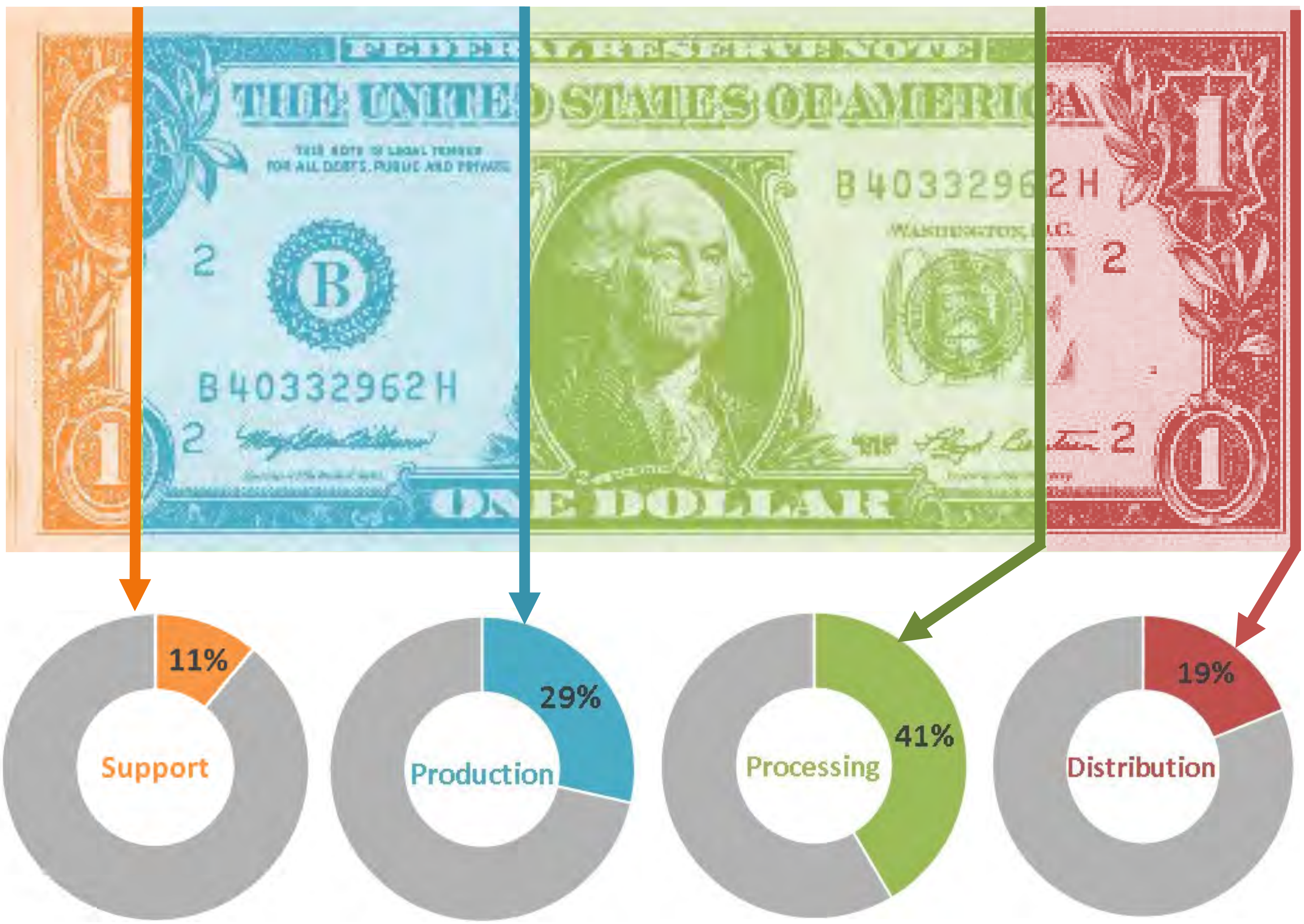
Specialty Crop Cluster



The specialty crop cluster extends beyond the farm to include core food system industries. Firms in the processing subsector of the cluster process, manufacture, package, or prepare food products using specialty crops as inputs (e.g., oil processing, specialty canning, and wineries). Distribution firms pack, store, or transport specialty crop products (e.g., packer shippers, warehousing and storage, food service contractors). Firms in the support segment of the cluster support specialty agricultural production by providing resources and equipment for growing and harvesting specialty crop products (e.g., fertilizer, pesticides, and farm and food machinery and equipment).

In the past several years, the value of regional specialty crop production has soared to record levels.

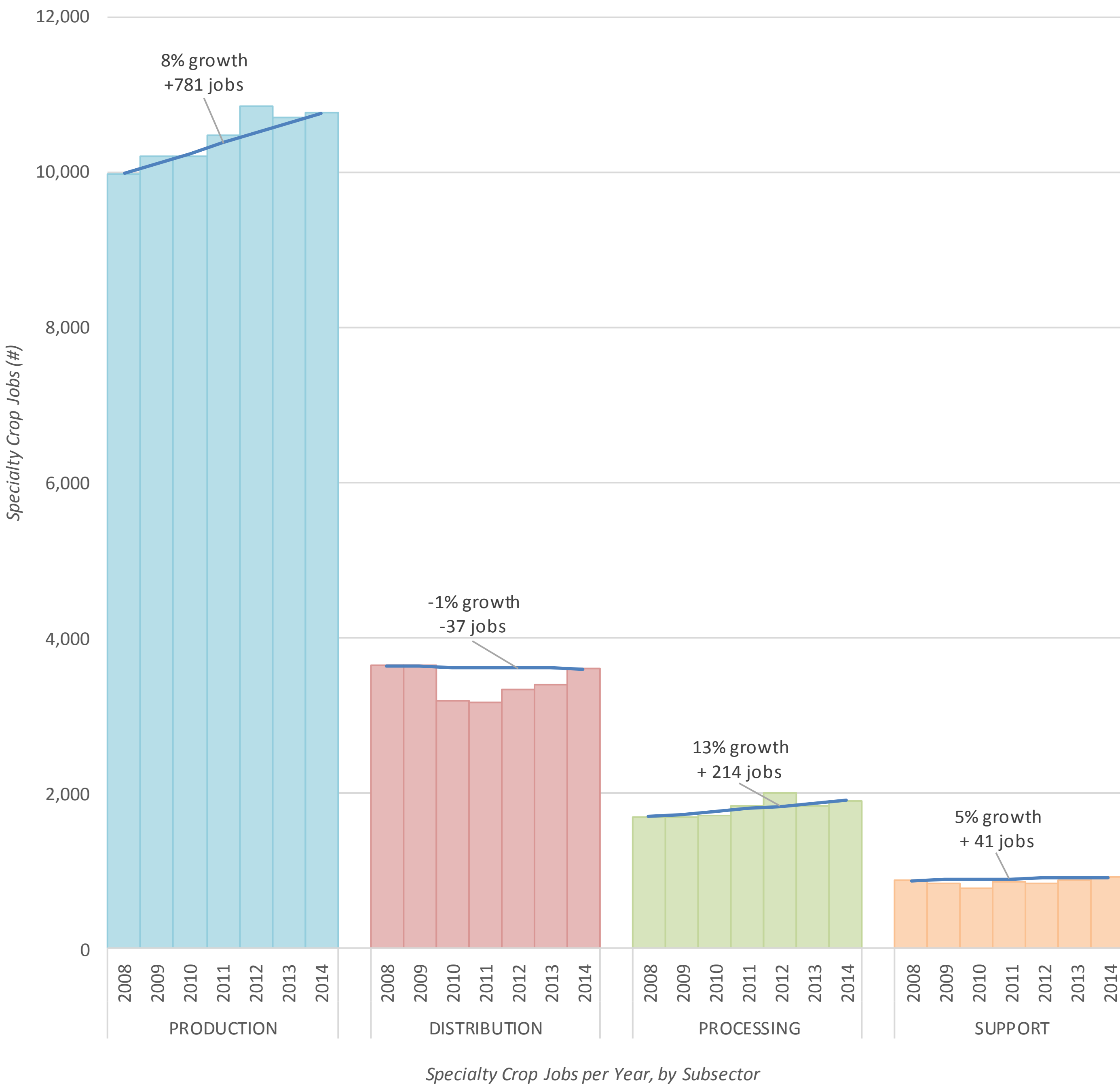
Specialty Crop Cluster Direct Output Value



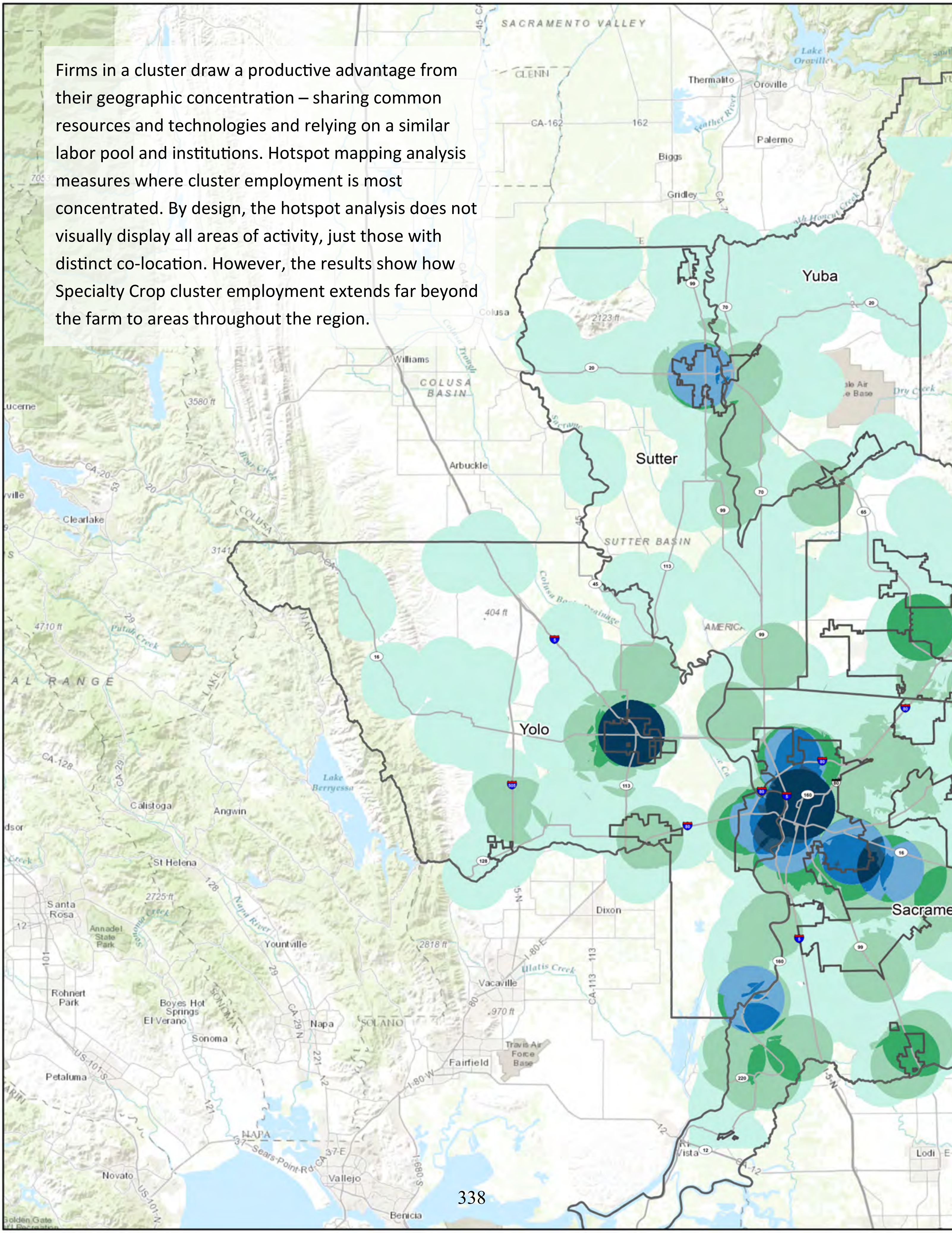
The Specialty Crop cluster provides significant benefits to the regional economy. Taken together, the various components of the cluster add nearly $4 billion in direct output (the value of an industry's aggregate sales) a year to the Sacramento regional economy. Only around 30 percent of the cluster's direct output stems from the value of specialty crops as they leave the farm – the majority of the cluster's gross output value is in fact generated as specialty crops move through the larger regional food system. Value add (an industry's end sales minus the value of purchases) is another economic measure of the cluster. The indicator highlights the net economic addition of each segment of the cluster (production, support, processing, and distribution) by controlling for the cost of inputs and purchases between businesses. Approximately $1.2 billion of the cluster's total direct output is estimated as attributable to value add.

While specialty crop production includes the majority of employment within the cluster, over 6,400 jobs (or 37 percent) fall into the distribution, processing, and support subsectors off the farm. Taken together, employment in the specialty crop cluster increased by 6 percent from 2008 to 2014 – a stark contrast to both the overall economy and to non-specialty crop agriculture, which each actually declined in employment over the same period. Specialty crop processing industries helped lead this recent increase in cluster employment with the highest percentage of job growth within the cluster (13 percent), while specialty crop production added the most overall jobs (around 780) during the same period. Indeed, the specialty crop cluster has outpaced the region at large in economic recovery from the recent recession.

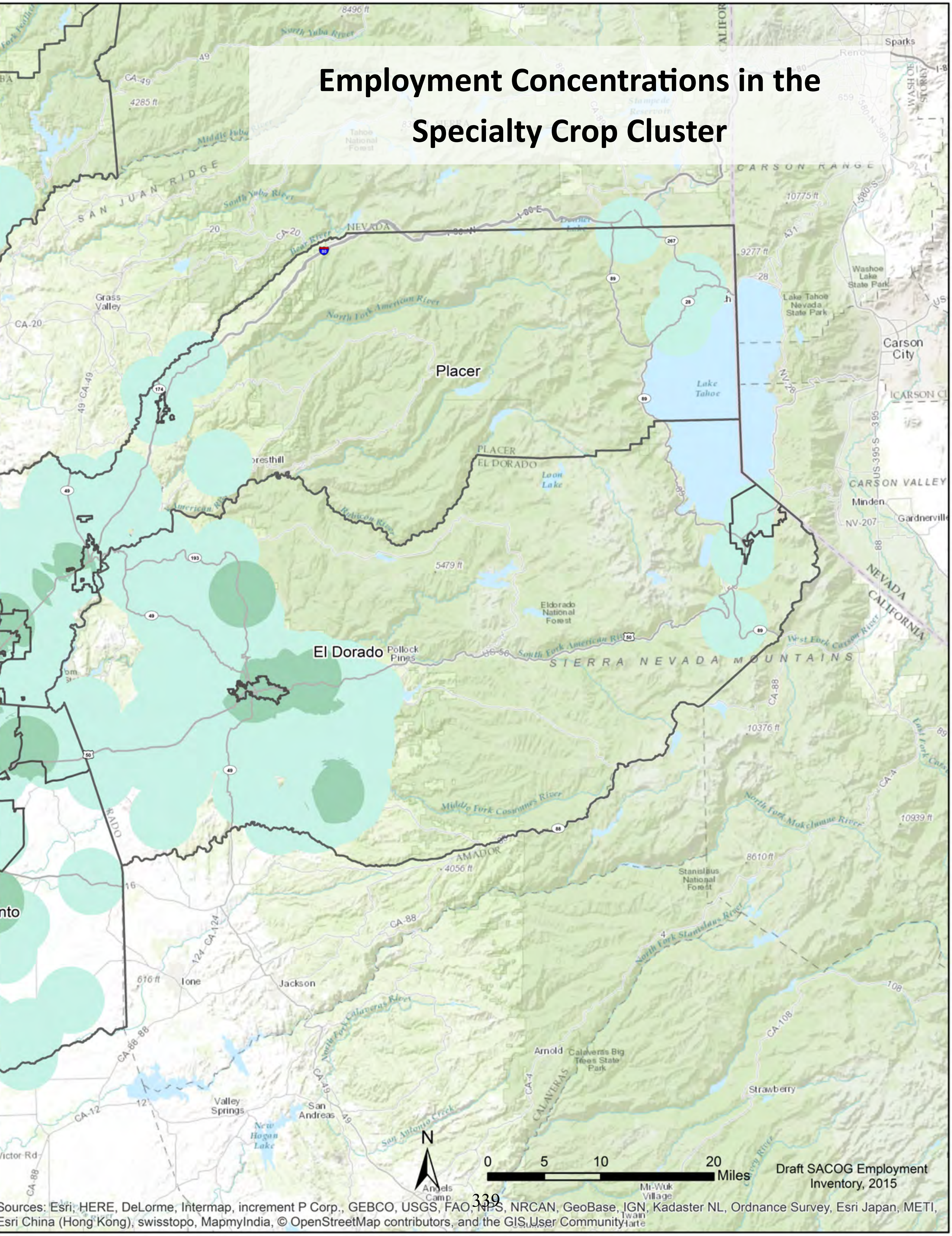
Specialty Crop Cluster Employment Change and Concentration



Firms in a cluster draw a productive advantage from their geographic concentration – sharing common resources and technologies and relying on a similar labor pool and institutions. Hotspot mapping analysis measures where cluster employment is most concentrated. By design, the hotspot analysis does not visually display all areas of activity, just those with distinct co-location. However, the results show how Specialty Crop cluster employment extends far beyond the farm to areas throughout the region.



Employment Concentrations in the Specialty Crop Cluster



Economic Activity in the Larger Economy: The Specialty Crop Food System Multiplier Effect

A look at employment and direct output in the region's specialty crop cluster provides an expanded – although still incomplete – snapshot of the role of specialty crops in the Sacramento region's overall economy. In addition to the activities covered in the cluster, growers purchase a wider range of goods and services from local suppliers, while restaurants, stores, and institutions purchase local food products. Likewise, income from jobs in specialty crop production, processing, support, and distribution allows cluster workers to consume various goods and services in the community. In other words, each dollar of economic value generated by a specialty crop business generates further 'multiplier' effects in other industries.

To calculate the multiplier effect of specialty crop agriculture, the project team created an updated economic model drawing on numerous interviews with local farmers, processors, and distributors, as well as supplemental data sources. The work culminated in a customized tool based on extensive local data to better measure the larger ripple effect of the region's specialty crop food system. With project multipliers generally five percent higher than the default model data, this new tool provides substantial improvements in accuracy compared to the tools the region currently has to quantify the food system. In short, the project's updated multiplier model documents a fuller economic contribution of specialty crops in the Sacramento region: over 31,000 jobs created by specialty crop businesses, $2.4 in value add contribution to the regional economy, and almost $6 billion in total output value. From an economic multiplier perspective, this translates into an employment multiplier of 1.82 (every job in specialty crops generates another 0.82 jobs in other areas of the regional economy) and a value added multiplier of 1.90 (each dollar of the specialty crop cluster's direct contribution to gross regional product also generates $0.90 in additional value added across other industries).

$2.4 billion
Value Add

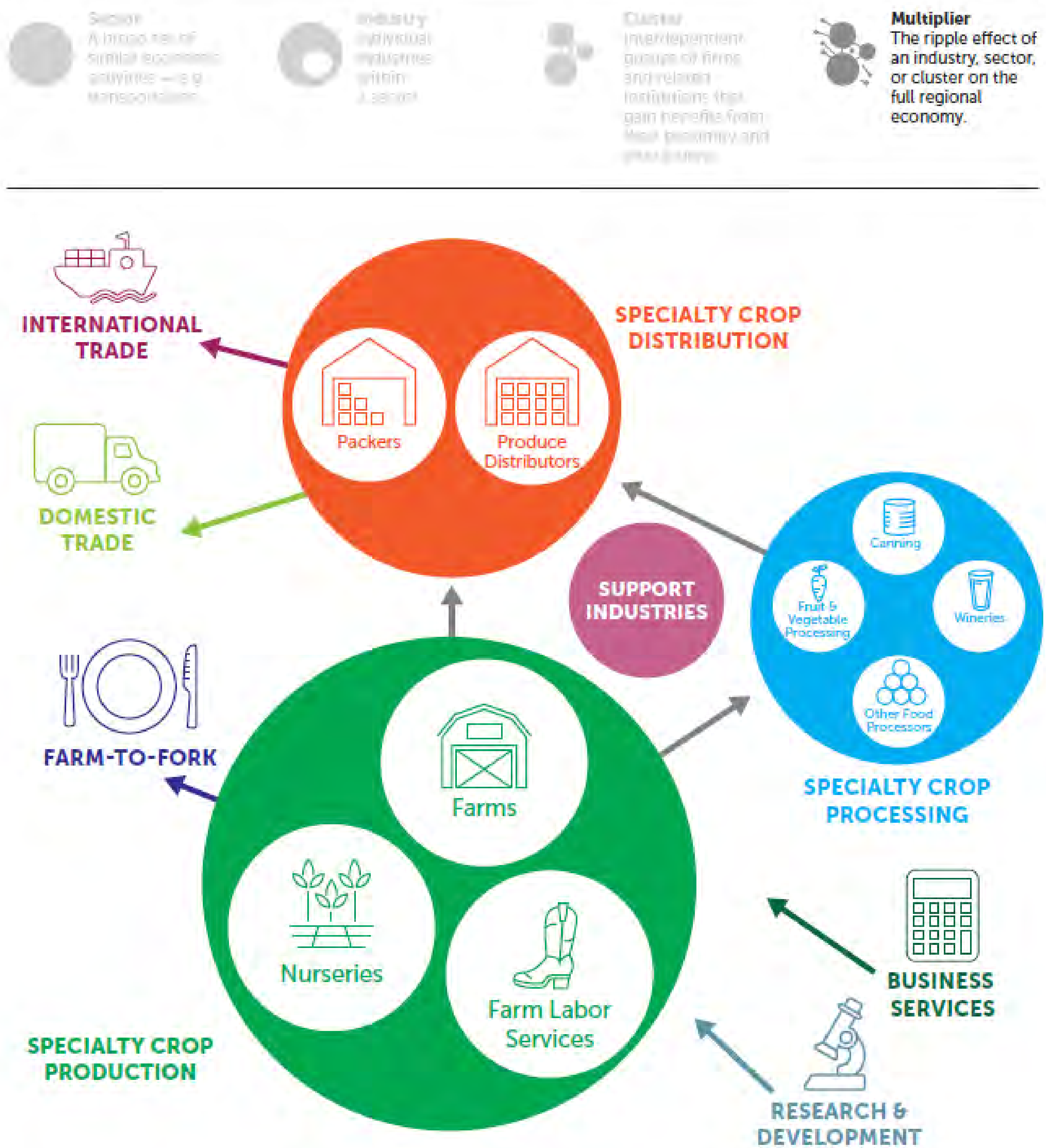
$5.8 billion
Total Output Value

31,176
Full Time Equivalent Jobs

1.82
Employment Multiplier

1.9
Value Added Multiplier

Specialty Crop Multiplier



A multiplier effect estimates a fuller web of activity generated by a business or industry (in this case the Sacramento region's specialty crop cluster) on the regional economy, including that for businesses supplying goods and services to the cluster and the household spending of income earned in the cluster and by supporting industries. The project's estimates of this full economic contribution derive from an updated economic model which provides a more accurate portrayal of specialty crop economic activity within the six-county Sacramento region.

Local Data Yields More Accurate Multipliers

This project draws on interviews with local specialty crop businesses as well as supplemental regional data to create an updated economic multiplier model for the Sacramento region. As illustrated in the tables below, the study model results in more accurate multipliers compared to the base IMPLAN data that relies in part on national averages not representative of Sacramento region specialty crop agriculture.

Employment Multipliers for Specialty Crop Cluster	Default Data Multiplier	Study Multiplier	Percent Change
Miscellaneous vegetable farming	1.88	2.31	23%
Processing tomato farming		2.38	27%
Miscellaneous fruit farming	1.38	1.52	10%
Olive farming		1.64	19%
Peach farming		1.56	13%
Wine grape farming		1.53	11%
Miscellaneous tree nut farming	1.63	2.05	26%
Walnut farming		2.09	28%
Greenhouse, nursery and floriculture production	1.79	1.87	4%
Support activities for ag and forestry	1.19	1.19	0%
Nut hulling		1.82	53%
Olive oil mills	N/A	5.74	-
Canned fruits and vegetables manufacturing	2.63	2.63	0%
Canned specialties	3.51	3.50	0%
Processing tomato canning		4.85	38%
Dehydrated food products manufacturing	2.15	2.15	0%
Roasted nut and peanut butter manufacturing	3.48	3.46	-1%
Wineries	2.58	2.58	0%
Wholesale trade	1.86	1.86	0%
Produce distributors and shippers		5.79	211%

Output Multipliers for Specialty Crop Cluster	**Default Data Multiplier**	**Study Multiplier**	**Percent Change**
Miscellaneous vegetable farming	1.43	1.74	22%
Processing tomato farming		1.87	31%
Miscellaneous fruit farming	1.50	1.82	21%
Olive farming		1.70	13%
Peach farming		1.63	9%
Wine grape farming		1.78	19%
Miscellaneous tree nut farming	1.45	1.85	28%
Walnut farming		1.65	14%
Greenhouse, nursery and floriculture production	1.51	1.59	5%
Support activities for ag and forestry	1.51	1.54	2%
Nut hulling		1.48	-2%
Olive oil mills	1.34	1.57	18%
Canned fruits and vegetables manufacturing	1.50	1.51	0%
Canned specialties	1.56	1.53	-2%
Processing tomato canning		1.64	5%
Dehydrated food products manufacturing	1.45	1.46	0%
Roasted nut and peanut butter manufacturing	1.50	1.49	-1%
Wineries	1.63	1.63	0%
Wholesale trade	1.55	1.63	5%
Produce distributors and shippers		1.61	4%

Tools Supporting Policy Development and Investment for Specialty Crops

In addition to calculating the fuller economic contribution of specialty crops today, this project has developed an integrated set of tools to test the effect of future policy and market changes in the cluster. The tools consist of a crop production model to simulate specialty crop farmers' responses to changes in market conditions, and an updated multiplier model to show how these field-level decisions then ripple through the larger regional economy. These tools can help capitalize on the specialty crop employment and output momentum documented in this project, by facilitating the development of effective strategies, investments, and policies supporting the vital specialty crop cluster into the future.

Through RUCS, SACOG has focused on opportunities that support jobs and economic growth in the specialty crop cluster. The program's technical work and stakeholder engagement have resulted in a series of case studies using scenario planning to show the effect of potential policy outcomes across the region's vast agricultural lands. The tools built as part of this multiplier project complement the larger RUCS toolkit by connecting what happens on the farm to the economy at large, showing how policies and strategies impact a food system that is both rural and urban. In particular, the project's additions to the RUCS toolkit allow for further data-driven decision-making and scenario analyses that hone in on synergies between the region's rural and urban areas in meeting shared goals of new economic opportunity and enhanced quality of life.

The project applied this new integrated toolkit in two test examples. The first looked at the effect of regulations on the specialty crop cluster, finding that an estimated 6.4 percent of total specialty crop farm income is spent on regulatory compliance. The second application tested the potential economic impact of food system investment, through the hypothetical example of attracting a peach processing facility in the region. The integrated tools show how more jobs, value add, and taxes currently flowing out of the Sacramento region could stay in the area if this potential scenario is implemented, with a net increase of 600 jobs, $43 million in value added, and $146 million in total output value to the regional economy from this one business attraction scenario alone. Notably, these 600 additional jobs consist of employment opportunities for the full region, be it on the farm, at the processing facility, or in the community in general.

Application of Tools: Peach Processing Case Study

608

Additional Jobs

$43 million

Increase in Value Add

Conclusion

The specialty crop agricultural economy in the Sacramento region starts at the field – the several hundred thousand specialty crop acres harvested regionally a year employ over 10,000 workers in producing food worth $1.5 billion. Yet while the specialty crop economy begins at the field, this project has shown that its economic contribution to greater Sacramento certainly does not end there. Specialty crop growers engage with suppliers, processors, and distributors to form a larger cluster, while each dollar generated by a specialty crop business then leads to a multiplier effect in other industries. By expanding the food system beyond the farm, this study finds the contribution of the specialty crop base economy to be over 31,000 jobs, $2.4 billion in value add, and $5.8 billion in total output value in the Sacramento region. And perhaps to an extent not achieved by any other segment of the economy, this specialty crop food system helps also connect the region's many rural and urban communities.

To arrive at the full economic contribution of specialty crops, the project draws on a data and modeling effort unprecedented in understanding specialty crop agriculture in the region. The findings are underpinned by interviews conducted with local specialty crop producers, processors, and distributors, with numerous additional data sources supplementing this primary data collection. The project's dual technical deliverables describe the substantial data collection efforts and citations, while this executive summary has focused on the top level findings to succinctly demonstrate the role of specialty crop agriculture in the Sacramento region. The results of this technical undertaking have led to an updated and much more accurate multiplier for the regional economy compared to default economic modeling and prior analyses not customized to the Sacramento region.

Overall the Sacramento region boasts an unrivaled array of assets supporting the specialty crop food system, including productive soils and farmland, multi-generational knowhow, food entrepreneurs, favorable climate and water supply, and supportive institutions such as RUCS and the world-renowned departments at UC Davis. These assets, coupled with recent specialty crop employment and output growth, suggest strong positioning for specialty crop production in the region into the future. This project's integrated toolkit provides a means to test scenarios, strategies, and investments that capitalize on our competitive strengths and momentum to make specialty crop agriculture an even more impactful economic engine for the entire region.

The project's demonstration scenario models the effect of attracting a peach processing facility on regional employment and output. The results lead to even more jobs and economic growth, with an additional 600 jobs and $150 million in total output value from the peach processor scenario. Yet this scenario represents just one possible investment in the specialty crop cluster. Future work can not only test a broader range of policy considerations and possible market outcomes, but also expand the look at the food system to include wholesale, retail, and consumption activities. SACOG looks forward to working with specialty crop farmers, stakeholders, investors, and policymakers to leverage these new tools, data, and capacity in support of specialty crop agriculture.

"By demonstrating the economic potential of agricultural lands and related food industries, there may be more incentive to invest in specialty crop production and food chain infrastructure and to preserve working lands. This can enhance the marketability and competiveness of specialty crops, inform potential regulatory reform at various levels, and facilitate development of effective policies and strategies supporting specialty crop agriculture."

S A C O G

FINAL REPORT

ERA Economics
Environment • Resources • Agriculture

Food System Multipliers for Specialty Crops in the Sacramento Region

Prepared for the Sacramento Area Council of Governments (SACOG) under Contract Nos. 15160002 and 15160029 with

Funding provided through California Department of Food and Agriculture 2013 Specialty Crop Block Grant "*Food System Multipliers for Specialty Crops in the Sacramento Region*"

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prepared by

ERA Economics, LLC
Duncan MacEwan , PhD
Jennifer Scheer
Richard Howitt, PhD
Jay Noel, PhD

in collaboration with

BAE Urban Economics, Inc.
Aaron Nousaine
Matt Kowta

Sacramento Area Council of Governments
Garett Ballard-Rosa, Project Manager
David Shabazian, RUCS Program Manager

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1. Executive Summary

The Sacramento Area Council of Governments (SACOG) received funding through a competitive Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) to develop a suite of tools that can be used to analyze the economic value of specialty crop producers, processors, and distributors in the greater Sacramento region. According to the U.S. Department of Agriculture, specialty crops include "fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops including floriculture."[1] The geographic scope of the project is the six counties that comprise the Sacramento Area Council of Governments. These counties include El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba and are collectively referred to as the Sacramento region. SACOG contracted with ERA Economics LLC (ERA) and technical subcontractor BAE Urban Economics (the "ERA team") to develop the economic modeling framework for evaluating the economic contribution of specialty crop agriculture. The economic modeling framework for specialty crops developed under this project relies on two separate, but linked, approaches: an economic model of primary farm production in the Sacramento region and a regional model based on the Impact Analysis for Planning (IMPLAN) platform. Prior to this study, this suite of tools did not exist for Sacramento region specialty crop agriculture. Together the integrated framework is used to analyze the economic value of specialty crop agriculture from the field to the table.

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of new boutique processors creating new products for localized markets. Closely linked to specialty crop agriculture processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. The specialty crop agriculture cluster of producers, processors, and distributors includes many businesses that are vertically integrated. For example, grower-packer-shippers farm, process, and distribute fresh vegetables, and many farming operations rent equipment and offer custom farming services to other growers. It is important to consider the total economic activity generated by the entire specialty crop agriculture cluster in order to quantify the current value in the Sacramento region, and how it will grow in the future.

SACOG initiated this study to determine the economic value that specialty crop agriculture brings to the Sacramento region. In particular, the annual economic value that specialty crop agriculture provides to the six counties and twenty-two cities in the SACOG region is significantly greater than the $1.47 billion in gross farm-gate revenues. Growers purchase

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[1] U.S. Department of Agriculture. *What is a Specialty Crop?* Available at: http://www.ams.usda.gov/services/grants/scbgp/specialty-crop

materials and machinery from local suppliers, farm workers purchase goods and services in the community, restaurants purchase local produce, and businesses in all of these related industries pay local, state, and federal taxes. In other words, each dollar of economic value generated by a specialty crop business (the direct effect) generates multiplier effects in other industries. Multiplier effects are decomposed into indirect effects, economic activity generated through purchases from other businesses, and induced effects, economic activity generated by employee expenditures in the local economy. The total economic effect is the sum of the direct, indirect, and induced components.

While the direct farm-gate value of specialty crop agriculture is often understood and accurately quantified, the multiplier benefits are rarely quantified or cited in public policy discussion. This web of economic activity, alternatively referred to as an economic cluster, generated by specialty crop agriculture is the central focus of this study. Economic activity is expressed in terms of jobs, which is full time equivalent employment, output value, which is the gross sales value of an industry, and value added, which is the net contribution to the local economy after netting out double-counting of purchases between businesses.

The specialty crop agriculture cluster in the Sacramento region contributes significant jobs and value added to the regional economy. There are over 17,000 jobs in specialty crop agriculture production, processing, and distribution. Every jobs in specialty crop agriculture generates another 0.82 jobs in other areas of the regional economy. The total output value of the specialty crop cluster is approximately \$3.9 billion annually, with each \$1 of output generating an additional \$0.49 of output in other sectors of the regional economy. Specialty crop industries directly contribute over \$1.2 billion in total value added to the regional economy. For every dollar in value added, \$0.90 in additional value added is generated across other industries.

1.1 Analysis Approach

The economic modeling framework developed under this project relies on an economic model of primary farm production in the Sacramento region and a regional economic model based on IMPLAN. Together the integrated framework is used to analyze the total economic value of specialty crop agriculture. The analysis approach is decomposed into five central tasks: (i) preliminary analysis, (ii) data gathering and outreach, (iii) primary agricultural production model development, (iv) Input-Output model development, and (v) economic cluster analysis.

A preliminary analysis using the default IMPLAN 2013 R3 data finds that the specialty crop agriculture production cluster includes four sectors: vegetable and melon farming, fruit farming, tree nut farming, and nurseries and greenhouses. The coarse grouping of production sectors in the default IMPLAN data means that important differences in regional economic activity between crops cannot be accurately represented. For example, processing tomato farming and melon farming require different inputs, serve different markets, have different domestic and international sales, and have different links for post-harvest handling (processing and/or distribution). This aggregation bias is an important limitation to completing an economic cluster analysis. In addition, a preliminary analysis revealed that the default IMPLAN data for the specialty crop sectors does not accurately represent expenditures and economic activity associated with specialty crop agriculture in the SACOG region. Key measures of economic activity and expenditure patterns in the IMPLAN data are derived from national benchmark data provided by the Bureau of Economic Analysis (BEA), which the ERA team determined is not representative of specialty crop production in the Sacramento region. In particular, the proportion of expenditures on inputs (intermediate expenditures) is significantly higher than in the default IMPLAN trade flow data. This was a consistent finding in all surveys and alternative sources of data used in the analysis. In short, the default IMPLAN model reflects the best information that is available on a national basis, but this study finds that its application for agriculture – specialty crops in particular – must be improved using supplemental data in order to generate meaningful estimates of the economic value of specialty crop agriculture in the Sacramento region. This project develops a primary economic model of specialty crop production linked to a custom IMPLAN model representing regional purchases in the specialty crop agriculture cluster to address this deficiency.

Recognizing that the modeling framework is only as good as the underlying data, the ERA team undertook a comprehensive data gathering effort with surveys and supplemental research to characterize Sacramento region specialty crop agriculture. Over one hundred specialty crop farmers, processors, and distributors were contacted through phone, email, and in-person interviews over an eight month period. The surveys elicited information on expenditures, use of inputs, employees, and sales. In addition, the surveys quantified the regulatory cost facing specialty crop agriculture in the region. These data were compiled, combined with supplemental information gathered by the ERA team and from a study by UC Davis[2], and aggregated in a confidential database so that no one entity can be identified. The information was then used to develop a primary model of agricultural production and a customized version of the IMPLAN model.

A primary production model of Sacramento region primary agriculture was developed using the comprehensive data compiled under this project. The model covers all irrigated agriculture in the six-county SACOG area. It is used to estimate cropping patterns, use of inputs, outputs, and farm-gate returns across the diverse specialty crop production sectors in the Sacramento region. The modeling framework is designed to simulate the response of agriculture to changes in policy (e.g. new regulations), market conditions (e.g. prices and costs), resource conditions (e.g. drought), and a range of other factors. For this study, the model is used to quantify the farm-gate value of crop production in the Sacramento region, and simulate the economic response of the industry to changes in policy or other market conditions.

[2] http://sfp.ucdavis.edu/pubs/Economic_Impact_Reports/

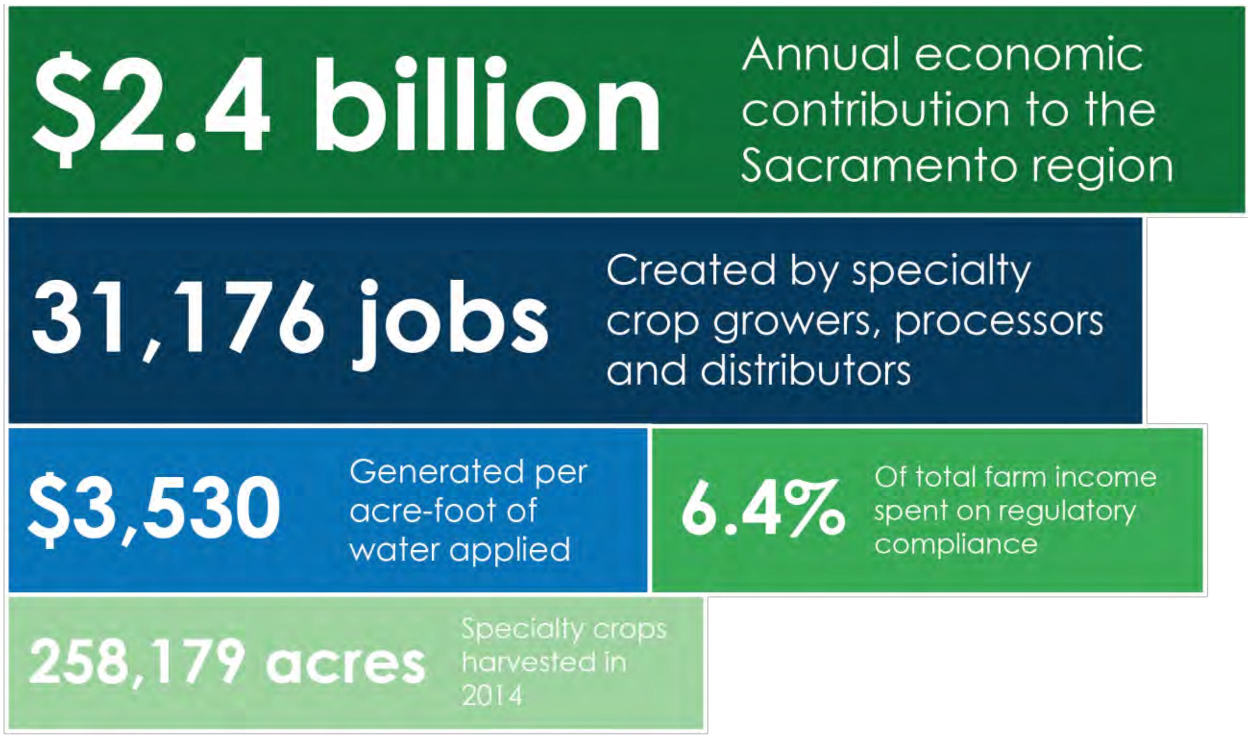
A custom IMPLAN model of Sacramento region primary agriculture was developed using the comprehensive data compiled under this project. This study developed a series of detailed IMPLAN model industry accounts which reflect the expenditures observed in the survey of specialty crop businesses. The primary production model simulates the responsiveness of agriculture to changes in market conditions or shifts in technology, and the regional IMPLAN model traces these changes from the farm to all related sectors of the economy. The model is used to estimate the linkages to the regional economy and quantify the total economic value of specialty crop agriculture.

The final phase of the analysis uses the data, the primary model, and the custom IMPLAN model to analyze the economic contribution of specialty crop agriculture to the Sacramento region, and analyze an industry cluster growth scenario. The economic contribution analysis evaluates the additional economic activity generated for each dollar of economic activity generated by specialty crop agriculture. To demonstrate how the models can be used to estimate future growth in the industry, the ERA team evaluated the economic impacts of increased peach production, and a new frozen peach processor moving into the region in response to an increase in the demand for frozen peaches. In both analyses, the economic activity is linked from the field to all related industries in the specialty crop agriculture cluster.

1.2 The Value of Specialty Crop Agriculture in the Sacramento Region

The farm-gate value of specialty crop production in the Sacramento region exceeds $1.47 billion annually. In spite of regulatory compliance costs that exceed 6 percent of total farm income, this production value is generated on just over a quarter-million acres in the Sacramento region. The primary farming sector supports businesses in the processing sector, and in turn, the distribution sector. Taken together the specialty crop cluster in the Sacramento region generates $3.9 billion in direct output value annually. Including indirect and induced multiplier effects, representing expenditures in ancillary businesses and by employees, respectively, the total output value exceeds $5.8 billion annually. The total value added contribution to the Sacramento region economy from the specialty crop agriculture cluster equals $2.4 billion dollars annually. The total cluster supports over 31,000 full time equivalent jobs in the Sacramento region. Figure ES-1 illustrates the economic contribution of the Sacramento region specialty crop agriculture economic cluster.

Figure ES-1. Total Economic Contribution of the Specialty Crop Agriculture Cluster



A diverse mix of specialty crops produced in the Sacramento region generates the economic activity of the specialty crop agriculture cluster. Foothill vineyards produce excellent wines for a growing market, Yolo County is the workhorse for processing tomato production to feed local canneries, and Sutter and Yuba counties are California's premier peach region for direct-to-consumer and processing demand. Each region has comparative advantages in growing a specific set of cops resulting from microclimate, soil conditions, and access to water, markets, and generations of farmer knowledge. These important regional differences are represented in the economic primary model and have important implications for the total value of the specialty crop cluster.

The recent robust growth in specialty crop agriculture in the Sacramento region is driven by comparative advantages in farming in the Sacramento region, market shifts in consumer tastes and preferences, and increasing domestic and international market demand for local crops. The Sacramento region is endowed with the three key natural resources required for successful agriculture: soil, climate, and water resources. Given the severe water shortages experienced by the San Joaquin and Tulare regions, and the potential for further costs or restrictions on through-Delta transfers, it is likely that the comparative advantage of the Sacramento Valley for primary irrigated production will be increasing in the future. For example, in the 2014 – 2015 drought there was a shift in processing tomato contracts to the Sacramento Valley region from the San Joaquin Valley region due to relative abundance of water supplies under drought conditions. With the recently enacted Sustainable Groundwater Management Act of 2014 (SGMA), the importance of groundwater as a drought reserve will be accentuated and this relative advantage of the Sacramento region over the San Joaquin and Tulare regions will continue to grow.

1.3 Frozen Fruit Processing Market Growth in the Sacramento Region

The ERA team applied the primary production model and IMPLAN model to evaluate an expansion in the frozen fruit processing sector in the Sacramento region. Currently, the Sacramento region has no large-scale frozen fruit processors. The potential to process fruit that is grown locally to meet a growing consumer demand for frozen fruit represents a significant opportunity for the regional economy. Jobs, value added, and taxes that are currently flowing out of the Sacramento region could stay in the area if a processor is attracted to the region by business-friendly policies.

An example application is developed for the frozen peach processing industry. Currently, the Sacramento region produces around 240,000 tons of peaches on 12,000 acres, generating approximately $92 million in gross farm-gate revenues. Most of these are clingstone peaches grown in Sutter and Yuba counties for consumer and processing demand. Peaches represent a potential growth industry in response to increasing consumer demand for frozen fruit. The share of peaches in the U.S. that are frozen tripled from 3 percent of available peaches in 1970 to 9 percent in 2013. Individual quick freezing (IQF) transforms fresh raw produce into a frozen product in a matter of minutes. The speed of the transformation better maintains the texture, flavor, and color compared to traditional freezing methods. In addition, because the produce is individually frozen it is less likely to clump during storage, resulting in a more consistent product for a variety of uses.

The presence of a peach processor in the region will incentivize additional peach production by reducing production costs (e.g. transportation) or risks (e.g. long-term contracts) to growers. This can be modeled as an increase in the gross margin of peaches produced in the Sacramento region. The primary production model simulates a 10 percent increase in the gross margin for peaches. In response, total peach production increases by just over 35,000 tons, representing an increase of $14 million in gross farm-gate revenues. The new IQF processor is assumed to process all of the additional peach production. The increase in peach acreage pushes out some competing crops, including lower value field crops grown on more marginal lands and a mix of older orchards, primarily in Yuba and Sutter counties. The total farm-gate revenues for these other crops fall by just over $1 million dollars, thus the net increase in farm-gate production value in the Sacramento region equals $13 million dollars.

The expansion of the peach market and the addition of a new IQF processor in the region generate additional economic activity in the regional economy. The IMPLAN model is linked to the change in direct output value estimated using the primary model to evaluate this change. Table ES-1 summarizes the results of the impact analysis. The direct effect of the location of the IQF processor equals $88 million, or equivalently, the approximate sales value for 35,000 tons of IQF peach production equals $88 million. This direct output value generates an additional change in indirect expenditures with other businesses and induced expenditures by employees of all businesses, equal to $59.5 million. The total output value is equal to the sum of the direct plus indirect and induced ("multiplier"), which equals $147.9 million. In addition, the IQF processor generates $43.8 million in total value added in the Sacramento regional economy and 620 total jobs. Balanced against this increase in IQF production is a decrease in the value of production for other crops pushed out by the modest expansion in peaches. The direct output value decrease of $1.049 million results in an additional decrease of $710 million dollars from indirect and induced (multiplier) effects. Total value added losses equal $614,260 and total employment losses equal 12 full-time equivalent jobs. Taking the increase in IQF processing and the decrease in farm production of other crops together, the total net effect of an expansion in peach production and IQF processing is an increase of 608 jobs, $43 million in value added, and $146 million in total output value in the Sacramento region.

Table ES-1. Economic Impact of Peach IQF Processing Expansion

	Employment	Value Added	Output
New Processing Facility			
Direct Effect	190	$12,250,000	$88,353,000
Multiplier Effect	430	$31,625,000	$59,562,000
Total	**620**	**$43,875,000**	**$147,915,000**
Change in Farm Output			
Direct Effect	-7	($190,720)	($1,049,000)
Multiplier Effect	-5	($423,540)	($710,000)
Total	**-12**	**($614,260)**	**($1,759,000)**
Combined Impact			
Direct Effect	183	$12,059,000	$87,304,000
Multiplier Effect	425	$31,202,000	$58,853,000
Total	**608**	**$43,261,000**	**$146,157,000**

1.4 Summary

The ERA team developed a suite of tools that can be used to evaluate the economic contribution of the specialty crop agriculture cluster, and evaluate the impact of new policies or changes in market conditions that may affect this sector. The standard IMPLAN model includes a limited number of specialty crop sectors and the data used to populate the expenditure patterns describing the key financial linkages in the model are based on national averages which are not representative of Sacramento region agriculture. The ERA team developed a linked economic and regional modeling framework by developing an economic model of primary crop production and a custom IMPLAN model. These models were developed using primary data from a comprehensive, and confidential, survey of over one hundred specialty crop businesses in the Sacramento region.

Using the primary production model and the IMPLAN model to evaluate the economic contribution of the specialty crop agriculture cluster, this analysis finds that the total value added contribution equals $2.4 billion annually. The value added is generated on over $5.8 billion in total output value, and supports over 31,000 jobs. Put another way, through the lens of economic multipliers, there are over 17,000 direct jobs in the specialty crop cluster and every job in specialty crops generates another 0.82 jobs in other areas of the economy. Specialty crop industries directly contribute over $1.2 billion in total value added to the regional economy. For every dollar in value added, $0.90 in additional value added is generated across other industries. Total output value of the specialty crop sector is approximately $3.9 billion, with each $1 of output generating an additional $0.49 of output in all other sectors of the specialty crop cluster.

Looking forward, robust growth in the specialty crop agriculture cluster is likely because the Sacramento region has comparative advantages in water and climate, and more importantly, produces a set of healthy, safe, and reliable crops that are in high demand in domestic and international markets. In particular, the on-going shift toward high-value locally consumed fresh fruit and vegetables, and growth in the export market for high-value nut crops will drive growth in the specialty crop agriculture cluster. Specialty crop agriculture generates higher value per unit land (and water) than most non-specialty crops, and has the potential to generate additional employment in secondary processing and distribution. While many regions of California's premier agricultural economy are reeling from drought and water restrictions, the Sacramento region specialty crop agriculture cluster is well suited for years of robust growth.

2. Introduction

The Sacramento Area Council of Governments (SACOG) received funding through a competitive Specialty Crop Block Grant from the California Department of Food and Agriculture (CDFA) to develop a suite of tools that can be used to analyze the economic value of specialty crop producers, processors, and distributors in the greater Sacramento region. The geographic scope of the project is the six counties that comprise the Sacramento Area Council of Governments. These counties include El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba and are collectively referred to as the Sacramento region. SACOG contracted with ERA Economics LLC (ERA) and technical subcontractor BAE Urban Economics (the "ERA team") to develop the economic modeling framework for evaluating the economic contribution of specialty crop agriculture. The economic modeling framework for specialty crops developed under this project relies on two separate, but linked, approaches: a model of primary farm production in the Sacramento region and a regional economic model based on the Impact Analysis for Planning (IMPLAN) platform. Prior to this study, this suite of tools did not exist for Sacramento region specialty crop agriculture. Together the integrated framework is used to analyze the economic value of specialty crop agriculture from the field to the table.

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of new boutique processors creating new products for localized markets. Closely linked to specialty crop agriculture processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. The specialty crop agriculture cluster of producers, processors, and distributors includes many businesses that are vertically integrated. For example, grower-packer-shippers farm, process, and distribute fresh vegetables, and many farming operations rent equipment and offer custom farming services to other growers. It is important to consider the total economic activity generated by the entire specialty crop agriculture cluster in order to quantify the current value in the Sacramento region, and how it will grow in the future.

The economic modeling framework developed under this project relies on an economic model of primary farm production in the Sacramento region and a regional input-output model based on IMPLAN. Together the integrated framework is used to analyze the total economic value of specialty crop agriculture. The analysis approach is decomposed into five central tasks: (i) preliminary analysis, (ii) data gathering and outreach, (iii) primary agricultural production model development, (iv) Input-Output model development, and (v) economic cluster analysis.

2.1 Terminology

Given the technical nature of the analyses described in this report, it is necessary to use some economic jargon so that measures of economic activity can be presented consistently. Changes in economic activity are commonly expressed in terms of the following.

1. **Output value**. The gross sales value of an industry. In crop production, for example, this measure is equal to the price of the crop multiplied by the total production.
2. **Value added**. The net contribution of an industry to the Sacramento region economy. It is equivalent to the commonly-cited national measure of economic activity known as Gross Domestic Product (or GDP).
3. **Employment**: The number of full time equivalent jobs in a sector.

Each measure of economic activity can be decomposed into direct, indirect, and induced components. This is sometimes referred to as the multiplier effect. The components are defined as follows.

1. **Direct.** The economic effects of direct sales activity by an individual agricultural sector. For example, the farm-gate revenues from crop production.
2. **Indirect.** The economic effects of intermediate input purchases by the sector. For example, irrigation supply purchases for crop production.
3. **Induced.** The economic effects of spending by employees in all other industries. For example, farm workers purchase housing and food in the Sacramento region.

The multiplier effect can be expressed in terms of indirect and induced, together or individually, and may include or exclude direct effects. An intuitive way to understand the multiplier effect for this report is to think about the additional jobs (or output value/value added) created for each direct job (or output value/value added) in the sector of interest.

2.2 Organization of the Report

The first section of the report provides an overview of specialty crop agriculture in the Sacramento region. This section includes a description of current and historical trends in acreage and the value of production for major specialty crops to illustrate the significant growth in this industry. The following section describes the data collection effort including the surveys and supplemental data used to populate the economic models developed under this project. Two subsequent sections describe the development of the primary production model and IMPLAN model, respectively. The final section of the report summarizes the economic cluster analysis of specialty crop agriculture using the two models, and presents the market growth scenario for the peach processing sector. The main body of the report is written at a moderate level of technical detail, a series of nine appendices provide the interested reader with additional technical information.

3. Overview of Specialty Crop Agriculture in the Sacramento Region

Specialty crop agriculture is a valuable and growing industry in the six-county Sacramento region. Over the past decade, the farm-gate value of specialty crop production in the Sacramento area has nearly doubled, from $748 million in 2004 to $1.47 billion in 2014. In 2013, the top specialty crops in the Sacramento region based on value of production were walnuts, wine grapes, processing tomatoes, dried plums, and almonds. Across the region, cropland (including specialty crops and non-specialty crop agriculture) accounted for 37 percent of total land use.

Although several specialty crops are grown across the six county region of SACOG, there is a few that drive the production values within the region. Walnuts, wine grapes, and processing tomatoes are the three most valuable crops. Table 1 shows the twelve most valuable specialty crops produced in each of the Sacramento region counties.

Table 1: 2013 Top Specialty Crops (Millions 2016 dollars)

	El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba
Walnuts	0.17	5.46	2.69	**146.54**	64.00	**75.69**
Wine Grapes	8.18	0.94	**144.20**		70.97	
Processing Tomatoes			5.97	24.94	**110.19**	
Almonds				17.77	70.83	3.30
Plums	0.60	0.28		51.48	4.31	24.15
Peaches	1.24	0.54		42.58		19.14
Misc. Vegetables		1.53	24.61	1.14	34.19	
Misc. Nursery	1.75	**9.04**	25.44	0.42	11.16	
Pears	1.62	0.29	43.53			
Misc. Fruits and Nuts	1.32	0.75	3.41	2.93	14.58	11.14
Nursery Stock				25.80	4.26	
Apples	**28.08**	0.37				
Total Specialty Crop Value	46.38	21.85	259.68	340.72	402.97	138.53

Source: California Agricultural Statistics

As shown in bold in Table 1, walnuts were the top value specialty crop in two of the Sacramento region counties, Sutter and Yuba. Wine grapes and processing tomatoes were the highest value crops in Sacramento and Yolo County, respectively. El Dorado's top specialty crop was apples and Placer County generated the most value from miscellaneous nursery products, including Christmas trees.

Farm size also varies across counties in the Sacramento region, reflecting differences in climate, crop mix, and cultural practices. Table 2 summarizes the average farm size in each county using data from the 2012 Census of Agriculture. The Census of Agriculture does not differentiate by specialty crop so these figures represent both specialty crop and non-specialty crop agriculture. Placer and El Dorado counties have a smaller average farm size, reflecting smaller-scale vegetable farming and boutique wineries. The largest average farm size is in Yolo County where processing tomatoes and non-specialty crops such as rice are typically farmed on much larger acreage. Across the Sacramento region the average farm size is just over 200 acres.

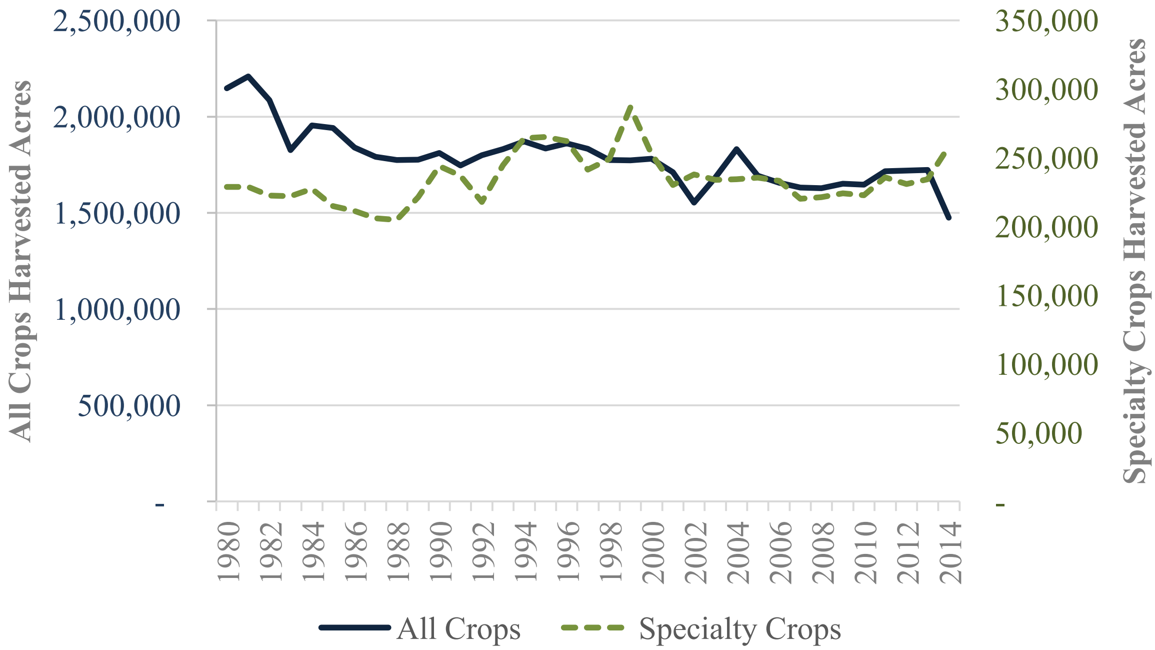
Table 2: Average Farm Size (in acres) in Sacramento Region Counties, 2012

El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba	Sacramento Region
95	67	183	276	456	236	206

Source: USDA, 2012 Census of Agriculture

Like most areas in California, the intensity of farming is increasing in the Sacramento region at the same time as the total irrigated footprint is decreasing. Total harvested acreage across the region declined by 31 percent from 1980 to 2014 for all crops. It is noteworthy that harvested acreage in specialty crops increased by 13 percent over the same time period, primarily due to increased plantings of fruits and nuts. The increase in nut production is driven by favorable terms of trade and increasing demand in Asian export markets, as well as increasing domestic demand. Nut prices have stabilized in 2016 in response to a stronger dollar and weakening global demand, declining by as much as 50 percent for some nuts. Figure 1 illustrates this trend.

Figure 1: 1980-2013 Total Annual Harvested Acres for All Crops and Specialty Crops in the Sacramento Region

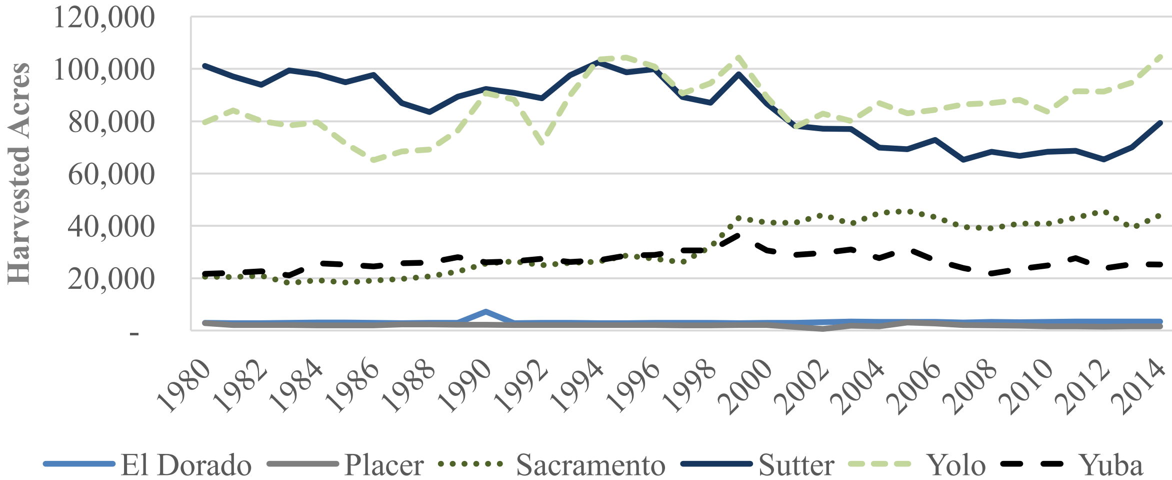


Source: California Agricultural Statistics

Acreage planted to specialty crops across the Sacramento region varies in response to market conditions across the six counties. Figure 2 illustrates the trends in specialty crop acreage in each of the six counties between 1980 and 2014. Sutter and Yolo County experienced an increase in acres, influenced predominately by the demand for nuts. However, other counties including El

Dorado and Placer maintain a fairly stable level of production. Acreage in El Dorado and Placer is primarily planted to orchards and vineyards with stable market conditions.

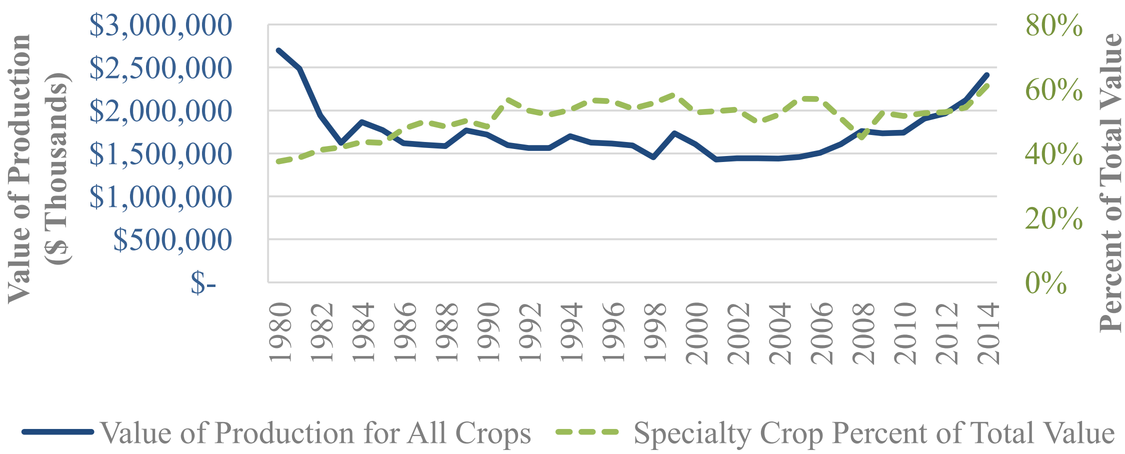
Figure 2: 1980-2014 Specialty Crop Harvested Acreage in the Sacramento Region



Source: USDA NASS, California Agricultural Statistics, 1980-2014

As harvested acreage increased, so did the value of production. In 2014, the total farm-gate value of production for specialty crops was $1.47 billion. Between 1980 and 1984, specialty crops accounted for 41 percent of total crop value. Between 2010 and 2014 this share was equal to 54 percent. As shown in Figure 3, the total value of production for all crops, including livestock and grain, in 2014 was $2.4 billion. From 1980 to 2014, specialty crops have contributed roughly half of the Sacramento region's annual agricultural production value.

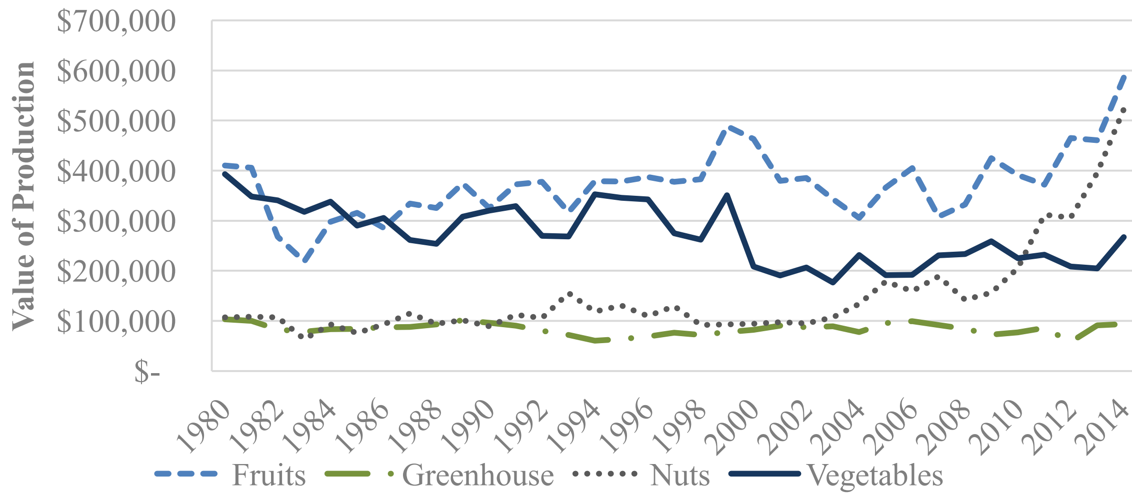
Figure 3: 1980-2014 Value of Production for All Crops and Percent of Value Attributed to Specialty Crops (2016 Dollars)



Source: California Agricultural Statistics

This increase in the share of total agricultural value contributed by specialty crops in the region is driven by a shift in acreage and the farm-gate price received for the crops produced. Fruit production in the Sacramento region area saw an increase in production value of 57 percent from 2011 to 2014. The value of nuts produced in the Sacramento region increased by 268 percent between 2008 and 2014. This has been driven primarily by rising prices as a result of favorable trading conditions and increased demand both domestically and internationally. In 2016, a strong U.S. dollar and weak export economies have dampened this trend and prices have settled back toward long-term averages. Figure 4 illustrates the trend in production value for major specialty crop categories.

Figure 4: 1980-2014 Production Value by Specialty Crop Category (2016 Dollars)



Source: California Agricultural Statistics

Gross farm output values have been increasing at the same time as the price of farm inputs have been increasing, with a net effect on farm income which varies by specialty crop and region. Table 3 summarizes number of farms by gross sales and average net farm income by county using the 2012 Census of Agriculture for all crops, including specialty and non-specialty. The average annual net farm income in the Sacramento region is $54,666 per year. However, the county average ranges from a $3,479 dollar loss in El Dorado County to a $174,606 average net profit in Yolo County. This figures represent a snapshot in time for 2012 market conditions, in the long-run farms are operating with a positive margin in these regions.

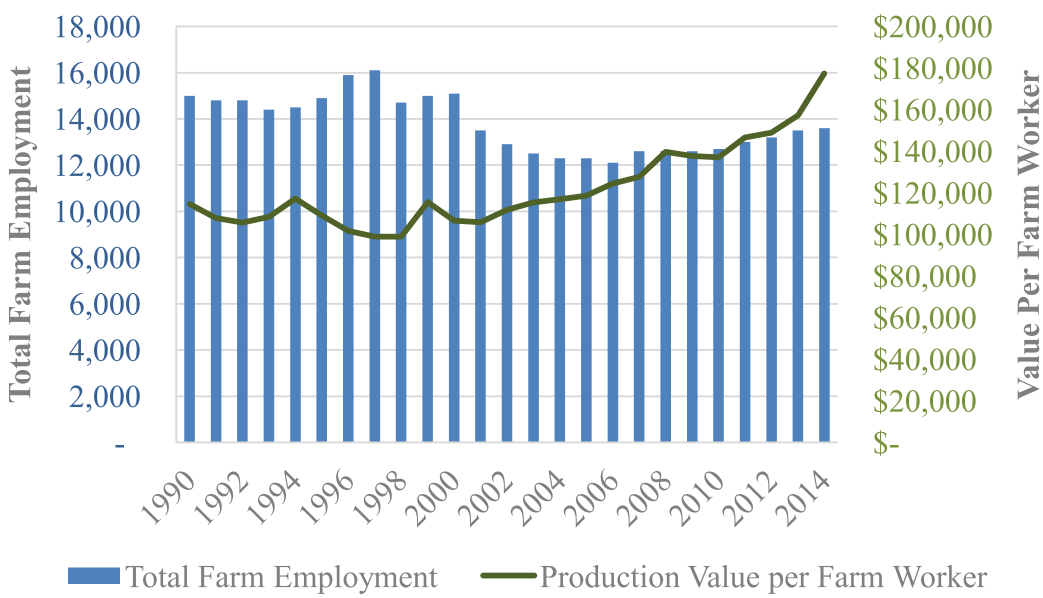
Table 3: Farms by Value of Sales in 2012

	El Dorado	Placer	Sacramento	Sutter	Yolo	Yuba
Less than $1,000	472	428	376	122	213	187
$1,000 to $19,999	589	688	501	272	243	320
$20,000 to $99,999	220	171	224	410	209	86
$100,000 to $249,999	55	28	83	209	105	58
$250,000 to $499,999	15	19	44	122	71	62
$500,000 or more	7	21	124	223	170	82
Total Farms	1,358	1,355	1,352	1,358	1,011	795
Average net cash farm income of operation	-$3,479	-$3,383	$28,073	$106,550	$174,606	$57,000

Source: USDA, 2012 Census of Agriculture

A critical input to specialty crop agriculture is on-farm labor. Figure 5 illustrates the on-farm labor in the Sacramento region using California Employment Development Department (EDD) data. EDD data do not differentiate between specialty crop and non-specialty crop farm labor, so these figures represent the sum of both. From 1990 to 2015, the number of on-farm employees ranged from 12,000 to 16,000 in the Sacramento region. Most counties have seen an increase in on-farm labor from 2005 to 2015 with Yolo County realizing the greatest increase in employees, expanding by 55 percent during that period. Placer and Yuba counties experienced a noticeable decrease in on-farm labor of 50 percent. Overall, the number of workers has been relatively stable in recent years while the value per worker continues to increase significantly. Since 1990, the production value per farm worker has increased by over 54%. The production value per farm worker increased 21 percent between 2011 and 2014, reflecting the recent growth in the value of agriculture in the region.

Figure 5: 1990-2014 On-Farm Employment and Production Value Per Worker



Source: EDD and California Agricultural Statistics

The production of crops, both specialty and non-specialty, in the Sacramento region supports the processing and distribution sectors. Specialty crop food processing across the region had a direct output value of $1.69 billion in 2013. Specialty crop food processors are primarily located in Yolo, Sacramento, and Sutter counties. El Dorado County boasts a robust industry of small and mid-sized wineries, and Placer and Yuba County have fewer specialty crop food processors. Specialty crop distribution includes small shares of large and diverse industries such as wholesale trade, retail food stores, and restaurants. The total output value for specialty crop distribution in 2013 equals $725 million, comprised primarily of fresh produce merchant wholesaling. The majority of the region's specialty crop distribution is located in Sacramento County with twenty-five of the region's thirty-seven fresh produce distributors.

In summary, the Sacramento region boasts a robust and growing sector of specialty crop agriculture. This sector has evolved in response to market conditions, and will continue to do so into the foreseeable future. The following sections of this report describe the primary production model and the IMPLAN model developed by the ERA team to characterize the total specialty crop cluster.

4. Outreach, Surveys, and Industry Data

The ERA team engaged local specialty crop businesses and stakeholders in an outreach and data gathering effort. Industry representatives were contacted early in the project so that key individuals were aware of, and generally supportive of, the project. Following this initial contact, the ERA team surveyed over one hundred specialty crop businesses.

4.1 Outreach

Initial outreach for this project was directed to agricultural organizations in the region. Local county Farm Bureaus, UC Cooperative Extension farm advisors, and Agricultural Commissioners were all provided with a project overview so they could inform their constituencies of the project. In addition, input was sought from umbrella organizations such as the California League of Food Processors.

4.2 Surveys

Growers, processors, and distributors of specialty crops in the Sacramento Region were surveyed to gather the information necessary to quantify specialty crop business expenditure patterns in the Sacramento region. The primary survey reached over 100 specialty crop businesses including growers, processors, and distributors in the Sacramento region. Surveys included a questionnaire used to construct the spending pattern of each of the major industries in the specialty crop cluster.

Based on the default IMPLAN model data, four preliminary crop categories were identified for grower interviews. These include Vegetable and Melon Farming, Fruit Farming, Tree Nut Farming, and Greenhouse and Nursery Farming. Survey priorities for processing and distribution were shaped by a preliminary cluster analysis that used the IMPLAN model to identify key industries linked to specialty crops. In addition, new and emerging markets with high potential for growth were surveyed in order to anticipate industry developments and provide forward-looking results that will remain meaningful as industries change.

The following factors further guided efforts to survey specialty crop growers, processors, and distributors:

1. **Value of production**. Priority was given to industries and sub-sectors with the highest values of production, since expenditures by these producers drive the economic multiplier effects.
2. **Entity size**. Surveys capture a range of entity sizes as expenditure patterns are likely to differ by entity size. For example, small farms are more likely to use custom services and to lease machinery whereas larger farms, with economies of scale, are more likely to keep these operations in-house.

Surveying efforts were challenged by the complexity and detail of the financial information requested, which is necessary to complete the analyses. Nonetheless, the quantity and diversity of surveys received are sufficient to inform the modeling and analysis. Table 4 summarizes survey activities by type of entity. One hundred and sixteen specialty crop growers, processors, and distributors were contacted to participate in the survey and 36 provided complete survey responses. To obtain these survey responses, potential survey respondents were called, emailed, and interviewed in-person through 307 unique communications.

Table 4: Sacramento Region Survey Results

Type of Entity	Entities Contacted	Communications	Returned Surveys
Growers	31	76	14
Processors	60	171	13
Distributors	25	60	9
General Ag Organizations	19	33	N/A
Total	116	307	36

Grower surveys were received from all major specialty crop sectors. All major processing industries were also surveyed. Surveys of potential industries that are currently absent in the Sacramento region, such as frozen fruit processing, were obtained from processors in other Northern California counties. Distributor surveys targeted produce distributors, grower-packer shippers, and produce stands in the SACOG region. In addition, surveys were obtained from farm product trucking companies, cold storage facilities, and broadline distributors. The survey instruments used in the analysis can be found in Appendix C.

5. Primary Agricultural Production Model for the Sacramento Region

The specialty crop cluster starts with producers, the primary farming activity in the region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. Production decisions at the field filter through all of the related sectors of the economy. Field-level production decisions are driven by a range of factors including experience, soil conditions, microclimate, access to markets, and in some cases, regional policy changes may also affect farming decisions.

The ERA team developed a primary model of field production which explicitly links to the regional IMPLAN model sectors developed in this study. The primary model is an economic optimization model that estimates field-level production decisions and the responsiveness of the farming industry to changes in market conditions, technology, and other factors. These changes, in turn, feed directly into the IMPLAN model which simulates the effect in all related industries. Combined, the linked models show the total economic effect of a change in the agricultural sector. The technical details of the primary agriculture model are provided in Appendix B, this section provides an overview of the model and application for this study.

5.1 Model Overview

The primary model is an economic model of irrigated agricultural production that simulates the decisions of agricultural producers (farmers) in the Sacramento region. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. Farmers sell and buy in competitive markets, and no one farmer can affect or control the price of any commodity. The model selects those crops, water supplies, and other inputs that maximize profit subject to constraints on water and land, and subject to economic conditions regarding prices, yields, and costs. A central feature of this modeling approach is that the model calibrates to, meaning it exactly reproduces, the observed farmer planting decisions in a set of base years. As such, it represents a robust framework for simulating the response to changes in policy and resource conditions.

The primary model is calibrated using the method of Positive Mathematical Programming (PMP), a widely-accepted economic modeling approach which has been used and subject to peer review[3,4] for the last several decades. The essence of the PMP economic modeling approach underlying the primary model can be described as follows. The decision by profit-maximizing producers to plant certain crops, given the market for those crops and the market for inputs, tells us about the physical and economic ability to produce crops in certain areas. These observed grower decisions are combined with additional information about market conditions, variability

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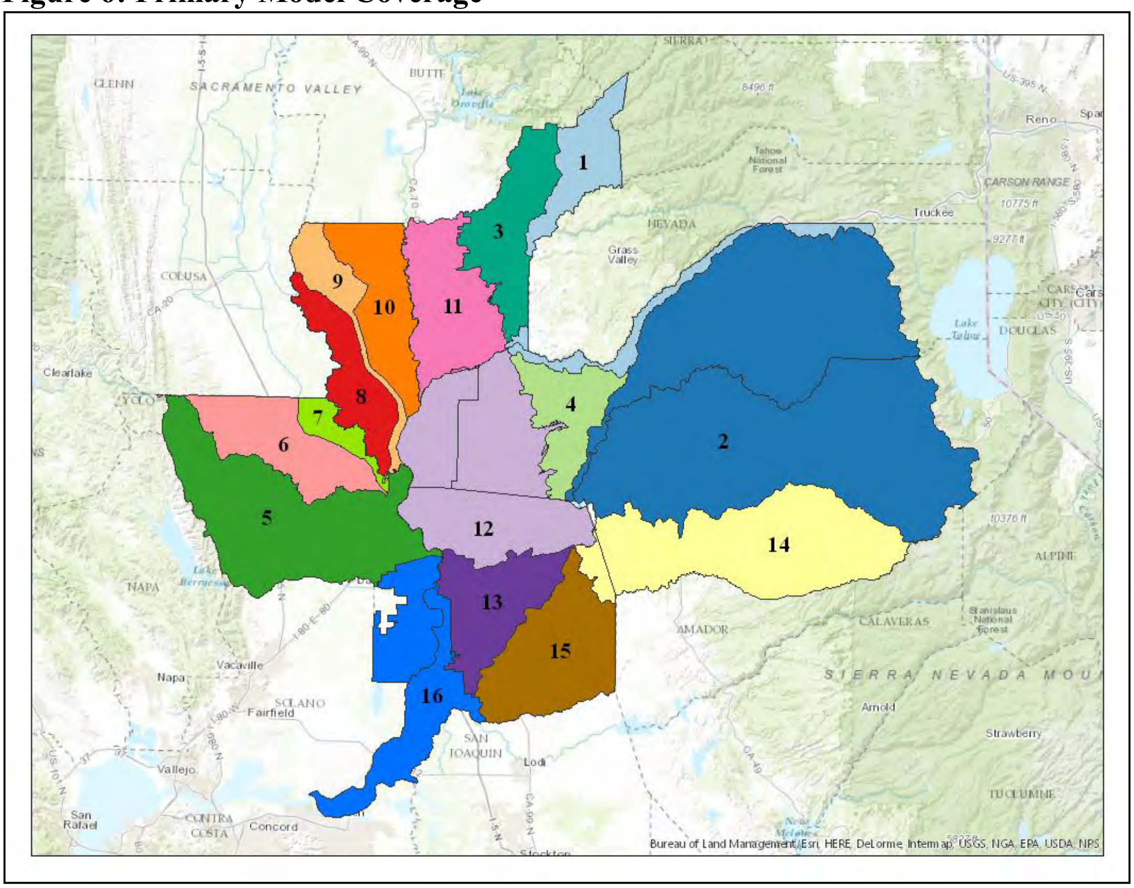
[3] Howitt. R.E. (1995). "Positive Mathematical Programming." American Journal of Agricultural Economics. 77(2): 329-342.
[4] Howitt. R.E, Medellín-Azuara. J, MacEwan. D, and Jay R. Lund. (2012) "Calibrating Disaggregate Economic Models of Agricultural Production and Water Management" Environmental Modeling and Software. 38: 244-258.

over time, and well-established economic principles to calibrate an economic model. For example, peaches are primarily produced in Yuba County because of soil and climate conditions (physical criteria) and a critical mass of growers with the detailed knowledge required to manage various risks and produce a profitable crop (economic criteria), as well as other considerations. In addition, Yuba County peach growers, like all peach growers, are subject to market fluctuations that affect aggregate demand and supply for their crop, ultimately determining the market-clearing price, and in turn, farm-gate profitability. The PMP approach is a method that combines all of this information to calibrate a model that exactly reproduces what growers actually do. The model is then used to simulate changes in production in response to changes in conditions (sometimes referred to as "policy simulations").

5.2 Model Coverage

The primary model covers all irrigated agriculture in the Sacramento region, represented by 16 different model regions. The subregions are based on water budget areas, called Detailed Analysis Units, which are commonly used for water planning in California. The model scope is shown in Figure 6.

Figure 6: Primary Model Coverage



The primary model regions are specified on the basis of 16 DAUs in the Sacramento region, which can be decomposed into 24 regions if county boundaries are included.

Figure 6 illustrates the 16 regions in the primary model. The figure also shows the county lines to illustrate model region DAUs which span multiple counties. For example, region 16, "Sacramento Delta" includes portions of Sacramento and Yolo Counties. Delta agriculture is relatively homogenous, with high-value vegetable and fruit production and corn, grain, and fodder field crops being produced in both Yolo and Sacramento Counties.

Crops are aggregated into 17 crop groups which are the same across all regions, although not all crops are produced in all regions. Each crop group represents a number of individual crops, but many are dominated by a single crop. Total acreage within any one crop group represents all of the crops within the group, production costs and returns are represented by a single proxy crop for each group. For each group, the representative (proxy) crop is chosen based on four criteria: (i) a detailed production budget is available from the University of California Cooperative Extension (UCCE) or from primary surveys completed under this project, (ii) it is the largest or one of the largest acreages within a group, (iii) its water use (applied water) is representative of water use of all crops in the group, (iv) its gross and net returns per acre are representative of the crops in the group.

5.3 Policy Simulation with the Primary Model

The fully specified base model is written and solved using a well-known but commercially-based program called GAMS (Generalized Algebraic Modeling System). The GAMS Development Corporation provides a free version of the program that can be downloaded and will run standard nonlinear algorithms. This free version GAMS restricts the maximum dimensions of constraints and variables possible in the model to be less than 300. Accordingly, the fully specified base model has been simplified, as described in Appendix B, enabling it to be solved with the free GAMS software in the initial stages of analysis. The principle applied was to simplify the model in terms of the complexity of the production function specification and price formation, but retain the full 16 regions and 17 potential crops that show the essential trade-offs in agricultural production within the Sacramento region.

For consistency with the IMPLAN model, the base year in the primary model is defined to be 2013. All prices, costs, land use, and market conditions, used to calibrate the model are for 2013. Having calibrated the model using the 2013 data, the model is then used for policy simulations under future conditions, and dollar values are deflated to current (2016) values.

The primary production model is a robust framework that can be used to simulate a range of policy responses. For example, changes in prices, yields, climate, water availability, and other changes in resource availability, as well as policy changes that affect production input costs. The ERA team has applied the model to evaluate the total contribution of specialty crop agriculture in the Sacramento region, and the impact of growth in the frozen fruit processing sector. Both of these analyses link to the IMPLAN model, described in the following section, and the results of the analyses are summarized in a subsequent section of this report.

6. Custom IMPLAN Model for the Sacramento Region

The ERA team analyzed specialty crop economic linkages using the social accounts available in the IMPLAN software, other underlying IMPLAN data, data collected through the primary survey of specialty crop businesses, and supplemental information compiled from other publically available sources and industry reports. This section of the report provides a summary of the refined structure of the specialty crop agriculture industry cluster within the greater Sacramento region for the custom IMPLAN model. The specialty crop industry cluster is defined by the magnitude of input purchases and output sales by and between the businesses that grow, process, and distribute specialty crops in the Sacramento region. This primarily takes the form of purchaser and supplier relationships, but also includes payments to governmental agencies, proprietor's income, and other monetary transfers.

6.1 IMPLAN

This study utilizes the IMPLAN Version 3.1 software package, in conjunction with the 2013 R3 IMPLAN economic data file for El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties in California. The IMPLAN software functions as an input-output economic model, which estimates the effects of assumed exogenous changes in final demand within the specified geographic region. The model leverages a robust data set of national and regional economic accounts that document purchasing relationships between industries through multiple rounds of spending. The software also incorporates institutional demand and inter-institutional transfers, which reflect purchases made by households and government agencies. An overview of the IMPLAN modeling effort is provided here and a more detailed discussion is available in Appendix D.

6.1.1 Model development

The output values typically generated through IMPLAN input-output analysis include the direct, indirect, and induced economic impacts. These are most commonly expressed in terms of output, but may also be expressed in terms of employment, labor income, or one of the four components of value added (employee compensation, proprietor income, other property type income, or tax on production and imports). By definition, the direct impacts are associated with the initial dollars spent within the study area. Amounts paid to entities located outside of the study area are excluded from the analysis and considered economic "leakage" because these dollars do not circulate within the local economy and thus cannot be counted among the local economic impacts. As a result, the direct impact estimates reported in the model outputs may differ somewhat from the gross dollar values that are initially reported, since the direct impact estimates account for economic leakage. The indirect impacts are estimated as industries that receive direct spending for the purchase of materials and services necessary for production. Induced impacts result from household consumption made possible by wages paid to workers and by income generated to proprietors and institutions. When combined, this cycle of spending represents an economic multiplier effect, by which a direct increase in exogenous demand, as input from the economic primary production model, results in a total economic effect that is greater than the initial direct impact.

6.1.2 Customizing the IMPLAN Model

An evaluation of the data underlying the IMPLAN model identified that at least some of the default data for the four crop sectors may not be fully representative of economic activity associated with specialty crop farming in the Sacramento region. For example, data on the ratio of value added to output is based on national benchmark data provided by the U.S. Bureau of Economic Analysis (BEA). While IMPLAN utilizes detailed county-level data to define the output values associated with agricultural commodities, the model estimates total value added based on national benchmark data provided by the BEA. The breakdown of value added is similarly derived, since the BEA reports things like proprietor income only at the farm level with no detail provided that would help to distinguish between commodities. While the IMPLAN model offers a detailed spending profile for intermediate expenditures, the list of commodities purchased is held constant across commodities. Likewise, purchasing coefficients are held constant in proportion to the intermediate expenditure coefficient. Though this model reflects the best information that is available on a national basis, modifying the model using alternative data sources that better reflect the characteristics of the local specialty crop agricultural producers and related industries makes it possible to leverage the robust systematic methods associated the IMPLAN input-output software while also improving the accuracy of the resulting multipliers.

In order to develop a customized IMPLAN model that more accurately reflects the expenditures by specialty crop growers, processors, and distributors within the SACOG region, the ERA team supplemented primary survey data with assorted secondary data. When developing unique subsectors of industries, survey data is insufficient to establish the output value of the subsector and additional data is needed. For instance, to model processing tomato farming as an activity separate from vegetable and melon farming, the total output value for processing tomato farming must be known. USDA statistics provide the basis for determining the output value for crops and other data sources are used for subsectors in the processing and distribution industries.

Complicating efforts to determine the value of sectors and subsectors in the Sacramento region specialty crop food system is IMPLAN's use of North American Industry Classification System (NAICS). Businesses are assigned a single NAICS codes based on their "primary business activity". For this reason, revenues for businesses producing more than one product are imperfectly translated using NAICS. A farm growing processing tomatoes, wheat, and almonds produces three diverse products but is only classified by its primary business activity.

The ERA team developed custom IMPLAN model sectors reflecting 19 specialty crop production in the Sacramento region. However, the IMPLAN National Trade Flows Model data limit the ability of an analyst to customize a range of sectors simultaneously. As such, the ERA team developed two custom IMPLAN models, one with modified industry sectors for the default IMPLAN groupings, and one with all 19 custom industry sectors. The result is a flexible modeling framework that can be used to evaluate policy changes and industry-specific multiplier effects, and corresponding economic contribution.

The two custom models developed for this research include one that is aggregated to correspond to the default IMPLAN sectoring scheme and one that is disaggregated using re-purposed IMPLAN sectors that represent custom industry sectors that were broken out from the default industries. Both the aggregated and disaggregated models include custom industry data based on the ERA team's research into specialty crop businesses.

In the aggregated model, the custom industry profiles for each break-out sector were combined using a weighted average method. The aggregated custom model will provide the most reliable and internally consistent economic impact results because the IMPLAN National Trade Flows Model is preserved. The disaggregated model can be used to evaluate the economic multiplier effects of individual specialty crop agriculture sectors. This difference is because the trade flow data associated with re-purposed IMPLAN sectors (those used to represent custom industry sectors, such as the tobacco farming sector which was re-purposed to represent the processing tomato farming sector) may not be fully representative of the custom industry trade flows. This affects dollars flowing into the custom sector, and therefore, analyses focused on dollars flowing out of custom sectors can be reliably modeled using the disaggregated model.

6.2 Custom IMPLAN Model Sectors

Based on survey responses, industry research, and preliminary IMPLAN analysis, custom subsectors were created from existing sectors to be added to the specialty crop cluster using a two-step process. A list of subsectors was generated including subsectors that were either (i) industries that comprise a large share of an IMPLAN specialty crop sector, (ii) an industry with strong connections to other specialty crop sectors in the region such as input suppliers or processors, (iii) a specialty crop industry with high leakage to other geographical areas, or (iv) emerging specialty crop industries in the Sacramento region. This list was evaluated using survey data to exclude industries for which the default IMPLAN sector is representative of the identified industry. The result is a set of specialty crop agriculture industries that are significant in the Sacramento region, but are not currently represented in the default IMPLAN model. The custom IMPLAN model includes a total of 19 sectors representing the specialty crop agriculture cluster. Table 5 summarizes the list of sectors.

Table 5: Custom Sectors in the IMPLAN Model

SACOG IMPLAN Model	Default IMPLAN Model Sector
Producers	
Processing tomato farming	Vegetable and melon farming
Misc. vegetable farming	Vegetable and melon farming
Misc. fruit farming	Fruit farming
Olive farming	Fruit farming
Peach farming	Fruit farming
Wine grape farming	Fruit farming
Walnut farming	Tree nut farming
Misc. tree nut farming	Tree nut farming
Greenhouse, nursery, and floriculture prod.	Greenhouse and nursery production
Processors	
Nut hulling	Support activities for agriculture and forestry
Support activities for ag. and forestry	Support activities for agriculture and forestry
Olive oil mills	Soybean and other oilseed processing
Frozen peach processing	N/A
Processing tomato canning	Canned specialties
Canned specialties	Canned specialties
Canned fruits and vegetables mfg	Canned fruits and vegetables mfg
Dehydrated food products mfg	Dehydrated food products mfg
Boutique nut processing	Roasted nuts and peanut butter manufacturing
Roasted nuts and peanut butter mfg	Roasted nuts and peanut butter manufacturing
Wineries	Wineries and distilleries
Distributors	
Packer-shippers	Wholesale trade
Produce distributors	Wholesale trade

6.3 IMPLAN – Primary Production Model Crosswalk

The primary model links directly to the IMPLAN model developed for the project. Table 6 shows the crosswalk between IMPLAN sectors and the primary model. All crops, not just specialty crops, are included in the primary model because the joint production of some crops is an important factor in planting decisions. For example, as a nitrogen-fixer alfalfa is sometimes included as a break crop to improve fertility in a multi-year rotation system. The primary model crop groups are linked to the IMPLAN model sectors by using the crosswalk. Changes in gross revenues (output value) can be input into the IMPLAN model to simulate the effect of that change in primary production on the related processing and distribution sectors. The integrated framework can be used to simulate the specialty crop agriculture cluster.

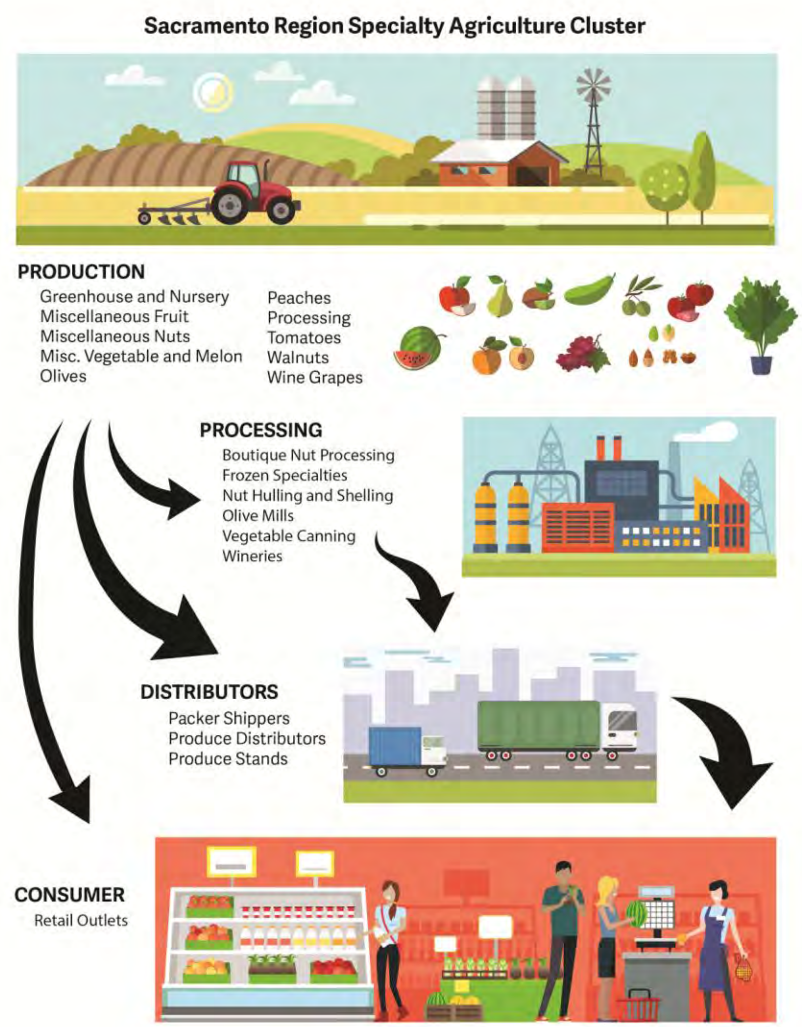
Table 6: Primary Model – Custom IMPLAN Model Crosswalk

Number	Crop Group	IMPLAN Sector Number	IMPLAN Sector Name
1	Alfalfa	10	All other crop farming
2	Almonds	5	Misc. tree nut farming (revised)
3	Corn	2	Grain farming
4	Cucurbits	3	Misc. vegetable farming (revised)
5	Dry Beans	10	All other crop farming
6	Grain	2	Grain farming
7	Olives	9	Olive farming
8	Other Deciduous	4	Misc. fruit farming (revised)
9	Other Field	1	Oilseed farming
10	Other Truck	3	Misc. vegetable farming (revised)
11	Pasture	11	Ranching and grazing farming
12	Peach	23	Peach farming (custom)
13	Processing Tomatoes	7	Processing tomato farming (custom)
14	Rice	2	Grain farming
15	Safflower	1	Oilseed farming
16	Vines	25	Wine grape farming (custom)
17	Walnuts	26	Walnut farming (custom)

7. The Value of Specialty Crop Agriculture in the Sacramento Region

The specialty crop cluster starts with producers, the primary farming activity in the Sacramento region. From rows of fresh vegetables to blooming orchards and rolling hills of wine grapes, this sector is the heart of specialty crop agriculture in the Sacramento region. The linked processing sector thrives on local specialty crop production. Processing businesses include post-harvest handling, canning, large scale processing, and a range of boutique processors creating new products for localized markets. Closely linked to specialty crop processing and production is the distribution sector, which includes businesses such as produce distributors, fruit stands, and farmer's markets who work seamlessly with the production and processing sectors to meet consumer demand. Figure 7 illustrates the specialty crop agriculture cluster in the Sacramento region.

Figure 7: Specialty Crop Agriculture Cluster Graphical Representation

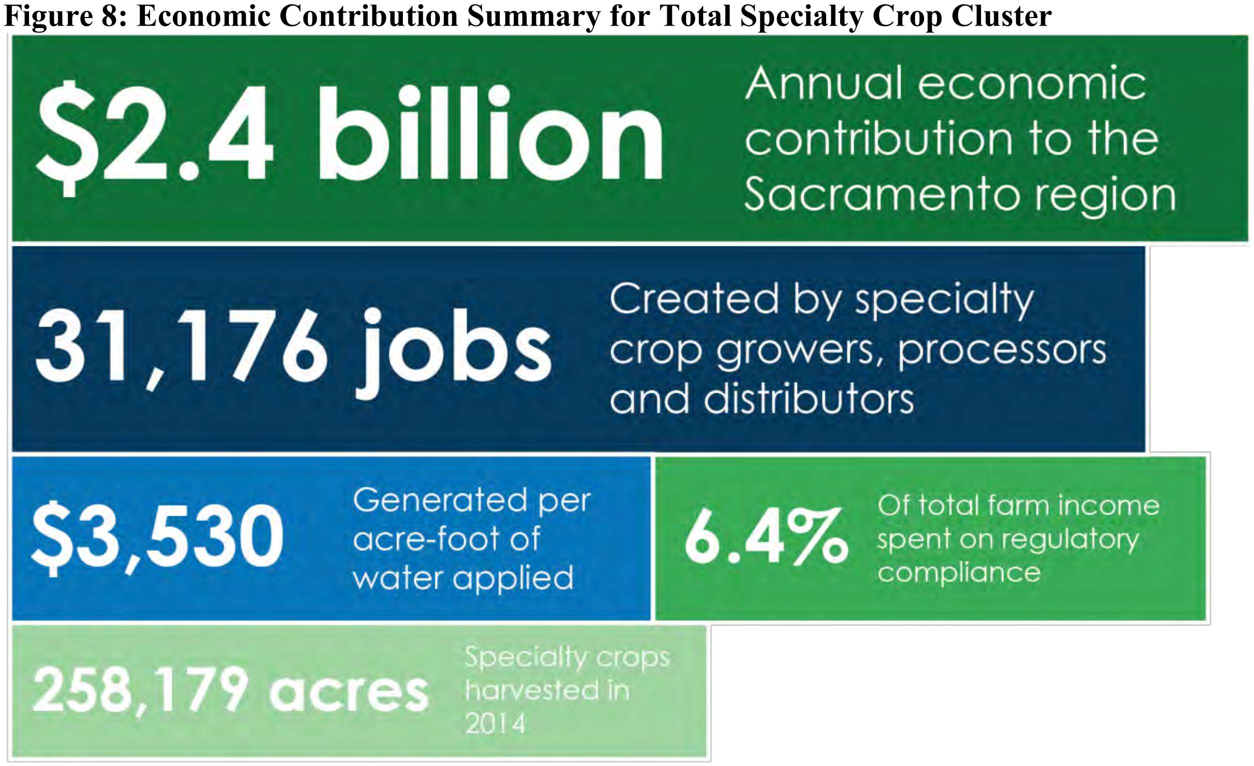


7.1 The Economic Contribution of Specialty Crop Agriculture

The economic contribution of an industry is a measure of the total jobs, output (sales) value, and value added created by the industry, considering the expenditures in all related industries. It is a true measure of the importance of an industry to the local economy. The contribution is expressed in terms of direct effects and indirect and induced effects (together "secondary" effects) for key measures of jobs, output value, and value added. Value added is the key measure of economic contribution because it excludes double counting the gross sales value between industries in the same cluster. The custom IMPLAN model is used to evaluate the total economic contribution of all specialty crop agriculture businesses included in the cluster, and for each of the specialty crop clusters – producers, processors, and distributors – individually.

Taken together the specialty crop cluster in the Sacramento region generates \$3.9 billion in direct output value annually. Including indirect and induced multiplier effects, representing expenditures in ancillary businesses and by employees, respectively, the total output value exceeds \$5.8 billion annually. The total value added contribution to the Sacramento region economy from the specialty crop agriculture cluster equals \$2.4 billion dollars annually and supports over 31,000 full time equivalent jobs. Figure 8 illustrates the economic contribution of the Sacramento region specialty crop agriculture economic cluster.

Figure 8: Economic Contribution Summary for Total Specialty Crop Cluster

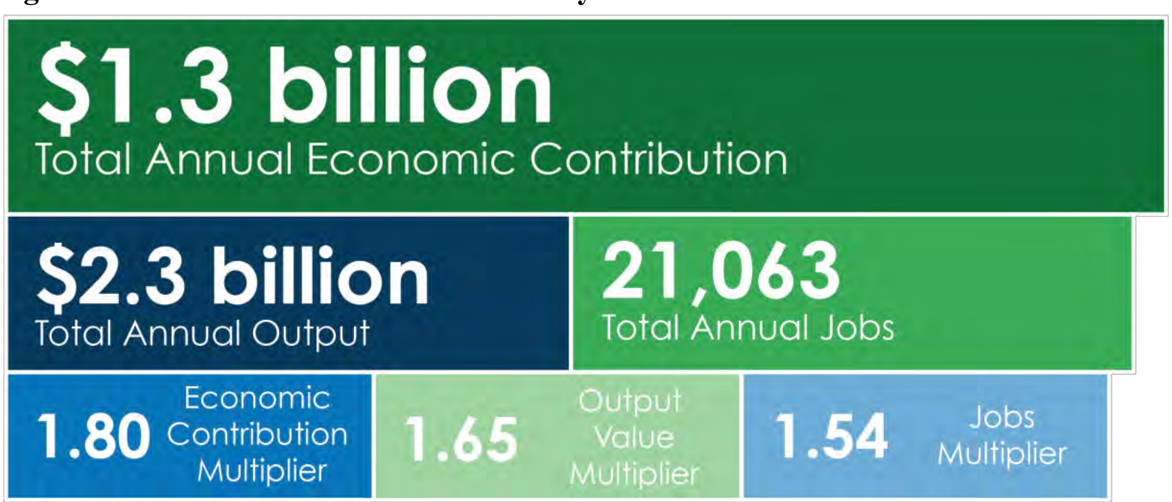


7.1.1 Specialty Crop Producers Economic Contribution

The specialty crop production sector is comprised of 10 IMPLAN model categories: nine farming activities and one sector for support services. The sector includes growth markets such as olives for olive oil — a crop well suited for the region's Mediterranean climate. Americans consumed 317,000 metric tons of olives in 2015 compared to just 55,000 metric tons in 1985 and California olive oil producers have responded to the trend by doubling olive oil output every year for the last ten years. The peach sector is another growth sector which includes production of freestone and clingstone peaches for fresh market and processing. The share of peaches in the U.S. that are frozen tripled from 3 percent of available peaches in 1970 to 9 percent in 2013. A unique specialty crop sector is greenhouse, nursery, and floriculture production. Most of the value in this sector is generated by nurseries that raise immature tree fruits, tree nuts, and vines. These are typically transplanted for commercial agriculture, so this sector represents a strong connection as an input to fruit farming and nut farming as well as to other greenhouse and nursery firms.

The specialty crop production sector, including primary crop farming and support services, contributes a total (including all multiplier effects) annual economic value added of $1.3 billion to the Sacramento region. This value added is generated on total annual output value of $2.3 billion and creates 21,063 jobs in the Sacramento region. Figure 9 illustrates the contribution of the primary production sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the producer sector.

Figure 9: Economic Contribution Summary for Producers

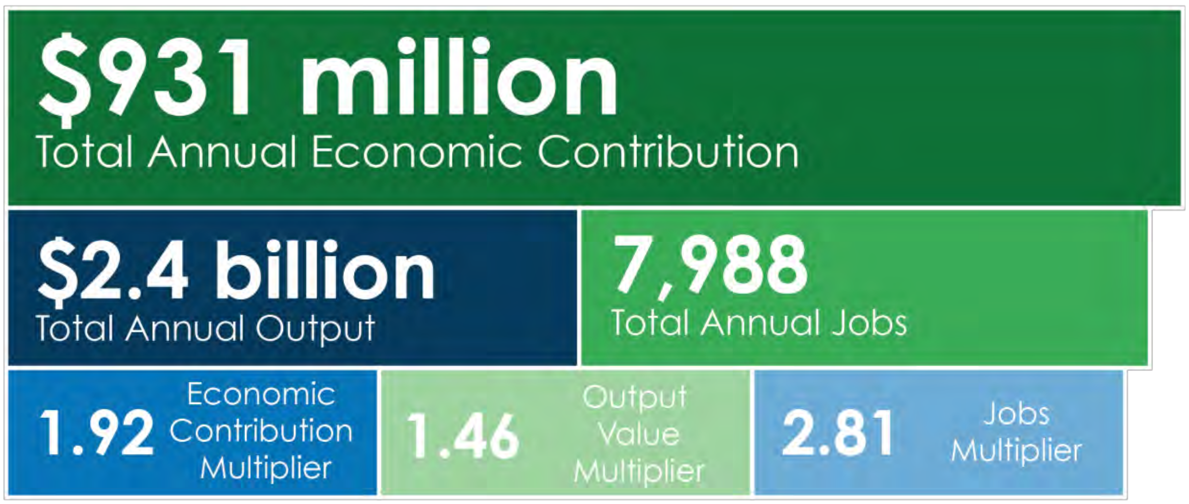


7.1.2 Specialty Crop Processors Economic Contribution

The processing sector includes a range of supporting business related to primary crop production, typically for post-harvest handling. This first-stage of post-harvest processing typically takes place relatively near the farm, therefore economic activity is likely to remain in the region with relatively little leakage. Some of these processing sectors include nut hulling and other processing, olive milling, and vegetable canning. This cluster also includes potential growth industries such as frozen fruit processing, and current growth industries such as wineries.

The specialty crop processing sector contributes a total (including all multiplier effects) annual economic value added of $931 million to the Sacramento region. This value added is generated on total annual output value of $2.4 billion and creates 7,998 jobs in the Sacramento region. Figure 10 illustrates the contribution of the processing sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the processing sector.

Figure 10: Economic Contribution Summary for Processors

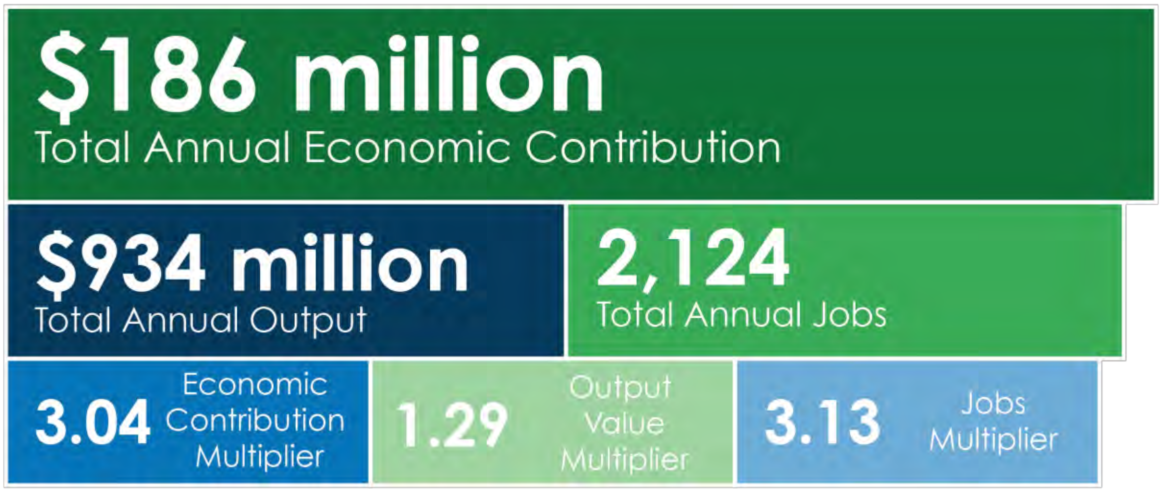


7.1.3 Specialty Crop Distributors Economic Contribution

Consumers, particularly domestic markets, increasingly demand fresh produce. The farming industry has met this demand by growing more produce for the fresh market and by improving shelf-life through increased prevalence of on-farm refrigeration and breeding improvements. As more produce is marketed through fresh market distribution channels, fresh produce distributors and packer-shippers have become increasingly important in the specialty crop agriculture economic value chain. The produce distribution sector includes the primary packing and shipping of specialty crop production. Grower-packer-shippers fill an important niche in creating a market for specialty crop growers. This sector includes first-handlers that market crops for growers, many of which are in fact grower-shippers that market production for themselves as well as others. Marketing is typically confined to one or a few crops, but these businesses are, by definition, vertically integrated (grower-packer-shippers), and create strong connections to the specialty crop production sectors. Produce distributors offer primarily perishable items or possibly just fresh produce, delivering to food service and retail outlets.

The specialty crop distribution sector contributes a total (including all multiplier effects) annual economic value added of $186 million to the Sacramento region. This value added is generated on total annual output value of $934 million and creates 2,124 jobs in the Sacramento region. Figure 11 illustrates the contribution of the distribution sector. The value added, output value, and jobs multipliers show the additional economic activity generated for each dollar of direct value added, output, and jobs created by the distribution sector.

Figure 11: Economic Contribution Summary for Distributors



7.2 Specialty Crop Agriculture Economic Multipliers

Another way to conceptualize the economic contribution of specialty crop agriculture is by calculating a multiplier. An economic multiplier is a parameter that describes the ripple effects of changes in final demand in one industry on all related industries. Multipliers are expressed in terms of direct, indirect, induced, and total effect for jobs, value added, and output value contribution of each sector. By definition, the direct effect multiplier is equal to one.

Table 7 summarizes the output value multiplier for each of the default sectors in the IMPLAN model and each of the custom IMPLAN sectors created by the ERA team. The output value multiplier shows the additional dollars generated for each dollar in output (sales) by the primary industry. For example, for every dollar in direct sales by the vegetable and melon farming sector (farm-gate revenue), there is an additional 43 cents of output value (sales) created in other linked industries. This includes input purchases, and spending by employees in the local economy. The custom IMPLAN model has been defined with a miscellaneous vegetable farming sector and a processing tomato farming sector using the data compiled by the ERA team. The output multiplier increases for both indirect and induced effects over the default sector. Table 7 additionally illustrates the percent change in the multiplier relative to the default IMPLAN data, the industry output value, and the effect of the revised multiplier on the total economic value of activity generated in the Sacramento region.

Table 7: IMPLAN Output Multipliers for Specialty Crops

Industry	Default Model Output Multiplier	Custom Model Output Multiplier	Percent Change	Industry Output Value ('000)	Effect of Multiplier Revision ('000)
Miscellaneous vegetable farming	1.43	1.74	22%	$78,528	$17,043
Processing tomato farming		1.87	31%	$135,002	$41,571
Miscellaneous fruit farming	1.50	1.82	21%	$113,402	$24,373
Olive farming		1.70	13%	$5,998	$795
Peach farming		1.63	9%	$34,931	$3,142
Wine grape farming		1.78	19%	$123,342	$22,928
Miscellaneous tree nut farming	1.45	1.85	28%	$107,778	$30,112
Walnut farming		1.65	14%	$335,572	$45,763
Greenhouse, nursery, and floriculture prod.	1.51	1.59	5%	$171,787	$9,275
Support activities for ag. and forestry	1.51	1.54	2%	$344,611	$6,668
Nut hulling		1.48	-2%	$16,511	($337)
Olive oil mills	1.34	1.57	18%	$6,841	$1,217
Frozen peach processing	0.00	0.00	0%	$0	$0
Canned fruits and vegetables mfg	1.50	1.51	0%	$181,090	$574
Canned specialties	1.56	1.53	-2%	$46,969	($783)
Processing tomato canning		1.64	5%	$300,000	$14,833
Dehydrated food products manufacturing	1.45	1.46	0%	$285,398	$773
Roasted nut and peanut butter mfg	1.50	1.49	-1%	$661,937	($6,379)
Boutique nut processing		1.24	-17%	$5,000	($866)
Wineries	1.63	1.63	0%	$185,082	$284
Wholesale trade	1.55	1.63	5%	$8,207,725	$430,281
Produce distributors and shippers		1.61	4%	$725,220	$26,804
Change (relative to default IMPLAN data)	-	-	5.5%		$668,071

The custom IMPLAN model, based on surveys and supplemental data, confirms that the default IMPLAN model multipliers are not representative of specialty crop agriculture in the Sacramento region. Intermediate expenditures (input purchases) by specialty crop businesses represent a higher proportion of total expenditures than shown in the default IMPLAN model based on national trade flow averages. As such, the output value contribution is actually higher than shown in the default IMPLAN data, but the value added contribution is lower. This is because a larger proportion of purchases are going to other specialty crop businesses. However, it is also true that more of these expenditures stay within the Sacramento region. As shown in Table 7, the net effect is an increase in the total output value generated by the specialty crop agriculture cluster equal to $668 million, representing a 5.5 percent increase. Small changes in the multipliers generate a significant change in total economic contribution of the specialty crop cluster. The custom IMPLAN model multipliers represent a significant improvement in accuracy over the default IMPLAN model data.

8. Conclusion

This report summarizes the outcomes of a comprehensive 11 month study of the specialty crop agriculture cluster in the Sacramento region. The ERA team developed a suite of tools that can be used to evaluate the economic contribution of the specialty crop agriculture cluster, and evaluate the impact of new policies or changes in market conditions that may affect this sector. The standard IMPLAN model includes a limited number of specialty crop sectors and the data used to populate the expenditure patterns describing the key financial linkages in the model are based on national averages which are not representative of Sacramento region agriculture. The ERA team developed a linked economic and regional modeling framework by developing an economic model of primary crop production and a custom IMPLAN model. These models were developed using primary data from a comprehensive, and confidential, survey of over one hundred specialty crop businesses in the Sacramento region.

Using the primary production model and the IMPLAN model to evaluate the economic contribution of the specialty crop agriculture cluster, this analysis finds that the total value added contribution equals $2.4 billion annually. The value added is generated on over $5.8 billion in total output value, and supports over 31,000 jobs. Put another way, through the lens of economic multipliers, there are over 17,000 direct jobs in the specialty crop cluster and every job in specialty crops generates another 0.82 jobs in other areas of the economy. Specialty crop industries directly contribute over $1.2 billion in total value added to the regional economy. For every dollar in value added, $0.90 in additional value added is generated across other industries. Total output value of the specialty crop sector is approximately $3.9 billion, with each $1 of output generating an additional $0.49 of output in all other sectors of the specialty crop cluster.

Looking forward, robust growth in the specialty crop agriculture cluster is likely because the Sacramento region has comparative advantages in water and climate, and more importantly, produces a set of healthy, safe, and reliable crops that are in high demand in domestic and international markets. In particular, the on-going shift toward high-value locally consumed fresh fruit and vegetables, and growth in the export market for high-value nut crops will drive growth in the specialty crop agriculture cluster. Sacramento region specialty crop agriculture also benefits from "boutique" industries that pop-up to capture a specialized market. For example, in the foothill regions the winery industry has grown both in volume, but more importantly, in prestige of the wineries. Along with this increase in prestige and value has come a burgeoning tourist industry, which contributes to the regional economy. Olive oil is another success story where the traditional low-productivity olive oil production in the Sacramento region with high volume commercial production using mechanized harvesting and pruning systems, has partially shifted to traditional tree production and harvesting specializing in boutique olive oil sales.

Specialty crop agriculture generates higher value per unit land (and water) than most non-specialty crops, and has the potential to generate additional employment in secondary processing and distribution. While many regions of California's premier agricultural economy are reeling from drought and water restrictions, the Sacramento region specialty crop agriculture cluster is well suited for years of robust growth.

8.1 Lessons Learned and Future Considerations

The most important lesson learned from this project is that the default IMPLAN data does not accurately characterize the expenditure patterns of specialty crop agriculture businesses. In fact, the default IMPLAN data does not accurately characterize expenditure patterns for most agriculture-related industries. An in-depth evaluation of the data underlying the IMPLAN model identified that key parameters of the default data for the 14 agricultural crop and livestock sectors is based on national benchmark data provided by the BEA. While IMPLAN utilizes detailed county-level data to define the output values associated with agricultural commodities, the model estimates total value added based on national benchmark data provided by the Bureau of Economic Analysis (BEA). These trade flows are imposed on specialty crop agriculture in the Sacramento region, and the survey of specialty crop agriculture businesses found that these national averages are significantly different than actual practices. In particular, the proportion of expenditures on inputs (intermediate expenditures) is significantly higher than in the default IMPLAN trade flow data. The ERA team has created custom specialty crop sectors which better reflect actual expenditures, but future analysis should consider other farming sectors and ancillary businesses.

Surveying specialty crop businesses is a time-intensive process. The ERA team spent significant time calling, emailing, and following up with survey respondents. The ability to capture this survey information is critically important for the success of the project, as is the ability to leverage additional data to integrate with the survey results. Ideally, the survey process would start in the late summer and continue through the fall, leading up to the holidays. This preliminary data would be analyzed over the following 8 months, and follow-up surveys would take place in the following late summer and fall. This would allow time to gather data, analyze the data, and formulate follow-up questions while respecting the standard work schedules of specialty crop farmers.

There are several limitations to the modeling framework developed and SACOG should be cautious developing the models and applying the results. In particular, trade flows in the newly-created custom sectors default to the existing sector categories. This has several implications for policy analysis, most importantly the measures of household demand, institutional demand, and export values are unreliable. To circumvent this problem, the ERA team developed an aggregated version of the IMPLAN model which includes all of the data gathered under this project combined into the existing IMPLAN model sectors. The aggregated and disaggregated models are powerful analysis tools that should be used and interpreted carefully. This report and the appendices carefully document these limitations.

Appendix A. Supplemental Sources

The following is a list of the supplemental sources used by the ERA team to fill in gaps in the data collected in the primary specialty crop surveys. Other private sources the ERA team used, such as The Packer, which require a subscription and log-in, are omitted from this list. Thus, this represents a partial list of the supplemental sources used.

Beaman, J.A and A.J. Johnson. (2006), A Guide for New Manufacturers: Food Distribution Channel Overview, Oregon State University Extension Service, EM 8921.

Buzby, J.C., H. Wells, A. Kumcu, B. Lin, G. Lucier, and P. Agnes. (2010), Canned Fruit and Vegetable Consumption in the United States, United States Department of Agriculture, Economic Research Service.

California Department of Food and Agriculture, (CDFA). (2016), California Agricultural Exports 2014-2015.

California Employee Development Department, (EDD), Labor Market Information Division. (2016), Labor Data for Sacramento Valley Region, Sacramento-Roseville-Arden Arcade MSA, and Yuba City MSA.

Cook, R. L. (2011), Fundamental Forces Affecting U.S. Fresh Produce Growers and Marketers, Choices, Quarter 4.

Dimitri, C., A. Tegene, and P.R. Kaufman, (2003), U.S. Fresh Produce Markets: Marketing Channels, Trade Practices, and Retail Pricing/AER-825, United States Department of Agriculture, Economic Research Service.

The Morning Star Packing Company. (2016), 2016 Tomato Paste and Processed Tomato Statistics, Available online at http://morningstarco.com/statdocs/2016%20Exhibits%20Brochure.pdf.

Norton, M. and R. Duncan. (2009), Growing Processing Freestone Peaches in California: An Overview, University of California Division of Agriculture and Natural Resources, Publication 8358.

United States Census Bureau, (USCB). (2016), EC1242A1 - Wholesale Trade: Geographic Area Series: Summary Statistics for the U.S., States, Metro Areas, Counties, and Places: 2012, 2012 Economic Census.

United States Census Bureau, (USCB). (2016), North American Industry Classification System, Available online at http://www.census.gov/eos/www/naics/.

United States Department of Agriculture, (USDA). (2016), Fruit and Tree Nuts Yearbook 2015.

United States Department of Agriculture, (USDA). (2016) Vegetables and Melons Yearbook 2015.

United States Department of Agriculture, National Agricultural Statistics Service, (USDA NASS). (2014), 2012 Census of Agriculture: California State and County Data Volume 1, Part 5, AC-12-A-5.

University of California Cooperative Extension Cost and Return Studies. (2013), Sample Costs to Establish a Vineyard and Produce Wine Grapes: Chardonnay Variety, Sacramento Valley, Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2011), Sample Costs to Establish a Medium-Density Olive Orchard and Produce Bottled Olive Oil: North and Central Coasts, Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2014), Sample Costs to Produce Processing Tomatoes: Sub-Surface, Drip Irrigated (SDI) in the Sacramento Valley & Northern Delta. Available online at http://coststudies.ucdavis.edu/current/.

University of California Cooperative Extension Cost and Return Studies. (2011), Sample Costs to Establish and Produce Processing Peaches: Cling and Freestone Late Harvest Varieties, Sacramento Valley and San Joaquin Valley. Available online at http://coststudies.ucdavis.edu/current/.

Appendix B. Sacramento Region Primary Agricultural Production Model

1. Introduction

The primary model of agricultural production developed by ERA Economics for SACOG encompasses the geographic area defined by the Sacramento region.[1] The primary agricultural production model is used to simulate production decisions by growers in the Sacramento region, and the statewide market for those crops. This model links directly to the IMPLAN model. The primary model evaluates changes in farm production and the IMPLAN model simulates the corresponding effect on related industries within the broader specialty agriculture cluster.

2. Overview

The primary agricultural production model (hereafter "primary model" or simply "model") is a regional agricultural production and economic optimization model that simulates the decisions of growers across the Sacramento region. The model simulates the input and output markets for major specialty crops produced in the Sacramento region under current conditions, and in response to changes in policy, prices, or resource (e.g., water) availability. The primary model inputs include user-defined policies or other changes in market conditions. Outputs include the change in gross farm-gate production value, acreage, yield, prices, and input use. Farm-gate production value (or output value) is a direct input into the IMPLAN model. The sixteen production regions in the Sacramento area differ with respect to soil type, microclimate, and crop suitability. These regional differences result in widely varying measures of agricultural productivity, which are the returns to land and management per acre. The values vary widely—from \$427 to \$1073 per acre. This range of returns to agricultural production reflects the large differences in the value of production in the Sacramento region, with premium winegrowing regions being the highest valued, and field crops such as wheat and safflower being the lowest.

The primary model is calibrated using the method of Positive Mathematical Programming (PMP), a widely-accepted economic modeling approach which has been used and subject to peer review[23] for the last two decades. The essence of the PMP economic modeling approach underlying the primary model can be described as follows. The decision by profit-maximizing producers to plant certain crops, given the market for those crops and the market for inputs, reflects the physical and

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[1] The Sacramento region is defined to include the six counties that are within the SACOG region. These include the counties of El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba.

[2] Howitt. R.E. 1995. "Positive Mathematical Programming." American Journal of Agricultural Economics. 77(2): 329-342.

[3] Howitt. R.E, Medellín-Azuara. J, MacEwan. D, and Jay R. Lund. (2012) "Calibrating Disaggregate Economic Models of Agricultural Production and Water Management" Environmental Modeling and Software. 38: 244-258.

economic ability to produce crops in certain areas. These observed grower decisions are combined with additional information about market conditions, variability over time, and well-established economic principles to calibrate an economic model. For example, peaches are primarily produced in Yuba County because of soil and climate conditions (physical criteria) and a critical mass of growers with the detailed knowledge required to manage various risks and produce a profitable crop (economic criteria), as well as other considerations. In addition, Yuba County peach growers, like all peach growers, are subject to market fluctuations that affect aggregate demand and supply for their crop, ultimately determining the market-clearing price, and in turn, farm-gate profitability. The PMP approach incorporates all of this information to calibrate a model that exactly reproduces what growers actually do. The model is then used to simulate changes in production in response to changes in conditions (sometimes referred to as "policy simulations").

2.1 Primary Model Technical Overview

The primary model assumes that growers select the crops, water supplies, and other production inputs to maximize profit subject to resource constraints, technical production relationships, and market conditions. Growers face competitive markets for inputs and outputs, where no one grower can influence the market price. The competitive market is simulated by maximizing the sum of consumer and producer surplus subject to the following characteristics of production, market conditions, and available resources:

1. Constant Elasticity of Substitution (CES) production functions for every crop in every region. A production function is a mathematical relationship that shows how inputs (land, water, chemicals, etc) are combined to produce a crop. The CES has 4 fundamental inputs: land, labor, water, and other supplies. CES production functions allow for limited substitution between inputs which allows the model to estimate both total input use and input use intensity. The parameters of the CES production technology are calibrated to *observed* grower decisions using the method of PMP.
2. Decreasing Returns to Scale (RTS). Production exhibits decreasing returns to scale in land. Additional land into production for a particular crop is generally less productive than the primary land allocated to that crop, resulting in decreasing returns.
3. Crop production input costs, including water costs, are representative of cultural practices within the regions included in the model. The prices paid for inputs, and the quantity of inputs used, are partially based on primary grower surveys.
4. Downward sloping, linear, statewide crop demand functions. A demand function is a mathematical relationship that describes willingness to pay for a particular crop. Growers in the Sacramento region participate in the statewide (or international, for some crops) agricultural market.
5. Resource constraints on land, water, and other input availability by region. These are limits to the amount of resources available for use by agriculture. For example, water supplies were curtailed under the current drought.

6. Other agronomic and economic constraints. These are technical relationships that describe various aspects of farming in the Sacramento region. For example, the standard productive life of an orchard is 25 – 30 years and some crops are commonly grown as part of a multi-year rotation.

The model maximizes profits by choosing the optimal values of land, water, labor, and other input use in addition to input use intensity, as described by the CES production surface, subject to these constraints and definitions. Downward-sloping crop demand curves guarantee, all else constant, that as production increases crop price decreases (and vice-versa). Over time, crop demands may shift in response to real income growth and increases in population.

The calibrated model is used for policy simulation. As conditions change within a region (e.g., SACOG incentivizes frozen fruit processing which decreases transportation costs for peach growers) the model optimizes production by adjusting the crop mix, water sources and quantities, and other inputs. It also fallows land when that appears to be the most cost-effective land-use response to resource conditions.

3. Primary Model Coverage

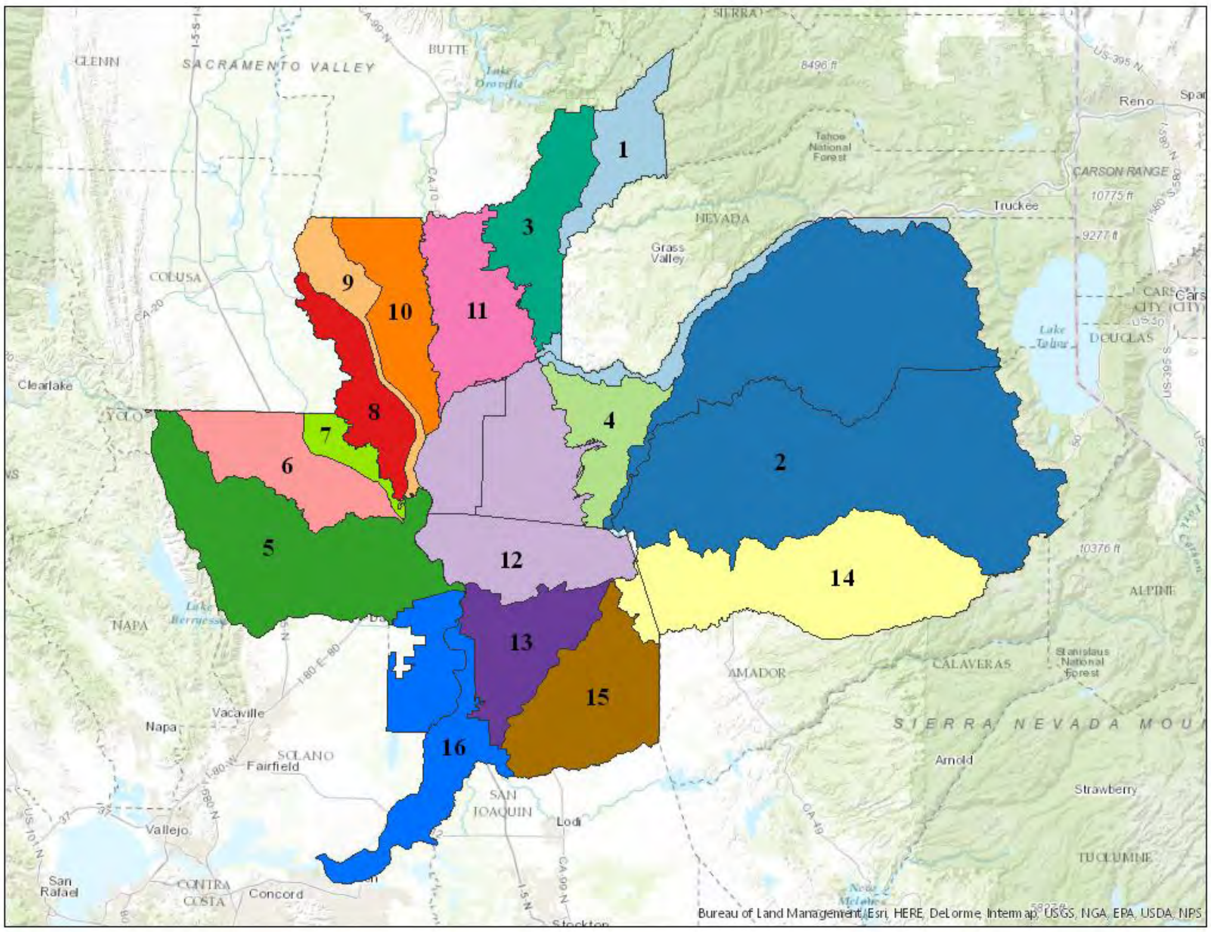
The primary model coverage includes all irrigated acreage in the Sacramento region. The model regions are defined on the basis of political boundaries (counties) and production regions. The production regions are based on water and land use planning areas known as Detailed Analysis Units (DAUs), as developed by the California Department of Water Resources. Table B.1 summarizes the 16 regions included in the primary model.

Table B.1: Primary Model Regions

Region Number	Model Region Name (DAU)	Counties
1	Yuba-Bear Rivers	Placer, Yuba
2	American River	El Dorado, Placer
3	Yuba Foothill	Yuba
4	Placer Foothill	Placer
5	Lower Cache Creek	Yolo
6	Willows-Arbuckle	Yolo
7	Glenn-Knights Landing	Sutter, Yolo
8	Meridian-Robbins	Sutter
9	Durham-Sutter	Sutter
10	Yuba City-Gridley	Sutter
11	Yuba	Sutter, Yuba
12	Placer	Placer, Sacramento, Sutter
13	Sacramento	Sacramento
14	Consumnes-Mokelumne-Calaveras	El Dorado
15	Elk Grove	Sacramento
16	Sacramento Delta	Sacramento, Yolo

The primary model regions are specified in the basis of 16 DAUs in the Sacramento region, which can be decomposed into 24 regions if county boundaries are included. Figure 1 illustrates the 16 regions in the primary model. The figure also shows the county lines to illustrate model region DAUs which span multiple counties. For example, region 16, "Sacramento Delta" includes portions of Sacramento and Yolo Counties. Delta agriculture is relatively homogenous, with high-value vegetable and fruit production, as well as corn, grain, and fodder field crops being produced in both Yolo and Sacramento Counties. The model definitions follow the convention used in the DAU regions.

Figure B.1: Primary Model Coverage



Crops are aggregated into 17 crop groups which are the same across all regions, although not all crops are produced in all regions. Each crop group represents a number of individual crops, but many are dominated by a single crop. Total acreage within any one crop group represents all of the crops within the group, production costs and returns are represented by a single proxy crop for each group. For each group, the representative (proxy) crop is chosen based on four criteria: (i) a detailed production budget is available from the University of California Cooperative Extension (UCCE) or from primary surveys completed under this project, (ii) it is the largest or one of the largest acreages within a group, (iii) its water use (applied water) is representative of water use of all crops in the group, (iv) its gross and net returns per acre are representative of the crops in the group. The relative importance of these criteria varies. Crop group definitions and the corresponding proxy crop are shown in Table B.2.

Table B.2: Crop Group Definitions in the Primary Model

Number	Crop Group	Proxy Crop	Example Other Crops
1	Alfalfa	Alfalfa	
2	Almonds	Almonds	
3	Corn	Grain corn	
4	Cucurbits	Honeydew melons	Squash, other melons
5	Dry Beans	Dry beans	
6	Grain	Wheat	Other miscellaneous grains
7	Olives	Olives	
8	Other Deciduous	Prunes	Apples, cherries, kiwi, pears
9	Other Field	Sunflower	Miscellaneous irrigated hay
10	Other Truck	Fresh tomatoes	Berries, misc small vegetables
11	Pasture	Irrigated pasture	
12	Peach	Clingstone peaches	Freestone peaches
13	Processing Tomatoes	Processing tomatoes	
14	Rice	Rice	Wild rice
15	Safflower	Safflower	
16	Vines	Wine grapes	
17	Walnuts	Walnuts	

All crops, not just specialty crops, are included in the primary model because the joint production of some crops is an important factor in planting decisions. For example, as a nitrogen-fixer alfalfa is sometimes included as a break crop to improve fertility in a multi-year rotation system. The primary model crop groups are linked to the IMPLAN model sectors by using the crosswalk shown in Table B.3. Changes in gross revenues (output value) can be input into the IMPLAN model to simulate the effect of that change in primary production on the related processing and distribution sectors. The integrated framework can be used to simulate the specialty agriculture cluster.

Table B.3: Primary Model – Custom IMPLAN Model Crosswalk

Number	Crop Group	IMPLAN Sector Number	IMPLAN Sector Name
1	Alfalfa	10	All other crop farming
2	Almonds	5	Misc. tree nut farming (revised)
3	Corn	2	Grain farming
4	Cucurbits	3	Misc. vegetable farming (revised)
5	Dry Beans	10	All other crop farming
6	Grain	2	Grain farming
7	Olives	9	Olive farming
8	Other Deciduous	4	Misc. fruit farming (revised)
9	Other Field	1	Oilseed farming
10	Other Truck	3	Misc. vegetable farming (revised)
11	Pasture	11	Ranching and grazing farming
12	Peach	23	Peach farming (custom)
13	Processing Tomatoes	7	Processing tomato farming (custom)
14	Rice	2	Grain farming
15	Safflower	1	Oilseed farming
16	Vines	25	Wine grape farming (custom)
17	Walnuts	26	Walnut farming (custom)

3.1 Primary Model Inputs and Outputs

As discussed previously, the primary model characterizes crop production with a CES production function for each region and crop. This production function captures the relationship between the inputs used to produce a crop and the realized output (yield) of that crop. Constant Elasticity of Substitution production functions in the primary model are region-specific, thus regional input use is combined to determine regional production for each crop.

For consistency with the IMPLAN model, the base year in the primary model is defined to be 2013. All prices, costs, land use, and market conditions, used to calibrate the model are for 2013. Having calibrated the model using the 2013 data, the model is then used for policy simulations under future conditions, as described in a subsequent section. Table B.4 summarizes the components of the model calibration data.

Table B.4: Primary Model Inputs

Input	Description
Land Use	Cropping patterns for the 2013 base year, by region and crop group.
Crop Prices	Farm-gate price received for the crops produced using an average of 2011 and 2012 prices to reflect grower expectations for the crops planted in 2013.
Crop Yields	Average yield realized in 2013 for the crops produced.
Interest Rates	All interest rates for short-term production loans, and long-term capital recovery are normalized to 2013 levels, equal to 4.75% and 5.75%, respectively.
Land Costs	The land rental rate or capital recovery cost of the land, per acre.
Other Supply Costs	Other supply costs include variable material and chemical inputs to crop production, such as fertilizers and pesticides. All input costs are in 2013 dollars.
Labor Costs	Labor costs include on-farm, contractor, and custom operator labor inputs into to crop production. All input costs are in 2013 dollars.
Surface Water Costs	Surface water costs per acre-foot for each region are a weighted average of the rates paid by growers in major water districts in the Sacramento region.
Groundwater Costs	Groundwater pumping costs are calculate per acre-foot and include the amortized fixed cost of the well and pump, an annual maintenance cost, and variable energy pumping cost per foot of dynamic head.
Irrigation Water	Crop applied water requirements, in acre-feet per acre, are used to establish the average applied irrigation water for each crop and region.
Elasticities	Demand and supply elasticities are estimated from a 30 year time-series of cropping data and used to establish the statewide market for crops produced in the Sacramento region.

3.2 Gross Returns and Market Conditions

Farm-gate gross revenues are calculated by multiplying the farm-gate price received by the realized crop yield. Crop yields and prices vary over time, both jointly and individually. Average crop yields by crop and region are established using a time-series of historical yields within each of the model regions. Farm-gate prices received are established over the same time series. The economic theory underlying the model calibration requires that the base year (2013) is representative of production conditions, and resulting grower planting decisions, in that year. As such, prices reflect a lagged two-year average to approximate grower price expectations when making 2013 planting decisions. Crop yields reflect the county average yield, which is also assumed to be representative of grower expectations when making planting decisions.

Having calibrated the economic model, it is then used for policy simulations. In these simulations the realized price and yield for each crop, in a given region, are estimated by (meaning, are an output from) the economic model. Total crop production and the market for that crop determine the market-clearing price any given year. Additionally, crop yields (and therefore total output) are estimated by the model and vary in response to market conditions. The model is specific to the Sacramento region, but the market for crops produced in the region follow the supply and demand conditions for the statewide agricultural market. For example, the farm-gate price for wheat in the Sacramento region is determined by demand and supply conditions elsewhere in California and internationally. The market outside of the Sacramento region is accounted for in the primary model and implicitly held constant so that the response to changes in Sacramento region production causes a small (if any) change in the market for a given crop.

3.3 Production Costs

The primary model includes four aggregate inputs to the CES for production of each crop and region: land, labor, water, and supplies. All units are converted into monetary terms, e.g., dollars of labor per acre instead of worker hours. Land is simply the number of acres of a crop in any region. Land costs represent basic land investment, cash overhead, and (when applicable) land rent. Labor costs represent both machinery labor and manual labor from on-farm sources, farm labor contractors, and custom operators. The “other supplies” category captures a range of inputs including fertilizer, pesticides, chemicals, custom, capital recovery, and interest on operating capital. Water costs and use per acre vary by crop and region. All costs are representative of prices paid by growers in 2013.

4. Policy Simulations with the Primary Model

The fully specified base model is written and solved using a well-known but commercially-based program called GAMS (Generalized Algebraic Modeling System). The GAMS Development Corporation provides a free version of the program that can be downloaded and will run any of the standard nonlinear algorithms. For this free version that SACOG will initially use to test the model, the vendor restricts the maximum dimensions of constraints and variables possible in the model to no more than 300. Accordingly, the ERA team has simplified the fully specified base model in the following ways to enable it to be solved with the free GAMS software in the initial stages of analysis. The principle that the ERA team applied was to simplify the model in terms of the complexity of the production function specification and price formation, but retain the full 16 regions and 17 potential crops that show the essential trade-offs in agricultural production within the SACOG region. The simplifications required to reduce the dimensionality of the model were: (i) Replacing the full regional crop CES production functions with a simpler function that has decreasing returns to scale in the acreage of crop grown for any region, but leaves the quantities of variable input per acre, namely land and labor and water, constant for any given region; (ii) simplifying the specification of water resources over multiple different supplies for each region to a single aggregated water supply and priced at the average cost observed in the base years; and (iii) replacing the formation of output prices—which are responsive and endogenous in the fully specified model—with prices that were fixed at the market clearing values in the base year data in the simplified model.

While it is obviously preferable to have more flexible specifications for input use per acre, prices that adjustment in response to changes in supplies, and potential changes in the mix of water sources used, the simplified model calibrates exactly and retains the essential economic trade-offs between the 16 regions and 17 crops which will show changes in gross agricultural output by location and type for a given policy scenario. The output of the simplified model is both presented and interacts with the IMPLAN model in exactly the same way as the full specification model since it calibrates exactly and generates the same change in gross agricultural returns for each region, and very similar responses to most policy scenarios.

ERA estimates that the initial stages of analysis the savings in software costs of approximately $6,000 is worth the simplifications in the model specification. At a later stage or for more complex price-based policy analysis, the fully specified endogenous prices and input use model can be swiftly combined with the simpler model.

For policy analysis (using the model to estimate the response by agriculture to changes in any condition) using the primary model the user needs three things:

1. Microsoft (MS) Excel workbook data input file;
2. GAMS data include file; and
3. GAMS program file; and

Simple changes for a policy scenario, such as changing the value of a single input or parameterizing a change in some resource (e.g., water supply) over a range, can be changed from the MS Excel input file. The input file is well documented so that the user can understand which inputs to change.

The model generally runs in under 2 minutes. The output from the model is exported using a GAMS data-exchange (GDX) routine which translates GAMS output into Excel. The output is populated in a MS Excel file and the user can easily visualize and manipulate the output from the model. For example, changes in gross farm revenues can be output and linked to the IMPLAN model using the primary model to IMPLAN model crosswalk shown above in Table B.3.

4.1 Data Input File

The MS Excel workbook data input file contains all of the user-defined data tables required for the model. Other data and calibration parameters are included in the GAMS include file. Some scalar parameters are incorporated into the model file itself rather than the data input file. Features of the data input file include the following:

- The input data file is automatically imported into the program file using the built-in GAMS program “xls2gms.” This program reads the tables and parameters from each tab in the data file and generates the “.INC” file which GAMS can read. Thus the user can edit data within the MS Excel file and it will be automatically updated in the model.

- The data input file must be saved as ".xls," GAMS does not recognize the default extension for Excel 2007, ".xlsx".

4.2 GAMS data include File

The data include file (.inc) contains additional data used to populate the model. This includes the calibrated parameters. The user can modify these data, but it is generally not necessary, thus they are left in the include file.

4.3 Program File

The program file (.gms) contains all of the model code. This includes a routine to automatically update input data and the policy simulation models. Simple or parameterized data input changes can also be made within the program file, if the user is feeling adventurous. The program file contains numerous comments and references. Sub-routines are all clearly detailed within the model and all set definitions follow the convention: region, input, and crop.

4.4 Output File

The program file will automatically export summary tables to a MS Excel workbook. The user can create different output tables within the program file, or can export results with two other methods. It is up to the user to decide how output should be organized; ERA Economics has created a series of default, standard summary metrics.

4.5 Post-Processing Workbook

It is good practice to create a post-processing MS Excel workbook. It typically includes a series of tables, charts, and figures used to summarize relevant output statistics. The post-processing workbook allows the user to quickly summarize model output and thus facilitates sequential model simulations. ERA Economics has prepared a standard post-processing MS Excel workbook for SACOG with default summary statistics.

5. Summary

The primary model is an optimization model that calibrates to observed grower decisions and the market for crops produced in the Sacramento region. It is a flexible, robust framework that can be, and has been, used to simulate a wide range of response by primary agriculture to changes in policy or market conditions. The model is being refined so that SACOG staff can make basic changes to the inputs and outputs and simulate the resulting effect on production in the Sacramento region. The model links directly to the IMPLAN model to simulate the total effect of changes in the economic cluster.

Appendix C. Producer, Processor, and Distributor Survey Responses

1. Introduction

Growers, processors, and distributors of specialty crops in the Sacramento Region were surveyed to: (i) gather the information necessary to establish economic multipliers for industry sub-sectors; and (ii) determine the key regulatory areas that affect the specialty crop value chain. Survey responses provide the foundational data necessary to establish economic multipliers and to model scenarios. Survey responses also inform the summary of regulatory costs provided in Appendix E. Surveys priorities were informed by a preliminary cluster analysis.

2. Sampling Universe

Using the United States Department of Agriculture (USDA) definition of specialty crops, four IMPLAN categories were identified for grower interviews. These include farming of vegetables and melons, fruit, nuts, and greenhouse and nursery farming. A preliminary cluster analysis identified key industries linked to specialty crops using the IMPLAN model, focusing on processing and distribution. That information and the following factors guided efforts to survey specialty crop growers, processors, and distributors:

1. **Value of production**. Priority was given to industries and sub-sectors with the highest values of production, since expenditures by these producers drive the economic multiplier effects. Special focus was given to the region's major specialty crops and to the associated industries that process and distribute these crops.
2. **Entity size**. Surveys capture a range of entity sizes as expenditure patterns are likely to differ by entity size. For example, small farms are more likely to use custom services and to lease machinery whereas larger farms, with greater economies of scale, are more likely to keep these operations in-house.

In addition, new and emerging markets/industries with high potential for growth were surveyed in order to anticipate industry developments and provide progressive results that will remain meaningful as industries change.

3. Outreach

Survey tools and sampling criteria were finalized with SACOG in August 2015 and survey outreach began in September 2015. Initial outreach was directed to agricultural organizations in the region so they could inform their constituencies about the project. Local county Farm Bureaus, UC Cooperative Extension farm advisors, and Agricultural Commissioners were all provided with a project overview and some disseminated the overview to their constituencies. In addition, input was sought from umbrella organizations such as the California League of Food Processors.

Table C.1 summarizes survey outreach by type of entity. Total values do not include outreach to agricultural organizations and agencies. One hundred and sixteen specialty crop growers, processors, and distributors were contacted to participate in the survey and thirty-six provided a survey response. To obtain these survey responses, potential survey respondents were called, emailed, and interviewed in-person in 307 unique communications.

Table C.1: Survey responses through June 15, 2016, by type of entity

Type of Entity	Entities Contacted	Communications	Returned Surveys
Growers	31	76	14
Processors	60	171	13
Distributors	25	60	9
General Ag Organizations	19	33	N/A
Total	116	307	36

4. Responses

Crop production surveys were primarily obtained from growers in Sutter and Yuba counties. El Dorado, Placer, Sacramento, and Yolo county specialty crop farmers were surveyed under a separate analysis led by Dr. Shermain Hardesty and her team at UC Davis. Dr. Hardesty provided aggregate survey data for this project, and the ERA team is grateful for her contribution. When Sutter and Yuba county producers were unavailable, supplemental surveys were obtained from specialty crop producers in the other four SACOG counties or in neighboring counties. Grower surveys received represent all four specialty crop sectors in IMPLAN.

Processors of vegetables and melons, fruit, and nuts were surveyed. As noted above, processor surveys focused on industries with strong links to the four IMPLAN specialty crop categories as reported in the preliminary cluster analysis. In addition, surveys were conducted in emerging industries in the SACOG region. Surveys of potential industries that are currently absent in the SACOG region were obtained from processors in other Northern California counties.

Specialty crop distribution is associated with several large industries in the six-county Sacramento area. Distributor surveys targeted produce distributors, grower-packer shippers, and produce stands in the SACOG region. In addition, surveys were obtained from farm product trucking companies, cold storage facilities, and broadline distributors. Table C.2 summarizes survey results for growers, processors, and distributors by farm or facility location.

Table C.2: Survey responses through June 15, 2016, by location

County	Entities Contacted	Communications	Returned Surveys
El Dorado	11	16	1
Placer	9	14	3
Sacramento	17	46	5
Sutter	34	105	14
Yolo	26	75	7
Yuba	19	51	6
Total	116	307	36

Note: Values do not include outreach to agricultural organizations and agencies.

Appendix C.1. Producer Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

Specialty crop agriculture is a valuable and growing industry in the Sacramento area. Our region has enjoyed robust growth in specialty crop value over the past several years, establishing itself as a growing food hub. In the last 10 years the value of specialty crop production in the Sacramento area has more than doubled, from $400 million to over $900 million annually. The specialty crop food system value chain, including producers, processors, and distributors, generates significant economic activity and jobs in the region. The Sacramento Area Council of Governments (SACOG) wants to better understand this economic web, and the current regulations which may be stifling growth, to encourage continued growth in the sector and ancillary industries.

The purpose of this study is three-fold: (i) to quantify the economic linkages in the specialty crop food system in the Sacramento area, (ii) to understand key regulatory costs affecting each industry, and (iii) to develop an economic framework that SACOG and its partners can use to evaluate policies that will encourage growth in the regional agricultural and food system economy.

Structure of the Study

This study of the Sacramento area specialty crop food system is initiated by SACOG and funded through a California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant. The project is being conducted by a team of researchers at the agricultural and resource economics consultancy ERA Economics, based in Davis, California. The regulatory cost component of the survey is led by Dr. Jay Noel of ERA Economics and professor in the Agribusiness Department at Cal Poly, San Luis Obispo. The agricultural value chain linkages component of the survey is led by Dr. Richard Howitt of ERA Economics and professor emeritus in the Agricultural and Resource Economics Department at UC Davis. The project is managed by Dr. Duncan MacEwan of ERA Economics and Mr. Garett Ballard-Rosa of SACOG.

Benefits for your business and compensation for your participation

This study will generate the information required to quantify the economic linkages between the different sectors in the specialty crop food system and other sectors in the broader Sacramento area economy. Our research team will use this information to calculate the direct economic value

and jobs created by the specialty crop food system in the Sacramento area and the “ripple” (or sometimes called “multiplier”) effects in all related industries. For example, specialty crop businesses purchase inputs from local suppliers and employ workers, and these workers spend money in the local economy. The suppliers from which specialty crop businesses purchase inputs also employ workers who spend money in the local economy. SACOG wants to understand these linkages so that they can better showcase the full contribution of specialty agriculture and help support strategies and policies that encourage continued growth in the specialty crop food system.

We anticipate the study will be complete by late summer 2016. **In exchange for your participation in this study you will be provided with the following**:

1. Periodic updates on the progress of the research and you will be invited to attend any meetings where SACOG presents results of the study.

2. Key “multipliers” for the sector in which your business operates. A multiplier is a number that tells you the total economic value for each dollar generated by your business. In particular, we will provide you with multipliers for total jobs and total output value generated by your business in the Sacramento area. We will provide this information to you as an appropriately referenced memorandum so that you can cite and use it for internal planning or marketing.

Thank you for taking the time to participate in this important study.

Survey Participant Information and Confidentiality Statement

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT, "Sacramento Area Food System Multipliers and Regulatory Costs Study"

A research project to quantify the economic linkages in the Sacramento area specialty crop food system and understand key regulatory costs affecting each industry is being conducted by the research team at ERA Economics at the request of SACOG, and funded by a grant from CDFA.

You are being asked to take part in this study by *answering a series of questions regarding your regulatory costs and business expenditure profile.* Your participation will take approximately *1 hour*. Please be aware that you are not required to participate in this research and you may discontinue your participation at any time without penalty. You also do not have to answer any questions, or parts of questions, you choose not to.

There are no risks anticipated with your participation in this research. Your confidentiality will be protected; no personal identifying information will be used in reports of this research. The information gathered will be placed in a database and used for aggregate statistical analysis. This database will be maintained by ERA Economics and only the aggregate statistical analysis may be shared with SACOG or its partners. The results of the statistical analysis will be used to create the economic model of the specialty crop food system web in the Sacramento area. Potential benefits from this research include encouraging future growth in the Sacramento area specialty crop food system.

If you have questions regarding this study, please feel free to contact Dr. Duncan MacEwan (530-341-3374), Mr. Garett Ballard-Rosa (916-319-5183), Dr. Jay Noel (805-756-5014), or Dr. Richard Howitt (530-304-4123).

If you agree to voluntarily participate in this research project as described please indicate your agreement by completing the questionnaire. Please retain a copy of this consent form for your reference and thank you for participating in this research.

Definitions

Study scope

Specialty crop: The U.S. Department of Agriculture defines specialty crops as "fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture." Examples include beans, citrus, grapes, herbs, melons, processing tomatoes, propagative materials, sweet corn, walnuts, and raising any specialty crop for seed. Fiber crops, forage crops, grain crops, livestock, and oil seed crops are NOT considered specialty crops. Examples of local crops that are NOT specialty crops include sorghum, sugar beets, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include foodservice companies in the Bay Area, farmers' markets in southern California, grocery stores in other U.S. states, and processors overseas.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found in box B on your Schedule F.

Sales

Sales: This category includes all sales of specialty crops from your farming operation. In addition to sales of raw products such as garlic, peaches, and squash, this includes sales of specialty crops that are minimally processed before sale such as honey, hulled walnuts, olive oil, and wine.

Direct sales: This category includes sales directly to the end consumer, including agri-tourism revenues. Examples include sales through farmers' markets, farm stands, u-pick, and community supported agriculture (CSA).

Retail sales: This category includes sales from your farm to a retail or foodservice buyer who prepares or packages your product for sale directly to consumers. Some examples include sales to grocery/specialty stores, restaurants, hotels, and institutions.

Wholesale sales: This category includes sales of undifferentiated, bulk products to traditional buyers, including cooperatives. Examples include sales to processors, packer-shippers, distributors, and brokers.

Expenses

Operating expenses: This category includes all costs associated with running your business's core operations on a daily basis. Common examples include labor costs, cost of inputs, and insurance.

Capital expenditures: Examples include land purchases and the principal portion of mortgage payments, the establishment of permanent plantings such as orchards and vineyards, the development of roads, structures, wells, and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your farming operation headquartered? _______________ County.

2. Which specialty crop(s) do you grow? ____
____

3. How many acres of specialty crops did you farm in 2014? __________ acres.

4. For the year 2014, what was your farm's:

Total expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

5. What is the NAICS code for your primary farming operation? __________
Please list the NAICS code(s) for any affiliated or subsidiary entities. _____________________

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your farm. Assign a 1 to the area with the greatest impact, a 2 to the area with the second greatest impact, etc.

Regulatory Area	Rank
Air quality	
Food safety	
Immigration reform (farm labor supply)	
Land use	
Occupational hazards and safety	
Pesticide application	
Pesticide registration	
Solid and hazardous waste disposal	
Technology (e.g. Tier 4 requirement on purchase of new farm equipment)	
Water allocation	
Water quality	
Wildlife protection	
Other:	

2. How would you describe the complexity of the regulatory environment?
   a. Very Complex_____ c. Somewhat Complex_____
   b. Complex_____ d. Not Complex_____

Inputs and Services	**Expenses ($)**	**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Hired labor (including payroll taxes, workers' comp., benefits, etc.)			
Contract labor			
Bookkeeping and tax services			
Custom hire (machine work)			
Freight and trucking			
Fuel, oil, grease			
Car and truck expenses			
Utilities			
Supplies			
Fertilizer and soil amendments			
Pesticides, herbicides, etc.			
Crop advising services			
Seeds and plants			
Processing expenses			
Storage and warehousing			
Insurance			
Land rent or crop share			
Other rent or lease payments			
Repairs and maintenance			
Taxes			
Interest			
Depreciation			
Certifications, licenses, permits			
Office expenses			
Marketing costs (including marketing order assessments)			
Other operating expenses:			
TOTAL			

3. Have you found duplication of effort among federal, state, and local regulatory agencies?
   a. A lot_____ b. Some_____ c. None_____

4. Have you found conflicts in policy goals among federal, state, and local agencies?
   a. Yes_____ b. No_____

III. Operating Expenses

Please complete the table below by entering information regarding your farm's operating expenses in 2014, including inputs purchased, type of input supplier, and location of input supplier.

IV. Capital Expenditures

Please complete the table below by entering information regarding your farm's capital expenditures in 2014.

Capital Expenditures	Expenditures ($)	Within Sacramento Region (%)	Outside Sacramento Region (%)
Machinery and equipment			
Structures			
Irrigation systems			
Establishment expenses (trees/vines)			
Other infrastructure			
All other capital expenditures			

V. Sales

Please complete the table below by entering information regarding your farming operation's sales in 2014, including the specialty crop sold and proportion of sales within and outside the Sacramento Region. Please provide information for your top crops by value of sales (up to 5).

Specialty Crop (e.g. basil, cling peaches, dry beans, olive oil)	% of Sales Within Sacramento Region	% of Sales Outside Sacramento Region	% of Sales Internationally

Appendix C.2. Processor Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

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and jobs created by the specialty crop food system in the Sacramento area and the “ripple” (or sometimes called “multiplier”) effects in all related industries. For example, specialty crop businesses purchase inputs from local suppliers and employ workers, and these workers spend money in the local economy. The suppliers from which specialty crop businesses purchase inputs also employ workers who spend money in the local economy. SACOG wants to understand these linkages so that they can better showcase the full contribution of specialty agriculture and help support strategies and policies that encourage continued growth in the specialty crop food system.

We anticipate the study will be complete by late summer 2016. In exchange for your participation in this study you will be provided with the following:

1. Periodic updates on the progress of the research and you will be invited to attend any meetings where SACOG presents results of the study.

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Thank you for taking the time to participate in this important study.

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You are being asked to take part in this study by *answering a series of questions regarding your regulatory costs and business expenditure profile.* Your participation will take approximately *1 hour*. Please be aware that you are not required to participate in this research and you may discontinue your participation at any time without penalty. You also do not have to answer any questions, or parts of questions, you choose not to.

There are no risks anticipated with your participation in this research. Your confidentiality will be protected; no personal identifying information will be used in reports of this research. The information gathered will be placed in a database and used for aggregate statistical analysis. This database will be maintained by ERA Economics and only the aggregate statistical analysis may be shared with SACOG or its partners. The results of the statistical analysis will be used to create the economic model of the specialty crop food system web in the Sacramento area. Potential benefits from this research include encouraging future growth in the Sacramento area specialty crop food system.

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Study scope

Specialty crop: The U.S. Department of Agriculture defines specialty crops as "fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture." Examples include beans, citrus, grapes, herbs, melons, processing tomatoes, sweet corn, and walnuts. Fiber, forage, grain, livestock, and oil seed crops are NOT considered specialty crops. Examples of local crops that are NOT specialty crops include cotton, dairy, sugar beets, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include foodservice companies in the Bay Area, confectioners in southern California, grocery stores in other U.S. states, and processors overseas.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found on your tax return.

Sales

Domestic sales: This category includes product sales within the 50 U.S. states and Puerto Rico. This includes sales to retailers, foodservice, other processors, food manufacturers, and consumers in the U.S.

International sales: This category includes product sales that are exported to any entity outside of the 50 U.S. states and Puerto Rico. This includes sales to retailers, foodservice, other processors, food manufacturers, and consumers outside the U.S.

Expenses

Operating expenses: This category includes all costs associated with running your business's core operations on a daily basis. Common examples include labor costs and costs of goods sold.

Capital expenditures: Examples include land purchases and the principal portion of mortgage payments, the development of roads, structures, wells, and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your business located? ____________ County.
2. Which specialty crop(s) does your business process? _________________________________
   How many tons of each crop did you process in 2014? _______________________________
   What percent of each crop you processed was grown in the Sacramento Region? __________

3. Does your business send raw materials to be finished at another company facility (for example, you grade nuts but another facility is responsible for processing)? _____ (yes/no)

4. Please enter the NAICS code for your business ____________. If you have any subsidiary or affiliated entities enter them here:____.

5. For the year 2014, what was your:

Total operating expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your business. Give a 1 to the area with the greatest impact, a 2 to the second greatest impact, etc.

Regulatory Area	**Rank**
Air quality	
Employee regulations (minimum wage laws, right to organize, etc.)	
Nutrition labeling	
Food safety	
Food processing byproduct waste disposal	
Health care (Affordable Care Act compliance, cost, etc.)	
Immigration and E-Verify (e.g. worker availability, reporting requirements, etc.)	
Occupational hazards and safety	
Water allocation	
Water quality	
Other:	

2. How would you describe the complexity of the regulatory environment?
   a. Very complex_____ c. Somewhat complex_____
   b. Complex_____ d. Not complex_____

3. Have you found duplication of effort among Federal, State or Local regulatory agencies?
   a. A lot_____ b. Some_____ c. None_____

Please give an example:

III. Sales

Please complete the table below by entering information regarding your business sales in 2014. Begin by entering the product name in the first column. In the first row of the second column, indicate the percent of the product's total sales that are domestic, then in the second row of the second column indicate what percent of domestic sales were inside and outside the 6-county Sacramento Region. In the third column, indicate what percent of the product's total sales were international sales. Please provide information for your top four products.

Product (e.g. prunes, walnuts)	**Domestic Sales** as % of Total Sales		**International Sales** as % of Total Sales
	% within 6-county region	% outside 6-county region	
Example: Walnuts	*10%*		*90%*
Regional breakdown:	*5%*	*95%*	--
1.			
Regional breakdown:			--
2.			
Regional breakdown:			--
3.			
Regional breakdown:			--
4.			
Regional breakdown:			--

Walnuts. *In this example, NorCal Walnuts, Inc. sells 10% of its in-shell walnuts domestically and 90% are sold internationally. Of the 10% of walnuts sold domestically, 5% are sold to a natural foods store in Davis and 95% are sold to natural foods stores outside the region.*

IV. Capital Expenditures

Please complete the table below by entering information regarding capital expenditures in 2014, including all major capital expenditures. Fill out the first column by estimating the costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Capital Expenditures	**Expenditures ($)**	**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Machinery and equipment			
Structures			
Other infrastructure			
Other capital expenditures (please list)			

V. Operating Expenses

Please complete the table below by entering information regarding the share of your business operating expenses in 2014. Fill out the first column by estimating the operating costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Inputs and Services	**Expenses ($ or %)**	**Percent Within Sacramento Region**	**Percent Outside Sacramento Region**
Employee compensation (including wages, benefits, payroll taxes, workers' comp., etc.)			
Cost of raw materials			
Packaging materials			
Bookkeeping and tax services			
Storage and warehousing			
Freight and trucking			
Utilities			
Waste management and remediation			
Insurance			
Rent or lease			
Repairs and maintenance			
Taxes			
Interest			
Depreciation			
Certifications, licenses, permits			
Marketing costs			
Office expenses			
Other operating expenses:			
TOTAL			

Appendix C.3. Distributor Questionnaire

As a primary business in the Sacramento area specialty crop food system we are requesting your input in an important study of the economic value and regulatory costs in the specialty crop food sector. We hope that you will take some time to review the study and fill out the survey questions. The information generated in this study will directly benefit your business and will be shared with you upon completion of the project.

Purpose of this Study

Specialty crop agriculture is a valuable and growing industry in the Sacramento area. Our region has enjoyed robust growth in specialty crop value over the past several years, establishing itself as a growing food hub. In the last 10 years the value of specialty crop production in the Sacramento area has more than doubled, from $400 million to over $900 million annually. The specialty crop food system value chain, including producers, processors, and distributors, generates significant economic activity and jobs in the region. The Sacramento Area Council of Governments (SACOG) wants to better understand this economic web, and the current regulations which may be stifling growth, to encourage continued growth in the sector and ancillary industries.

The purpose of this study is three-fold: (i) to quantify the economic linkages in the specialty crop food system in the Sacramento area, (ii) to understand key regulatory costs affecting each industry, and (iii) to develop an economic framework that SACOG and its partners can use to evaluate policies that will encourage growth in the regional agricultural and food system economy.

Structure of the Study

This study of the Sacramento area specialty crop food system is initiated by SACOG and funded through a California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant. The project is being conducted by a team of researchers at the agricultural and resource economics consultancy ERA Economics, based in Davis, California. The regulatory cost component of the survey is led by Dr. Jay Noel of ERA Economics and professor in the Agribusiness Department at Cal Poly, San Luis Obispo. The agricultural value chain linkages component of the survey is led by Dr. Richard Howitt of ERA Economics and professor emeritus in the Agricultural and Resource Economics Department at UC Davis. The project is managed by Dr. Duncan MacEwan of ERA Economics and Mr. Garett Ballard-Rosa of SACOG.

Benefits for your business and compensation for your participation

This study will generate the information required to quantify the economic linkages between the different sectors in the specialty crop food system and other sectors in the broader Sacramento area economy. Our research team will use this information to calculate the direct economic value

and jobs created by the specialty crop food system in the Sacramento area and the “ripple” (or sometimes called “multiplier”) effects in all related industries. For example, specialty crop businesses purchase inputs from local suppliers and employ workers, and these workers spend money in the local economy. The suppliers from which specialty crop businesses purchase inputs also employ workers who spend money in the local economy. SACOG wants to understand these linkages so that they can better showcase the full contribution of specialty agriculture and help support strategies and policies that encourage continued growth in the specialty crop food system.

We anticipate the study will be complete by late summer 2016. **In exchange for your participation in this study you will be provided with the following:**

1. Periodic updates on the progress of the research and you will be invited to attend any meetings where SACOG presents results of the study.

2. Key “multipliers” for the sector in which your business operates. A multiplier is a number that tells you the total economic value for each dollar generated by your business. In particular, we will provide you with multipliers for total jobs and total output value generated by your business in the Sacramento area. We will provide this information to you as an appropriately referenced memorandum so that you can cite and use it for internal planning or marketing.

Thank you for taking the time to participate in this important study.

Survey Participant Information and Confidentiality Statement

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT, “Sacramento Area Food System Multipliers and Regulatory Costs Study”

A research project to quantify the economic linkages in the Sacramento area specialty crop food system and understand key regulatory costs affecting each industry is being conducted by the research team at ERA Economics at the request of SACOG, and funded by a grant from CDFA.

You are being asked to take part in this study by *answering a series of questions regarding your regulatory costs and business expenditure profile.* Your participation will take approximately *1 hour*. Please be aware that you are not required to participate in this research and you may discontinue your participation at any time without penalty. You also do not have to answer any questions, or parts of questions, you choose not to.

There are no risks anticipated with your participation in this research. Your confidentiality will be protected; no personal identifying information will be used in reports of this research. The information gathered will be placed in a database and used for aggregate statistical analysis. This database will be maintained by ERA Economics and only the aggregate statistical analysis may be shared with SACOG or its partners. The results of the statistical analysis will be used to create the economic model of the specialty crop food system web in the Sacramento area. Potential benefits from this research include encouraging future growth in the Sacramento area specialty crop food system.

If you have questions regarding this study, please feel free to contact Dr. Duncan MacEwan (530-341-3374), Mr. Garett Ballard-Rosa (916-319-5183), Dr. Jay Noel (805-756-5014), or Dr. Richard Howitt (530-304-4123).

If you agree to voluntarily participate in this research project as described please indicate your agreement by completing the questionnaire. Please retain a copy of this consent form for your reference and thank you for participating in this research.

Definitions

Study scope
Specialty crop: The U.S. Department of Agriculture defines specialty crops as "fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops, including floriculture." Examples include beans, citrus, grapes, herbs, melons, potatoes, tomatoes, sweet corn, and walnuts. Fiber, forage, grain, livestock, and oil seed crops are NOT considered specialty crops. Examples of local products that are NOT specialty crops include cheese, dairy, eggs, sunflowers, and wild rice.

Within 6-county region: This study focuses on the economic value of specialty crop production, processing, and distribution in the 6-county Sacramento Region, which is limited to the following counties: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba. Transactions with entities physically located in these counties (though they may be headquartered elsewhere) fall into this category.

Outside 6-county region: Transactions with entities that are not physically located in El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties fall into this category. Examples include farmers in the San Joaquin Valley, foodservice companies in the Bay Area, and grocery stores in other U.S. states.

NAICS code: The North American Industry Classification System (NAICS) is the standard code used by federal agencies to classify business establishments. It can be found on your tax return.

Sales
Sales: This category includes sales and distribution of all specialty crops. In addition to sales of raw products such as garlic, peaches, and squash, this includes sales of specialty crops that are minimally processed before sale such as honey, hulled walnuts, olive oil, and wine.

Retail sales: This category includes sales to retail customers such as grocery and specialty stores.

Restaurant sales: This category includes sales to privately owned restaurants, including restaurant chains.

Institutional sales: This category includes sales to public or private institutions such as hotels, jails, schools, hospitals, casinos, and nursing homes.

Expenses
Operating expenses: This category includes all costs associated with running your businesses core operations on a daily basis. Common examples include labor costs and cost of goods sold.

Capital expenditures: Examples include land purchases and the principal portion of mortgage payments, the development of structures and other infrastructure, and purchase of vehicles, machinery, and equipment.

I. General Information

1. In which county is your business located? ____________ County.

2. Please enter the NAICS code for your business ____________. If you have any subsidiary or affiliated entities enter them here: ____.

3. For the year 2014, what was your:

Total operating expenses ($)		Sales revenue		Number of year-round employees		# of seasonal employees	

II. Regulatory Costs

1. The table below provides a list of regulatory areas. Please rank the top 4 based on their possible financial, operational, and managerial impacts on your business. Give a 1 to the area with the greatest impact, a 2 with the second greatest impact, etc.

Regulatory Area	**Rank**
Air quality	
Food safety	
Food waste disposal	
Health care (Affordable Care Act compliance, cost, etc.)	
Immigration and E-Verify immigration policy (e.g. worker availability, reporting requirements, etc.)	
Occupational hazards and safety	
Transportation (e.g. truck weight limits, lengths, truck availability, etc.)	
Other:	

2. How would you describe the complexity of the regulatory environment?
   a. Very complex_____ c. Somewhat complex_____
   b. Complex_____ d. Not complex_____

3. Have you found duplication of effort among Federal, State or Local regulatory agencies?
   a. A lot_____ b. Some_____ c. None_____

Please give an example:

III. Sales

1. In 2014, what percent of your sales were international? ___
2. In 2014, what percent of your domestic sales were within the 6-county Sacramento Region? _
3. In 2014, what percent (%) of your sales were to:

Retail		Restaurants		Institutions	

IV. Operating Expenses

Please complete the table below by entering information regarding your business operating expenses in 2014. Fill out the first column by estimating the operating costs for each category then indicate what proportion of each expenditure is spent within and outside the Sacramento region.

Inputs and Services	**Expenses ($ or % of total)**		**Percent Within Sacramento Region**	**Percent Outside Sacramento Region**
Employee compensation (including wages, benefits, payroll taxes, workers' comp., etc.)				
Cost of raw materials				
Bookkeeping and tax services				
Freight and trucking				
Fuel, oil, grease				
Car and truck expenses				
Utilities & Office Supplies				
Waste management and remediation				
Storage and warehousing				
Insurance				
Rent or lease (buildings)				
Repairs and maintenance				
Taxes				
Interest				
Certifications, licenses, permits				
Marketing costs				
Other operating expenses:				
TOTAL	100%			

V. Capital Expenditures

Please complete the table below by entering information regarding capital expenditures in 2014. Fill out the first column with an approximate dollar value for the capital expenditures and then indicate where the expenses were spent.

Capital Expenditures	**Expenditures ($)**		**Within Sacramento Region (%)**	**Outside Sacramento Region (%)**
Machinery & Equipment				
Structures				
Other infrastructure				
Other capital expenditures (please list)				

Appendix D. IMPLAN Methodology and Scenario Definition

1. Introduction

The purpose of this appendix is to provide an overview of the methods used to update and customize the IMPLAN input-output model based on primary survey data collected from specialty agriculture producers, processors, and distributors, as well as secondary data collected from a variety of sources.

1.1 IMPLAN Model Overview

This study utilizes the IMPLAN Version 3.1 software package, in conjunction with the 2013 IMPLAN economic data file for El Dorado, Placer, Sacramento, Sutter, Yuba, and Yolo Counties in California. The IMPLAN software functions as an input-output economic model, which estimates the effects of assumed exogenous changes in final demand within the specified geographic region. The model leverages a robust data set of national and regional economic accounts that document purchasing relationships between industries through multiple iterations, or rounds of spending, and makes this estimation possible. The software also incorporates institutional demand and inter-institutional transfers, which reflect purchases made by households and government agencies.

1.2 Understanding the Model Outputs

The output values typically generated through IMPLAN input-output analysis include the direct, indirect, and induced economic impacts. These are most commonly expressed in terms of output, but may also be expressed in terms of employment, labor income, or one of the four components of value added (employee compensation, proprietor income, other property type income, or tax on production and imports). By definition, the direct impacts are associated with the initial dollars spent within the study area. Amounts paid to entities located outside of the study area are excluded from the analysis and considered economic "leakage" because these dollars do not circulate within the local economy and thus cannot be counted among the local economic impacts. As a result, the direct impact estimates reported in the model outputs may differ somewhat from the gross dollar values that are initially reported, since the direct impact estimates account for economic leakage. The indirect impacts are estimated as industries that were the recipients of direct purchasing of the materials and services necessary for production. Induced impacts result from household consumption made possible by wages paid to workers and income generated to proprietors and institutions. When combined, this cycle of spending represent an economic multiplier effect, by which a direct increase in exogenous demand results in a total economic effect that is greater than the initial direct impact.

1.3 The Need for Customization

An evaluation of the data underlying the IMPLAN model identified that at least some of the default data for the 14 agricultural crop and livestock sectors may not be fully representative of economic activity associated with specialty agriculture in the SACOG region. For example, data on the ratio of *Value Added* to *Output* is based on national benchmark data provided by the Bureau of Economic Analysis (BEA). While IMPLAN utilizes detailed county-level data to define the *Output* values associated with agricultural commodities, the model estimates total *Value Added* based on national benchmark data provided by the BEA. The breakdown of *Value Added* is similarly derived, since the BEA reports things like proprietor income only at the farm level, with no detail provided that would help to distinguish between commodities. While the IMPLAN model offers a detailed spending profile for *Intermediate Expenditures*, the list of inputs purchased is held constant across commodities. Likewise, purchasing coefficients are held constant in proportion to the Intermediate Expenditure coefficient. While the model reflects the best information that is available on a national basis, it is possible to leverage the robust systematic methods associated the IMPLAN input-output software, while also improving the accuracy of the resulting multipliers by modifying it using alternative data sources that better reflect the characteristics of Sacramento area producers and related industries.

1.4 Working with Multiple Models

The ERA team initiated this research utilizing the default IMPLAN model using the 2013 IMPLAN dataset for El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties in California. The default model was used to preliminarily identify the structure of the specialty agriculture industry cluster within the Sacramento region. The default IMPLAN data was then used as the basis for developing two customized IMPLAN models. As noted elsewhere in this appendix, the ERA team incorporated additional local data based on primary survey research, as well as assorted secondary data sources. The method prioritized the use of local data where possible, utilizing the default IMPLAN data where local data sources were incomplete or unavailable. Note that the default model will continue to represent a useful tool moving forward, providing SACOG staff with a useful perspective regarding industries not included within the scope of this research, including, for example, non-agriculture related manufacturing. Also, IMPLAN has announced changes to their methodology for balancing industry accounts. As such, the 2014 data may offer some improvements over the 2013 data used for this research. SACOG may wish to utilize the default IMPLAN data in future years to update the custom models and to incorporate more current information into the decision making process.

The two custom models developed for this research include one that is aggregated to correspond to the default IMPLAN sectoring scheme and one that is disaggregated using re-purposed IMPLAN sectors that represent custom industry sectors that were broken out from the default industries. It is worth noting that both the aggregated and disaggregated models include custom industry data based on ERA's research into the unique economic behaviors associated with each specialty agriculture producer, processor, and distributor industry. In the aggregated model, the custom industry profiles for each break-out sector were simply combined using a weighted average method. For most research purposes, the aggregated custom model will provide the most reliable and internally consistent economic impact results. This is due to the way that the data which drives the IMPLAN software, such as the IMPLAN National Trade Flows Model, are applied, such that the aggregated model better maintains the internal consistency of the modeling framework.

However, under certain circumstances, the disaggregated model may better suite SACOG's research needs, in which case it may be used, but with certain qualifications. For example, the way the IMPLAN software treats *Commodities* implies that the trade flow data associated with re-purposed IMPLAN sectors (i.e., those used to represent custom industry sectors, such as the Tobacco Farming sector which was re-purposed to represent the Processing Tomato Farming sector) might not fully represent the custom industry. This only impacts dollars flowing into the custom sector; therefore, analyses focused on dollars flowing out of custom sectors (i.e., industry spending/purchasing) may be more reliably modeled using the disaggregated model, though the results should still be interpreted with caution.

2. Developing a Custom Model

In order to develop a customized IMPLAN model that more accurately reflects the economic behavior of specialty agricultural producers, processors, and distributors within the SACOG region, the ERA team utilized primary survey data supplemented by assorted secondary data (summarized in appendix A) to develop custom industry profiles for use in the IMPLAN model. This included estimating total *Output*, as well as *Value Added* and *Intermediate Expenditure* coefficients and *Industry Production* coefficients for eleven existing IMPLAN industry sectors and nine newly defined specialty agriculture producer, processor, and distributor industry sectors. However, due to limitations associated with the application of the IMPLAN National Trade Flows Model to custom industry sectors within the IMPLAN software, the ERA team elected to aggregate the 19 custom and revised industry sectors to correspond with the default IMPLAN sectoring scheme using a weighted average method, which reflects the unique industry behavior of each component sector commensurate with its share of the aggregate sector.

In addition, the ERA team has provided a set of industry profiles that contain the unique industry data for each of the 19 sectors, which may be utilized for scenario analysis. Utilizing the methods described below, SACOG staff may not only apply the custom industry profiles developed by the ERA team for scenario analysis, but can also develop new profiles that suit the needs of the agency. The method described below is intended for use by individuals who are at least generally familiar with the IMPLAN software and the techniques commonly used in economic impact analysis. Note that the methodology used to create revised and custom industry sectors uses the baseline IMPLAN data as a foundation, with modifications being made as appropriate to adjust for inaccuracies or irregularities, as identified through the survey results and through a review of the available secondary data. In the absence of more reliable information, the default IMPLAN data is assumed to be representative of the economic activities in question.

2.1 The Structure of the IMPLAN Model

The IMPLAN input-output model contains detailed social accounts data for 536 unique industries, as well as households and assorted institutions. Data for each industry are grouped into four main categories, including: *Study Area Data*, *Industry Production*, *Commodity Production*, and two sets of *Trade Flows*, which include the *Local Use Ratio (RSC)* and *Regional Purchase Coefficients (RPC)*. To view and modify each of these data components, you must enable model customization, which can be done through the *Customize* task bar. If the Customize task bar is not visible, the analyst can enable this and other advanced modeling features on the *User Preferences* window. This is accessed by going to *File* > *User Preferences* > *Analysis* and checking the boxes for *Advanced Modeling*, *Enable Accounts Explorer*, and *Enable Model Customization*. Once enabled, the *Customize* task bar should be visible on the left hand side of the IMPLAN interface, below the *Analyze* and *Explore* options, which provides options to view and customize the following types of data:

- **Study Area Data:** The suite of data defines the size and scope of each industry within the IMPLAN model. Variables included in the study area data for each industry include total industry output, total employment and the ratio of output per employee, and value added, which includes employee compensation, proprietor income, other property type income, and taxes on production and imports. Total output, minus all types of value added, are equal to intermediate expenditures, which is the value routed through the industry production function.

- **Industry Production:** This suite of data defines the production function for each industry included in the IMPLAN model. The production function for each industry identifies the list of commodities that are purchased as intermediate inputs. The coefficients represent the proportion of total output that gets allocated to purchases of each commodity. The sum of the coefficients identified in the industry production function must sum to the proportion of total output spent on all intermediate expenditures (i.e., output minus value added).

- **Commodity Production:** The commodity production function identifies the commodities produced by each industry, including the primary product and any associated byproducts. The coefficients in the commodity production function must sum to 1.0, with the coefficient for each commodity equal to a proportion of the total.

- **Trade Flows:** The trade flow data contained within the IMPLAN Model are broken down into two interrelated components:

- **Local Use Ratio:** The local use ratio defines the proportion of local production of a given commodity that is utilized by other domestic industries. The remainder is assumed to be leakage resulting from foreign and domestic commodity exports.
- **Regional Purchase Coefficient:** The regional purchase coefficient defines the proportion of gross demand for a given commodity that is supplied from local sources, with the remainder being imported from outside the analysis region.

2.2 Creating a Custom Industry Profile

Custom industry profiles for specialty crop agriculture in the SACOG region are developed using the following approach. While the aggregated model combined the profiles using a weighted average method in order to ensure consistency with the default IMPLAN sectoring scheme and the National Trade Flows Model, the custom industry profiles are available and may still be used under certain circumstances and with certain known limitations. The following information is intended to allow SACOG staff to develop additional custom industry profiles as necessary to meet future analytical needs.

2.2.1 Selecting the Baseline Industry

Prior to creating a custom industry profile, identify the IMPLAN sector that accounts for the economic activity in question. For example, this research created custom industry profiles for certain types of specialty agricultural production, like peach farming and walnut farming. In IMPLAN, the economic activity associated with peach production is captured within the broader Fruit Farming sector (IMPLAN 4), while walnut production is captured under the Tree Nut Farming sector (IMPLAN 5). In cases where this is unclear, refer to the NAICS sector to IMPLAN sector bridge file provided by IMPLAN, inc.[1]

2.2.2 Exporting the Default Industry Data

The next step is to export the industry balance sheet.

1) Select *Social Accounts* under the *Explore* task bar (left hand side of the screen).
2) In the *Social Accounts Explorer* window, select the *Balance Sheets* tab, and then export to MS Excel. This file includes all of the information for the baseline industry sector that will be needed to create a new custom industry sector, with the exception of *Total Employment* and the *RSC*. The industry balance sheet Excel file will include three tabs that summarize the IMPLAN data for commodity production, industry demand, and value added. Note that the *Total Commodity Demand* line item on the *Industry Demand* tab,

[1] The NAICS to IMPLAN bridge is provided by IMPLAN, inc., and can be downloaded directly from their website implan.com. Be sure to download the correct version, as there are multiple sectoring schemes and vintages.

plus the *Total Value Added* line item on the *Value Added* tab, equal *Total Output* from the industry sector in question.

3) To identify *Total Employment* for an industry, select *Study Area Data* under the *Explore* task bar and export to MS Excel.

4) To identify the *RSC* for an industry, select *Social Accounts* under the *Explore* task bar, then select the *Social Account Reports* tab and export to MS Excel.

2.2.3 Incorporating Alternative Data

Using the data provided in the industry balance sheet as a foundation, identify which pieces of survey data or secondary data warrant incorporation into a revised and/or custom industry profile. The emphasis is on identifying expenditures as a proportion of total output or sales. Data can be incorporated in a variety of ways and may include the addition or deletion of certain expenditures. Note that in those cases where you are creating a new industry sector, the most important step is to identify the *Total Output* value for the new industry as a proportion of the *Total Output* from the default sector.

Modifications can also be made to the *Study Area Data* and *Value Added* components, though no items may be added or deleted. All changes to the *Study Area Data* and *Value Added* components are input as dollar values, rather than output coefficient values. Changes to the *Industry Production* component may include the addition of new commodities, though commodities that you wish to remove can only be zeroed out. All changes to the *Industry Production* component must be input as output coefficient values, meaning as a percentage of total output.[2] For example, if the default *Industry Production* data do not include purchases of a commodity that is important to the sector you are trying to model, create a new line item and insert the new value. In those cases where you have a survey based expenditure total that does not reflect specific commodities, start by identifying the basket or suite of commodities that would most likely be included in the same expenditure class, then allocate the expenditure value based on the distribution of the default coefficients. For example, the IMPLAN *Industry Production* data for *Fruit Farming* includes a number of commodities that the ERA team roughly grouped as fertilizer and agricultural chemicals. The survey identified expenditures on fertilizers and agricultural chemicals as a single line item. The ERA team allocated that spending proportionally across the array of commodities included in the fertilizer and chemicals group based on the sum of the default coefficient values.

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[2] Before finalizing the revised or new industry profile, be sure to re-balance all of the coefficient values. The *Value Added* components, calculated as a share of total output, plus the sum of the *Industry Production* components, should equal 1.0. Similarly, the sum of the coefficients for each of the Commodity Production components should also equal 1.0. If not, the customized IMPLAN model will not function properly once the new and revised data are incorporated.

In those cases where you are creating a new industry sector, you will need to import the *Commodity Production* profile for the original sector, then modify it to reflect the characteristics of the new industry. In all cases, the coefficient for the commodity associated with the repurposed industry must be zeroed out. Not doing so will activate purchasing and production relationships, as well as trade flows, associated with the original sector. For example, if the Tobacco Farming sector (IMPLAN 7) is repurposed as a custom industry, some may be tempted to reutilize the Tobacco commodity (IMPLAN 3007) as a stand-in commodity for the new industry. However, the structure of the IMPLAN software utilizes the IMPLAN National Trade Flows model to exogenously determine foreign export quantities for each commodity. Utilizing the Tobacco commodity (IMPLAN 3007) to represent a custom industry commodity, like peaches or tomatoes, would subject that custom industry to the foreign export values, and other trade flows assumptions, for the Tobacco Industry (IMPLAN 3007). Therefore, the primary commodity produced by any custom industry sector should be the commodity associated with the industry upon which the new sector was derived. For example, when creating a new industry to represent processing tomato farming, the sector should apply the commodity production coefficients associated with the vegetable and melon farming sector (IMPLAN 3).

In addition to updating the *Value Added, Industry Production*, and *Commodity Production* components of the industry profile, changes can also be made to the *two Trade Flow* components, the *RSC* and *RPC*. There is only one RSC value for each commodity, which represents the proportion of the local supply that is used within the region. Conversely, the RPC for each commodity can vary based on the industry or institution that is doing the purchasing. Again, RPCs represents the proportion of total commodity demand that is satisfied by suppliers located within the region. Although IMPLAN allows the use of different RPCs for a given commodity that is being purchased by multiple industries, the default model applies the same RPC value for all industries and institutions. Both the RSC and RPC values can be modified as appropriate. However, the value of the RPC coefficients cannot result in *Total Local Demand* that exceeds *Net Commodity Supply*,[3] as calculated based on the underlying IMPLAN data.

2.3 Inputting a Custom Industry Profile into IMPLAN

When simply revising an existing IMPLAN industry sector, select the industry in question, then follow the steps outlined later in this section. Note that the IMPLAN software does not allow the creation of new industry sectors that are outside of the existing industry sectoring scheme. Therefore, to create a new industry sector, click on *Study Area Data* under the *Customize* task bar. Scroll down the *industry list* to identify an existing IMPLAN sector that has zero output, and then rename the industry.

[3] *Net Commodity Supply* is equal to *Total Commodity Supply*, minus *Foreign Exports*. As noted earlier, *Foreign Exports* is an exogenously derived value base on IMPLAN's underlying data, which cannot be modified.

2.3.1 Modifying the Study Area Data

1) Enter the appropriate *Study Area Data* values for the new or revised sector. There are two ways to do this. You can enter either total dollar values or per worker values.

    a. Enter revised data for any of the following variables: *Output*, *Employee Compensation*, *Proprietor Income*, *Other Property Type Income*, and *Tax on Production and Imports*.

    b. Click *Update*, which will re-balance the data and will update the *Total Value Added* field and *Intermediate Expenditures* field. Note that the values may change slightly, as the software will round them as part of the balancing process.

    c. Confirm that the values are still on the same order of magnitude as those entered. If you have not entered a new employment total, this will also be updated based on the default ratio of output per employee.

    d. When satisfied, click *Save*. Note that once saved, modifications cannot be undone.

    e. Select *Options* > *Construct* > *Multipliers* to reconstruct the model.

CAUTION: Be sure to make all of the modifications to the *Study Area Data* at this stage, as making changes later on and reconstructing the model may result in the software reverting back to the default *Industry Production*, *Commodity Production*, and *Trade Flow* data, deleting any changes that you may have already made to those components of the model. For this reason, it is important to keep the number of times that you reconstruct the model to a minimum.

2.3.2 Modifying the Industry and Commodity Production Data

1) Export the data for the industry sector that you are using as the baseline for the revised or new industry sector. If you are only modifying an existing industry, skip this step and simply modify the coefficients as necessary.

    a. Select *Industry Production* or *Commodity Production* under the *Customize* task bar, then select the industry in question.

    b. Select *Options* > *Export*.

2) Select the new industry from the list on the left, then select *Options* > *Import*.

    a. Add commodities and insert revised coefficients as appropriate.

    b. Select *Balance* at the bottom of the screen

    c. If satisfied, click *Save*.

    d. Select *Options* > *Construct* > *Multipliers*, to reconstruct the model.

CAUTION: Recognizing that the software can revert back to the default data under certain circumstances, it is helpful to also export the new or revised production function using the same method described above. In the event that the production function for a new industry sector reverts to its default state, simply import the new revised production function and select *Save*.

2.3.3 Modifying the RSC and RPC Values

1) Select *Trade Flows* under the *Customize* task bar.
   a. To revise the RSC value, select the *Trade Model* tab, then enter a new value that reflects the local use of local supply. This can be either a dollar value, or a percent RSC value.
      i. For the RSC, enter one value per commodity.
      ii. When satisfied, click *Save*.
   b. To revise the RPC values, select the *Industry/Institution RPC* tab. The default IMPLAN assumes the same RPC coefficient for each industry or institution that purchases a given commodity, though these can be different.
      i. Enter the new RPC values, as appropriate.
      ii. When satisfied, click *Save.*
   c. Select *Options* > *Construct* > *Multipliers*, to reconstruct the model.

3. Other Special Considerations

When developing customized IMPLAN models, there are a number of special considerations that should be taken into account to ensure that the resulting input-output model functions properly.

3.1 Wholesale and Retail Margining

In some instances, when expenditures are allocated to the wholesale and/or retail trade sectors, the analysis must also account for margining, which represents sales receipts, less the cost of goods sold, or put another way, equals the trade margin, plus sales taxes and excise taxes. Margining is less of a concern when dealing with Industry Production data, and more so when specifying economic impact events and scenarios. However, margining is an important concept that can impact where in the Industry Production profile certain expenditures are allocated. For example, purchases of gasoline can be coded to *Refined Petroleum Products*, a product of the oil refining industry, or can be coded to *Gasoline Stores*. Margins are not applied to the former, but they are applied to the latter, which can impact the way the dollars associated with that expenditure circulate through the economy.

4. Scenario Analysis using the Integrated Models

In addition to the custom IMPLAN model for specialty crop agriculture, the ERA team developed a primary agricultural production model. The technical details of the primary production model can be found in Appendix B. In contrast to the IMPLAN model, the primary model is an economic optimization model of the farm-level production decisions of growers and the market for specialty crops. As such, it can be used to simulate the response of the specialty agriculture production sector, by crop, to changes in policy, prices, market conditions, and resource availability. For policy analysis the primary model is used to estimate changes in the crop production sector, and the output from this model is linked to the IMPLAN model to simulate changes in the regional economy.

The ERA team developed three scenarios to demonstrate how to apply the primary production and IMPLAN models for policy analysis. Scenarios include a market growth scenario, market contraction scenario, and a business attraction scenario.

4.1 Market Growth Scenario

The market growth scenario considers an increase in the demand for specialty crop production in the Sacramento region. Crop production demand is determined by market conditions, and described using a crop demand curve in the primary production model. In 2014 and 2015 California agriculture suffered through two of the hottest and driest years on record. Surface water deliveries from the major state and federal water projects were zero for many regions in the San Joaquin Valley. In contrast, the Sacramento Valley received higher deliveries and had better access to groundwater, making drought conditions severe but comparatively better than conditions in the San Joaquin Valley. In response, the demand for processing tomato production in the Sacramento region increased, and processing tomato contracts shifted from the San Joaquin Valley back to the Sacramento Valley, reversing a long-term trend. This scenario assumes an increase in the production of processing tomatoes within the SACOG region of 35 percent.

The first step in conducting an impact assessment is to select an appropriate modeling approach. Here we use the primary production model to estimate the 35 percent increase in processing tomato production, and the custom IMPLAN model to evaluate the regional economic impacts. The next step in the modeling process is to identify the necessary inputs. Within the default and aggregate IMPLAN models developed by the ERA team, processing tomatoes are categorized within IMPLAN Sector 3 – Vegetable and Melon Farming. This research identified that total output value of processing tomatoes in the SACOG region equals $135 million[4]. A 35 percent

[4] This output value assigns a share (63.2%) of the IMPLAN Vegetable and Melon Farming output value based on the share of USDA-NASS vegetable and melon revenues represented by processing tomato farming. Total output

increase would equal approximately $47.25 million, which functions as the direct impact input value for this scenario analysis. The variables necessary to specify this impact scenario are summarized in Table D.1.

Table D.1: Impact Event Specification – Scenario 1

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Increase in Tomato Output	1	3 Vegetable and Melon Farming	$47,250,750

[1] The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
[2] The *Industry Sales* variable is equal to the change in output, production, or sales volume.

Follow the steps below to enter the impact event values into the IMPLAN software:

1) Open the IMPLAN 3.1 software and open the model titled *SACOG_SpecialtyAgriculture_AggregateModel_2016*;[5]
2) Select *Setup Activities* on the *Analyze* task bar (left side of the window);
3) On the *Activities* toolbar (top of the window under *Setup Activities*), select *New Activity*;
4) Select the parameters on the *Add New Activity* screen that correspond to those identified in Table D.1;
5) In the *Events* area of the screen, select the appropriate *Sector* and enter the *Industry Sales* value as identified in Table D.1;
6) Select *Next* in the bottom right corner of the screen;

values differ between the two sources because IMPLAN industry data is compiled from Economic Census data based on NAICS codes and NASS data is gathered from grower surveys.
[5] This presumes that the user has already downloaded and installed the necessary IMPLAN data package.

7) On the *New Scenario* window, select a name for the *Scenario* and enter 1 for the *Scenario Level*, then select *Save*;[6] [7]

8) Select the Activity(ies) included in the scenario from the *Available Activities* portion of the screen and move them to the *Selected Activity(ies)* portion of the screen using the *Select* and *Unselect* arrows, then select *Analyze Single Region.*

4.2 Market Contraction Scenario

The market contraction scenario considers a decrease in the farm-gate price of specialty crop production in the Sacramento region. Crop production demand is determined by market conditions, and described using a crop demand curve in the primary production model. A change in the price of a commodity is modeled in the primary production model.

Between 1997 and 2014 the farm-gate price of walnuts was highly variable, with average annual swings of 20 percent change in value. Through 2015 prices received for walnuts were over $1.50 per pound but as of 2016 walnut prices have settled closer to $0.90 per pound, a decrease of approximately 40 percent.

The first step in the analysis is to use the primary production model to simulate the effect of a change in the price received for walnuts. This can be accomplished two ways: simulating the statewide increase in the production of walnuts, which will capture the decrease in the price received for walnuts, or by calculating this shift and imposing the price change. This scenario applies the latter approach because it is simpler to implement, and because this scenario is a backward-looking analysis of a change in the market. The strength of the primary production model is the ability to simulate future changes in market conditions. This approach is discussed in the business attraction scenario. This scenario analyzes the 40 percent decrease in the price received for walnuts.

Follow the steps below to implement the price shift in the primary production model:

1) Copy and paste the GAMS file and data file into your desired folder.
2) Open the GAMS software.
3) Select *File > Project > New*
    a. Create a project file called “Scenario 2”.
    b. Save the project file in the same folder as the GAMS data file and GAMS program.
4) Select *file > open*.
    a. Open the GAMS program “SACOG Primary Model”.

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[6] A *Scenario* represents one or more *Events* that are run through the model at the same time, producing one set of impact estimates.
[7] The *Scenario Level* functions similar to the *Activity Level*, which reflects the number of times the scenario is repeated to create the final demand change.

5) Open the policy analysis Excel Workbook
    a. Enter data to decrease the price of walnuts by 40 percent.
    b. Save the file.
6) Select *file > run*.
    a. The program will run and execute output into the Excel file.
7) Open the output MS Excel file in the Project folder.
    a. Go to the desired output tab (prices, acreage, production) and summarize the change in desired extensive margin output metrics.
    b. Record the change in the total value of production (which should approximately equal a 40 percent decrease).

This scenario also uses a version of the IMPLAN model that has been customized to better represent specialty agriculture within the SACOG region; however, this scenario provides an example of how a custom industry profile can be used to add an additional level of accuracy and specificity to the analysis.

<u>Using a Custom Industry Profile</u>

The following are instructions for incorporating one of the custom industry profiles developed by the ERA team into the IMPLAN model:

1) Open the IMPLAN 3.1 software and open the model titled *SACOG_SpecialtyAgriculture_AggregateModel_2016*;[8]

2) Select *File > User Preferences > Analysis* and make sure the following boxes are checked, then close the window:

    a. Advanced Modeling

        i. Enable Accounts Explorer

        ii. Enable Model Customization

3) Select *Study Area Data* under the *Customize* task bar on the left side of the screen;

4) Scroll down the *Industry List* and locate a sector with zero output and employment, such as *IMPLAN Sector 7 – Tobacco Farming*;

5) Select *edit totals then update per worker values* in the *Edit Options* box;

6) Enter the *Study Area Data* variables as identified in the custom industry profile;

7) Select *Update*, then *Save*;

[8] This presumes that the user has already downloaded and installed the necessary IMPLAN data package.

8) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

9) Select *Industry Production* under the *Customize* task bar on the left side of the screen;

10) Select the appropriate industry sector, then input the *Coefficient* values as identified in the custom industry profile;

11) Under the column labeled *Fixed*, uncheck all of the boxes, then select *Balance*;

12) Double check the *Coefficient* values, then select *Save*;[9]

13) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

14) Select *Commodity Production* under the *Customize* task bar on the left side of the screen;

15) Enter zeros in the column labeled *Coefficient* for any commodity category not identified in the custom industry profile commodity production function;

16) Select *Options* > *Add a Commodity*, then select the appropriate commodity from the *Available Commodity List*, then enter a value in the space labeled *Byproducts Coefficient* and select *OK*;

17) Select *Balance* and *Save*;

18) Select *Options* > *Construct* > *Multipliers* to reconstruct the model;

19) Select *Trade Flows* under the *Customize* task bar on the left side of the screen;

20) Select the *Industry/Institution RPC* tab, then select a commodity from the drop down list;

21) Insert updated *Regional Purchase Coefficient* values for each industry and/or institution listed, then select *Save*;[10]

22) Select *Options* > *Construct* > *Multipliers* to reconstruct the model.

The next step in the modeling process is to identify the necessary inputs. While following the steps identified above for entering a custom industry profile into the IMPLAN software, a previously zeroed out industry sector was re-purposed for use as a custom industry. The impact event parameters described below will need to be entered in relation to this new industry.

The output value of walnuts in 2014 was approximately $335.6 million[11]. A 40 percent decrease equals $134.23 million, as shown in the primary production model analysis in the first step,

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[9] The values may change slightly as a result of the balancing process. This is due to rounding within the software.
[10] Though the IMPLAN model applies the same RPC values across all industries that purchase a given commodity, the software allows the user to define unique RPC values.

which is the direct impact input value for the IMPLAN model. The variables necessary to specify this impact scenario are summarized in Table D.2. To enter the impact event values into the IMPLAN software, follow the steps provided under Scenario 1.

Table D.2: Impact Event Specification – Scenario 2

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Decrease in Walnut Output	1	[Defined by the user]	($134,228,759)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

4.3 Business Attraction Scenario

The business attraction scenario evaluates the economic impact, or contribution, of a new specialty crop processor starting a business in the Sacramento region. The processor is attracted to the region through a RUCS imitative, other specialty crop agriculture initiatives, or business-friendly policies in the SACOG counties. The presence of a processor in the region may lower the production costs (e.g., transportation) or risks (e.g., long-term contracts) to growers, which may incentivize growers to produce the crop demanded by the processor. These changes in production conditions in the SACOG region are simulated using the primary production model. As regional production of the crop increases, the production of other crops decreases.

This scenario evaluates a new peach processing facility for Individually Quick Frozen (IQF) peaches. The market for frozen peaches has been expanding in recent years and the share of total

[11] This output value assigns a share (75.7%) of the IMPLAN Tree Nut Farming output value based on the share of USDA-NASS tree nut revenues represented by walnut farming. Total output values differ between the two sources because IMPLAN industry data is compiled from Economic Census data based on NAICS codes and NASS data is gathered from grower surveys.

available peaches represented by frozen peaches has tripled since 1970. Currently there is no frozen fruit processor in the SACOG region. It is likely that the frozen processor will be a diversified operation with a range of products including peaches. For simplicity, only peaches are evaluated in this scenario. The frozen peach processor reduces production costs or production risk for growers in the SACOG region. This can be modeled as a decrease in the price of inputs to peach production, or alternatively, as a shift in the demand (price) for peaches in the Sacramento region. The latter approach is used for this scenario, which simulates a 10 percent increase in the gross margin for peaches.

The first step is to evaluate the production response to the new processor. To implement the price shift in the primary production model:

1) Copy and paste the GAMS file and data file into your desired folder.
2) Open the GAMS software.
3) Select *file > project > new*.
    a. Create a project file called "Scenario 3".
    b. Save the project file in the same folder as the GAMS data file and GAMS program.
4) Select *file > open*.
    a. Open the GAMS program "SACOG Primary Model".
5) Open the policy analysis Excel Workbook.
    a. Enter data to change the demand for peaches.
        i. A shift of 10% is assumed for this demonstration
    b. Save the program file.
6) Select *file > run*.
    a. The program will run and execute output into the MS Excel file.
7) Open the output Excel file in the Project folder.
    a. Go to the desired output tab (prices, acreage, production) and summarize the change in desired extensive margin output metrics.
    b. Record the change in the total value of production of peaches across all regions.
    c. Record the change in the total value of production of all other crops across all regions.
    d. Record the change in production of peaches (in tons) across all regions.

Next, in the custom IMPLAN model create a new industry by inputting the custom industry profile for the Frozen Specialties Manufacturing sector (IMPLAN 80) using the method described in the previous scenario. Identify the total output that the proposed facility may be expected to generate using the primary production model (step 7.d.). The variables necessary to specify the impact scenario for the first phase of this analysis are summarized in Table D.3. Enter the values into the IMPLAN model using the method described in the previous section. To evaluate the impact of adding a new industry into the economy, the impact event is equal to the inverse of the total Output value for the industry. Prior to evaluating the results, convert them to positive values.

Table D.3: Impact Event Specification – Scenario 3 (Phase I)

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	New Processing Facility	1	80 Frozen Specialties Manufacturing	($88,352,700)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

Next, select the *Detailed Results* tab in the *Scenario Results* window, then select *Export* > *All Detailed Reports to Excel*. On the *Output* tab of the MS Excel document, identify the Fruit Farming sector (IMPLAN 3) and record the total impact value, then convert to a positive number.

The next phase of this impact scenario is to evaluate the change in production for all other crop sectors that are displaced by the increase in peach production.

To enter the outputs of the primary production model into IMPLAN, follow the steps provided in Scenario 1, creating a new *Event* for each crop category under the same *Activity*. Table D.4 summarizes the change in production value for other crops from the primary production model. Select *Analyze* on the *Analyze Scenarios* screen, then select *Detailed Results* on the *Scenario Results* screen. To export the results, select *Export* > *All Detail Reports to Excel*.

Table D.4: Impact Event Specification – Scenario 3 (Phase III)

Activity Type	Activity Name	Activity Level[1]	IMPLAN Sector	Industry Sales (Output Change)[2]
Industry Change	Farm Output Decrease (Oilseed)	1	1 Oilseed Farming	($44,210)
Industry Change	Farm Output Decrease (Grain)	1	2 Grain Farming	($601,768)
Industry Change	Farm Output Decrease (Veg)	1	3 Vegetable and Melon Farming	($33,558)
Industry Change	Farm Output Decrease (Fruit)	1	4 Fruit Farming	($178,835)
Industry Change	Farm Output Decrease (Nuts)	1	5 Tree Nut Farming	($84,315)
Industry Change	Farm Output Decrease (Other)	1	10 All Other Crop Farming	($39,241)
Industry Change	Farm Output Decrease (Ranch)	1	11 Ranching	($67,095)
			Total, All Sectors	($1,044,021)

1 The *Activity Level* represents a multiplier that is applied to all *Event Values* within an *Activity*, which reflects the number of times the event is repeated to create the final demand change.
2 The *Industry Sales* variable is equal to the change in output, production, or sales volume.

The next step is to combine the economic impact estimates associated with the recruitment of a new frozen fruit processing facility, with the impacts associated with changes in farm output. To do this, sum the *Direct*, *Indirect*, and *Induced* impact estimates from the two model runs, as illustrated in Table D.5. To estimate the multiplier, divide the combined impact for both model runs (including the *Direct*, *Indirect*, and *Induced* effects), by the combined *Direct* impact.

Table D.5: Model Output Values – Scenario 3

	Employment	Labor Income	Value Added	Output
New Processing Facility				
Direct Effect	190	$8,968,151	$12,249,991	$88,352,675
Indirect Effect	328	$14,584,420	$23,000,386	$45,272,249
Induced Effect	102	$4,757,845	$8,624,776	$14,290,245
Total, All	620	$28,310,416	$43,875,152	$147,915,168
Change in Farm Output				
Direct Effect	-7	($157,394)	($190,722)	($1,049,022)
Indirect Effect	-4	($180,317)	($298,359)	($502,019)
Induced Effect	-1	($69,093)	($125,185)	($207,507)
Total, All	-12	($406,803)	($614,266)	($1,758,548)
Combined Impact, All Events				
Direct Effect	183	$8,810,757	$12,059,269	$87,303,653
Indirect Effect	324	$14,404,103	$22,702,027	$44,770,230
Induced Effect	101	$4,688,752	$8,499,591	$14,082,738
Total, All	608	$27,903,613	$43,260,887	$146,156,621

Appendix E. Literature Review of Regulatory Compliance Costs for Specialty Crop Agriculture in the Sacramento Valley

1. Introduction

The agricultural sector in California is subject to some of the most stringent and complex regulations in the world. Regulations can provide benefits to producers by, for example, signaling to consumers that California produce is safe and reliable, but regulations also impose compliance costs on agricultural businesses. This analysis includes a review of published and unpublished studies to establish regulatory compliance costs to specialty crop producers, processors, and distributors in the Sacramento area.[1]

Regulatory costs can be classified as either direct, involving a cash outlay in response to the regulation, or indirect, involving an opportunity cost to the business or industry as a result of the regulation. Both direct and indirect costs of regulations have been increasing in recent years. The increasing costs of regulatory compliance, as well as the possibilities of even more stringent regulations in the future, are widely cited as a major source of concern in the agricultural industry. It is difficult to quantify the direct and indirect costs of a regulation because establishing these costs requires access to proprietary financial information. It follows that there is a relatively limited number of studies that estimate plausible regulatory compliance costs. The literature review identified 34 regulatory cost studies that represent the best available estimates.

The total cost of regulatory compliance for specialty crop producers in California is estimated to equal more than $2 billion per year (Hurley and Noel 2006a). There is no comparable estimate for the total cost of regulations to processing and distribution industries because these businesses are much more diverse and are affected by a range of complicated, and often intersecting, regulations. Table E.1 summarizes some of the key state and federal laws that impose regulations on agricultural businesses. In addition to state and federal requirements, there are numerous local regulations that affect agricultural businesses. The following sections summarize total, direct, and indirect costs of major regulations for specialty crop producers, processors, and distributors.

[1] Defined as the six-county area including El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba counties.

Table E.1: Example Laws Affecting Agricultural Businesses, by Area of Regulation

Environment	Law	Agency
Federal		
1969	National Environmental Policy Act	U.S. Environmental Protection Agency
1970	Federal Clean Air Act	U.S. Environmental Protection Agency
1972	Federal Clean Water Act	U.S. Environmental Protection Agency
1972	The Coastal Zone Management Act	National Oceanic and Atmospheric Admin.
1973	Federal Endangered Species Act	NOAA, U.S. Fish & Wildlife Service
1974	Safe Drinking Water Act	U.S. Environmental Protection Agency
1976	Toxic Substance Control Act	U.S. Environmental Protection Agency
1990	Pollution Prevention Act	U.S. Environmental Protection Agency
1996	Federal Insecticide, Fungicide, and Rodenticide	U.S. Environmental Protection Agency
State		
1969	Porter-Cologne Water Quality Control Act	CA Environmental Protection Agency
1970	California Environmental Quality Act	CA Natural Resources Agency
1973	California Forest Practice Act	CA Dept. of Forestry and Fire Protection
1976	California Coastal Act of 1976	CA Coastal Commission
1986	California Safe Drinking Water and Toxic	CA Office of Environmental Health Hazard
1988	California Clean Air Act	CA Environmental Protection Agency
2006	California Global Warming Solutions Act	CA Environmental Protection Agency
2014	Sustainable Groundwater Management Act	CA Department of Water Resources
Food Safety	**Law**	**Agency**
Federal		
1906	Federal Meat Inspection Act	USDA Food Safety and Inspection Service
1938	Federal Food, Drug and Cosmetic Act	U.S. Food and Drug Administration
1957	Federal Poultry Inspection Act	USDA Food Safety and Inspection Service
1990	Federal Organic Foods Production Act	USDA Agricultural Marketing Service
1996	Food Quality Protection Act	U.S. Environmental Protection Agency
2010	Food Safety Modernization Act	U.S. Food and Drug Administration
State		
2003	California Organic Products Act	CA Department of Food and Agriculture
Labor	**Law**	**Agency**
Federal		
1970	Occupations Safety and Health Act	U.S. Department of Labor
1983	Federal Migrant and Seasonal Worker Protection	U.S. Department of Labor
1993	Worker Protection Standard	U.S. Environmental Protection Agency
2009	Federal Fair Labor Standards Act	U.S. Department of Labor
State		
1975	California Agricultural Labor Relations Act	Agricultural Labor Relations Board

Notes: NOAA: National Oceanic and Atmospheric Administration; USDA: United States Department of Agriculture.

1.1 Regulatory Environment in California

The regulatory environment for agricultural and food production systems in California is stringent and complex, more so than in any other state. The regulation of agriculture is driven mainly by environmental concerns, such as water and air quality issues, as well as worker and consumer health and safety interests. While regulations may be in the public interest and can provide some benefits to the regulated industry, they may also affect firm and industry productivity and competitive performance. The increasing complexity of the regulatory environment in California has been cited by several studies as an area of growing concern for California producers and a factor that is likely to have negative impacts on the future competitiveness of the industry (Hurley 2005; Johnston and McCalla 2004; Noel, Paggi, and Yamazaki 2013).

The main areas of regulation in California agriculture can be classified as: (i) labor regulations, such as safety and health, worker compensation and rights, (ii) regulations pertaining to consumer health and safety, (iii) environmental regulations, such as air and water quality, water rights, threatened or endangered plants and animals, and wetlands, and (iv) regulations related to transportation of materials including hazardous waste (Carter et al. 1996). Specialty crop agricultural businesses face a range of regulations within each of these broader categories. The costs of regulatory compliance vary widely depending on the type of industry and the commodities being produced. For example, transportation regulations impose a proportionally higher cost on distributors than on primary producers, whereas labor regulations, particularly workers compensation rates, are proportionally higher for on-farm jobs.

2. Direct and Indirect Regulatory Costs

Regulatory compliance imposes direct and indirect costs on an industry. Direct costs include cash outlays, which are typically a direct out-of-pocket expense for a business. Examples include permit fees, fees for testing or verification, coalition charges, and other payments made specifically to assure compliance. Indirect costs result from foregone earnings (opportunity cost) and losses that result when a business changes their operations in response to a regulation. For example, labor costs to train and hire additional employees and fill out and submit required paperwork, as well as the time (both employee and proprietor) required to learn about the regulations and to assure compliance. Indirect costs require detailed financial information and are typically more difficult to quantify than direct regulatory costs.

The prevalence of indirect costs of regulatory compliance is discussed in several studies that examine the regulatory environment for producers of specialty crops in California. A survey of over 1,300 California producers of specialty crops, administered by the California Agricultural Statistics Service and analyzed by Hurley and Noel (2006b) and Hurley et al. (2006), found that indirect cost of management time devoted to regulatory compliance increased by 40 percent between 1999 and 2004. Survey respondents reported spending an average of 7.3 percent of their total working hours on regulatory issues in 1999, compared with 10.3 percent in 2004. This indirect cost of additional management time, which is typically at a higher wage rate than farm laborers, can be a significant cost on a per-farm or per-acre basis. In fact, California producers already pay the highest total labor costs in the country, which account for approximately 21 percent of their total costs of production, thus a three percent increase in the labor time for regulatory compliance represents a significant portion of on-farm costs (Hamilton 2006). It is also noteworthy that labor costs can account for upwards of 50 percent of total production costs for some vegetable crops.[2]

Direct cash costs of compliance have increased as well, especially fees associated with environmental regulation. Table E.2 compares estimated average regulatory costs per farm for California producers in 1999 and 2004 (Hurley and Noel 2006a) in 2004 dollars. Additionally, Hurley and Noel estimate that burning permits averaged $38 in 1999 and increased to $129 in 2004, representing a 240 percent increase in costs. Over the same time period air quality fees increased by 940 percent and chemical use fees increased by 127 percent.

Table E.2: Average annual regulatory costs, 1999 and 2004

Regulatory Cost	**1999**	**2004**	**Change**
	$ per farm		*%*
Burning Fees	38	129	240
Air Quality Fees	52	542	942
Chemical Use Fees	252	571	127
Solid Waste Fees	697	733	5
Water Quality Fees	968	993	3
Workers Compensation Costs	6,462	18,087	180

Source: Table 6 in Hurley and Noel (2006a). Costs are in 2004 dollars.

2.1 Business Perceptions of the Regulatory Environment

The regulatory environment in California is constantly changing in response to new laws, policies, and political pressure. The complexity of the regulatory environment is a major factor driving increases in the costs of compliance. Indirect compliance costs are perceived by specialty crop producers as having a higher negative impact on the production process than direct cash costs. This is largely due to the uncertainty created by the regulatory environment. Producers want to comply with regulations, but find it difficult to obtain timely information (Hurley et al. 2006). Local farm bureaus and industry groups offer meetings and information sessions, which requires growers to commit management time to attend these meetings, which can be costly.

A second source of concern for the specialty crop industry is that there are multiple agencies overseeing regulations. California producers face multiple agencies and regulations derived from at least twenty-eight separate state and federal laws governed by various separate state and federal agencies. Table E.3 summarizes some of the key agencies. Producers deal with multiple state and federal agencies separately, in some cases duplicating their efforts and further

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[2] For example, see a recent Op-Ed in the Mercury News, available from: http://www.mercurynews.com/opinion/ci_23817065/minimum-wage-santa-clara-county-proposal-would-hit

increasing their costs (Hurley 2005; Hamilton 2006). In addition to state and federal agencies, growers must navigate regulations from local coalitions, water districts, counties, and cities.

Table E.3: Federal and state agencies for regulatory compliance

Federal
United States Department of the Interior (including Reclamation)
United States Department of Agriculture
United States Environmental Protection Agency
United States Department of Health and Human Services
United States Department of Labor
United States Department of Commerce
United States Food and Drug Administration
State
California Department of Food and Agriculture
California Department of Fish and Game
California Department of Water Resources
California Coastal Commission
California Agricultural Labor Relations Board
California Environmental Protection Agency
California Department of Forestry & Fire Protection
State Water Resources Control Board
Department of Industrial Relations
County Agricultural Commissioners

Perceived complexity of the regulatory environment varies between the major agricultural regions in California (Hurley et al. 2006). Producers in Southern San Joaquin and Sacramento Valley regions are most likely to perceive the regulatory environment as complex or very complex, mostly because of strict labor and air quality regulations on emissions and particle pollution. Producers in the Southern Desert regions, including Coachella, Imperial, and Yuma, are less likely to view the regulatory environment as complex because regulations are less stringent. A survey of specialty crop producers who do not farm in California by Paggi et al. (2009) found that 74 percent of respondents viewed that California regulatory environment as more restrictive than that of their home state.

3. Total Costs of Regulatory Compliance for Specialty Crop Producers

The costs of regulatory compliance depend on the size of the farm, crop mix, and location. It follows that there are multiple ways to evaluate the cost of compliance with a specific regulation. For example, one can estimate the total cost of compliance for the entire farm, but how that cost is allocated to each crop grown on the farm, or each acre of a given crop in production, is not a simple calculation. This section summarizes the total costs of regulatory compliance, and the following sections summarize the total regulatory costs for specific regulations.

Research on the total costs of regulatory compliance for producers of specialty crops in California is surprisingly limited. Hurley and Noel (2006a, 2006b) completed initial work including estimates of farm-level costs of regulatory compliance, by farm income level. The authors found that growers, on average, spend about 6.4 percent of total farm income on regulatory compliance. In another study, Hurley et al. (2006) used data from a survey of specialty crop producers to estimate that survey respondents spent about 11 percent of capital investment on regulatory compliance. Of each dollar that was allocated to regulatory cost compliance, 16 percent was allocated to workers safety, 13 percent to abatement of water discharge, 9 percent to abatement of air emissions, and 6 percent toward providing wildlife habitat. The remaining 66 percent of capital investment was spent on other miscellaneous regulatory compliance.

The total costs of regulatory compliance are unevenly distributed by farm size. Approximately 10 percent of the farms in California realize annual income greater than $500,000. Hurley and Noel (2006a) found that these farms spent approximately 6 percent of their total farm income on regulatory compliance in 2004. They also found that that farms with income greater than $500,000 per year accounted for more than 88 percent of total regulatory costs for the state. The total costs of regulatory compliance for producers of specialty crops, including cash and labor costs, both direct and indirect, were estimated to equal between $2.19 billion and $2.21 billion in 2004 (Hurley and Noel 2006a). Table E.4 summarizes the results of the analysis.

Table E.4: Total regulatory cost by farm income

Farm Income Range	Regulatory Cost	Average Regulatory Cost		
	$	*$ per farm*	*$ per acre*	*% farm income*
Under $10,000	9,306,511	262	51	5.24
$10,000–$49,999	39,190,084	2,447	189	8.16
$50,000–$99,999	30,816,042	4,708	152	6.28
$100,000–$249,999	112,659,422	16,078	167	9.19
$250,000–$499,999	82,966,217	20,721	271	5.53
$500,000+	1,924,943,890	252,518	638	6.33
All incomes	2,199,882,166	28,570	162	6.41

Source: Table 3 in Hurley and Noel (2006a). Costs are in 2004 dollars.

3.1 Farm Budget Analyses

Because the regulatory environment is fluid and complex, many studies use stochastic farm-level simulation models to evaluate the impact of specific regulations on the profitability of agricultural producers. These simulation models are based on farm-level cost-of-production budgets (analogous to a standard Profit and Loss annual statement for any business) for representative growers and are used to analyze the impact of changing regulatory costs while holding other factors constant. The model simulates the effect of proposed or existing regulations on the net farm income of producers, typically per acre, taking into account the (stochastic) distribution of prices and yields. Since the model is stochastic it can be used to express regulatory costs both as per-acre cash-costs and probabilistically.

All of the studies using stochastic farm budget models find that increasing costs of regulatory compliance increases the probability of negative net farm income on a per acre basis. In one of the more recent studies, Paggi et al. (2010) found that compared with Texas, where the regulatory burden on the growers is much lower, the probability of incurring annual losses in California is 17 percent higher. Noel et al. (2013) find that regulatory compliance costs to orange growers in the Southern San Joaquin Valley decreased the five year average annual net farm income for orange producers by approximately 1.5 percent. Noel and Paggi (2012) estimate the cost of regulatory compliance to lettuce growers equals about $150 per acre per year, about 53 percent greater than the cost in Arizona. Paggi et al. (2009) use a simulation model to evaluate the effect of waste disposal fees on cling peach and processing tomato producers in Stanislaus County and find a reduction in annual net farm income ranging from 12 percent to 17 percent.

Table E.5 summarizes studies using stochastic farm-level models for producers of specialty crops in California. As discussed above, all studies found that regulatory costs reduce the average net returns and increase the probability of lower or negative returns per acre for agricultural producers. The first two columns summarize the crop and regulations considered by each study, and the simulation period is shown in column 3. Column 4 summarizes the cost of the regulation per acre to growers.

Table E.5: Regulatory costs using farm-level simulation models

Crop	Cost / Regulation	Simulation period	Cost per acre	Source
Oranges	Total cash cost: $216.19–$401.51 per acre	2008–2012	$216 - $402	Paggi et al. (2009, 2010)
Peaches (processing)	Waste disposal charge: $7.68–$10.56 per ton	2007–2009	$124–$176	Paggi et al. (2007, 2009)
Tomato (processing)	Waste disposal charge: $7.68–$10.56 per ton	2007–2009	$273–$376	Paggi et al. (2007)
Iceberg Lettuce	Total cash cost: $150/acre	2006–2010	$150	Noel and Paggi (2012)

4. Regulatory Cost by Type of Regulation

As discussed previously, most regulations affecting specialty crop businesses can be classified as labor, environmental, consumer health, or transportation (distribution). The following sections summarize key regulations and costs for each category of regulation.

4.1 Labor Regulations

Relative to other states, California has higher minimum wages, mandatory workers' compensation insurance, liability insurance, and health care benefits. Workers' compensation rates for agricultural workers vary between 10 and 25 percent of base salary for field and packing shed workers, to as low as 0.5 percent for clerical workers. Because of these regulations California producers spend millions more than farmers in states with lower labor expenses (Hurley 2005; Hamilton 2006). For some growers, workers' compensation can comprise up to half of total regulatory costs (Noel and Paggi 2012).

In recent years piece-rate compensation has been impacted by several case law developments. Under the Federal Fair Labor Standards Act an employer may average an employee's piece-rate earnings over all hours worked to determine whether that employee's pay meets the minimum wage requirement. Under this federal law, piece-rate earnings in excess of the minimum wage required to cover piece-producing time (PPT) may be applied to the minimum wage requirement to cover non-piece producing time (non-PPT). However, under California law, employers must fully pay for all hours worked, including non-PPT, at the regular hourly rate. In several cases, such as Armenta v. Osmose 2005, Cardenas v. McLane Food Services 2011, and Gonzalez v. Downtown LA Motors, LP 2013, California courts ruled the federal law that allows employers to average over all hours in a workweek to compute minimum wage obligations are not acceptable under California law. Therefore, employers who do not separately pay for non-PPT and rest breaks are potentially exposed to a lawsuit and could be required to pay back-pay, fines, and legal fees. Employers that try to minimize exposure by utilizing the piece-rate compensation system have to track PPT and non-PPT, as well as rest breaks, and ensure that employees are directly compensated for non-PPT and break time at more than the minimum wage. In addition, the piece-rate compensation for the PPT is at least equal to minimum wage. The time spent tracking the different categories of time worked, as well as the uncertainty over what constitutes compliance with labor laws, generates an additional cost for employers and employees (Resnick and Moody 2015).

Another important labor regulation in California is the Heat Illness Prevention standard. This is mandated by the Division of Occupational Safety and Health (DOSH or Cal/OSHA), and requires specific training and access to shade and water for outside workers. The requirements also cover an acclimatization period for new workers, high heat and emergency procedures, and require employers to develop written procedures and train employees in how to apply them. In 2010, the Cal/OSHA conducted a three-year campaign to publicize heat illness awareness. The results of the campaign were summarized in report by Teran (2013) to the California Department of Industrial Relations. The report identified several barriers that prevent workers from consistently following heat illness prevention practices. The main obstacle was the conflict between the recommended rest periods and the piece rate compensation structure, with workers being unwilling to stop for water or rest because they would be earning less. Both employees and employers reported that workers are less likely to stop for rest if they are working for piece-rate compensation. In some cases, workers paid by the hour reported not getting permission from supervisors to stop, drink water, and rest. In turn, the employers reported compliance with these regulations is costly, especially for employers with smaller operations.

Table E.6 summarizes the annual costs per acre of compliance with labor and other regulations for specialty crop producers from an in-progress study by McCullough et al. (2016). These labor costs do not include the cost of workers' compensation insurance because, the authors argue, it is a cost-of-business in California and not a separate regulatory cost. Education and training have the highest average compliance costs per acre. All farm labor has to undergo annual safety training. For example, if chemicals were applied to the crop, then the workers handling those chemicals had to go through special training to obtain a private applicators license. This labor time is a direct regulatory cost to the farm. The cost of labor compliance as a proportion of average annual operating costs ranges from less than 1 percent up to 2.5 percent.

Table E.6: Annual labor regulatory costs by crop

	Operating Costs	Education/ Training	Labor Requirements	Total Labor	Share of Operating Costs
		$/acre			*(%)*
Almonds	2,319	50.83	6.07	56.90	2.45
Tomato	2,942	5.25	2.77	8.02	0.27
Peach	8,658	44.72	1.49	46.21	0.05
Grapes	2,706	22.35	11.09	33.43	1.23
Orange	3,614	40.00	0.68	40.68	1.12
Lettuce	3,866			79.00	2.00

Source: McCullough et al. (2016). Costs are in 2012 dollars.

Estimates of costs per acre reported in Table E.6 are consistent with earlier studies of regulatory costs for orange producers. Costs of compliance with labor regulations were reported to equal between $48 and $56 per acre (2008 dollars), or about 3 percent of operating costs, in Paggi et al. (2010) and Noel and Paggi (2012).

4.2 Environmental Regulations

Following the development of the Central Valley Project (CVP) and State Water Project (SWP), California water management has shifted from an era of building dams to one of increased focus on the environment. Environmental concerns have generated many new regulations that affect agricultural producers. These regulations can be broadly classified as water quantity, water quality, air quality, and pesticide regulations. Table E.7 summarizes the annual costs per acre of compliance with environmental regulations for specialty crop producers. The following sub-sections provide more detail on the individual components.

Table E.7 shows that air emissions regulations impose the highest annual cost per acre. Meeting air quality requirements typically requires a capital outlay to purchase new machinery or replace diesel pumps, which carries a significant cost. As a share of operating costs, costs of compliance with environmental regulations per acre range from under 1 percent up to 4.7 percent.

Table E.7: Annual environmental regulatory costs by crop

	Operating Costs	Air Emissions	Water Quality	Pesticide Application	Total Environment	Share of Operating Costs
			$ per acre			*%*
Almonds	2,320	87.19	6.98	14.02	108.19	4.66
Tomato	2,942	22.17	0.06	16.12	38.35	1.30
Peach	8,658	52.88	3.01	6.86	62.75	0.07
Grapes	2,706	31.87	11.44	5.75	59.30	2.19
Orange	3,613	64.50	8.85	19.48	92.83	2.57
Lettuce	3,866				58.00	1.50

Source: McCullough et al. (2016), Noel and Paggi (2012). Costs are in 2012 dollars.

The findings of McCullough et al. (2016) are consistent with earlier studies. Paggi et al. (2010) and Noel and Paggi (2012) found that the costs of compliance with environmental regulations were between $41 and $242 per acre (2008 dollars), or about 12 percent of operating costs. The following subsections provide some background on these environmental costs.

4.3 Water Quantity

Regulation of water supply has been increasing in recent years, mostly driven by environmental concerns. The costs of water quantity regulations typically manifest as regional costs which are difficult to calculate on a per farm basis. When faced with water shortages, farmers typically respond by reducing levels of crop production (fallowing land), deficit irrigating crops, pumping additional groundwater, and switching to less water-intensive crops. As a result, the agricultural profits and the number of agricultural jobs decline. Two recent examples of water quantity regulations that have a direct effect on water use by farms are the 2009 Biological Opinion on Delta Smelt and the Sustainable Groundwater Management Act of 2014.

Under the Endangered Species Act of 1973, a Federal agency is required to request a Formal Consultation if it believes that its project may adversely affect an endangered species. A Biological Opinion (BO) is a formal document that results from this consultation and it contains the determination of whether or not a specific project is likely to jeopardize a listed species or adversely affect a listed species' critical habitat. The original BO issued by the U.S. Fish and Wildlife Service in 2005 determined that CVP and SWP would not jeopardize the Delta Smelt. This opinion was challenged in court, and a 2007 court ruling, known as the Wanger Interim Order for Delta Smelt, mandated a 25 to 30 percent reduction in water exports by the SWP in 2008. In 2009, a new BO was issued on Delta Smelt, stating that pumping by the CVP and SWP is likely to jeopardize Delta Smelt and suggested retaining the restrictions that resulted from the Wanger Interim Order and implementing additional cuts in pumping based on environmental conditions to mitigate the damage. Studies by Sunding et al. (2009) and Howitt et al. (2011)

found that these restrictions resulted in the loss of thousands of farm jobs and millions of dollars in farm revenue.

In 2014 the California legislature passed a set of three laws: AB 1739, SB 1319, and SB 1168, collectively known as the Sustainable Groundwater Management Act of 2014. AB 1739 and SB 1168 establish guidelines for sustainable groundwater management plans and provide rules for state intervention and interim management when local groundwater management agencies do not satisfy management requirements. The key feature of the bills is that management plans must contain measurable objectives to achieve groundwater sustainability within 20 years. In practice, the Sustainable Groundwater Management Act requires several immediate and future actions. Each medium and high-risk groundwater basin (as defined by DWR) must elect a Groundwater Sustainability Agency (GSA) by 2017. The GSA must establish and submit to DWR a Groundwater Sustainability Plan (GSP), which must be implemented by 2022. By no later than 2042 the basin must be brought into sustainable management where groundwater levels are stabilized. If a GSA is not formed, then the management of the basin will default to the county. If a GSA/county is not able to implement a GSP, the State Water Resources Control Board has a duty to take appropriate corrective actions. Preliminary estimates suggest sustainable groundwater management will require some groundwater basins, primarily in the San Joaquin Valley, to reduce groundwater pumping by up to 30 percent. Basins in the Sacramento Valley are in better shape, only overdrafted 3–7 percent, however the statewide reduction in groundwater pumping will increase the value of water, and in turn, increase the North-South economic gradient for water transfers out of the Sacramento Valley.

4.4 Water Quality

As shown in Table E.7, the water quality regulatory compliance cost can be as much as 18 percent of total per acre regulatory costs attributable to the environment. Water quality regulations are primarily paid through local water coalition fees, with the remaining costs being primarily associated with time spent filling out forms, permits, and documentation. Some farms have begun to monitor nitrogen displacement and most anticipate nitrogen management regulations coming soon (McCullough et al. 2016).

The primary federal statutes that mandate water quality in California are the United States Clean Water Act (1972) and Safe Drinking Water Act (1974). The Clean Water Act applies only to surface water and the Safe Drinking Water Act includes both surface and groundwater. The main state law governing water quality in California is the Porter-Cologne Act of 1969, which applies to both surface and groundwater. The State Water Resources Control Board and nine Regional Water Quality Control Boards administer the provisions for water quality regulations. Each regional Water Quality Control Board has the authority to regulate discharges of waste by issuing permits known as Waste Discharge Requirements (WDR). These permits include agricultural inputs, such as fertilizer, pesticides, and sediment discharge into state bodies of water. Growers are required to monitor nonpoint source discharge via an individual WDR, or to participate in a Conditional Waiver Program that charges fees and requires training and voluntary discharge monitoring. Bianchi and Harter (2002) summarize water quality risks from septic waste removal, agriculture, and dairies.

In 2003 the Central Valley Region Water Board created the Irrigated Lands Regulatory Program to address discharge of wastes from irrigated lands to surface water. The program has expanded to include discharges to groundwater. Coalition groups monitor surface water and groundwater at various monitoring points and charge fees to the growers to cover their costs, and the Water Board fees. There are 14 coalition groups, growers join these groups based on the location of their parcels that are required to have regulatory coverage (CA EPA 2016). In addition to monitoring water quality, coalitions provide education and outreach to the growers to inform them about requirements and assist in implementing practices recommended to protect water quality. Therefore, most growers incur the costs of complying with water quality regulations as fees for the coalition group membership ($2–10 per acre) as well as costs of on-farm practices that they may adopt, such as planting cover crops or other practices to reduce run-off.

Waste discharge from crop processing and food manufacturing is also regulated. Land application of effluent occurs when wastewater is applied directly to the land, to irrigate a fodder crop or as groundwater recharge (Paggi et al. 2009, Sexton et al. 2015). Wastewater discharge by food processors is regulated by the State Water Resources Control Board through the regional boards. Concerns over the contribution of food processors to water quality problems in the Central Valley have prompted numerous discussions about more stringent discharge requirements (Rubin et al. 2007, CA EPA 2014). A recent study by the Central Valley Water Quality Control Board found the impact of water quality regulations on the food processors in the Central Valley to be $78 million in direct lost industry output, plus an additional $73 million in indirect and induced output losses (Rubin et al. 2007).

4.5 Air Quality

As shown in Table E.7, air quality regulatory compliance accounts for 50 to 80 percent of total environmental regulatory costs. Senate Bill 700 was signed into law in 2003 and it contained six provisions to establish air quality and regulation requirements in California. The bill established the obligation to reduce fugitive dust emissions as well as particulate matter, commonly referred to as PM10, to improve air quality. California is comprised of 35 air districts with differing air quality compliance requirements. Air pollution is a concern primarily in the San Joaquin Valley region, where emission, dust and particle pollution from farm vehicle operations has been a focus of policy discussion in recent years.

The San Joaquin Valley is one of the two districts in the country classified as an “extreme nonattainment” area for ozone by the Environmental Protection Agency (EPA) and one of nine areas in the country to be classified as “serious nonattainment” for particulate matter. Farm activity has been found to directly emit 21 percent of ozone-forming gases in the San Joaquin

Valley and to account for more than half of direct emissions of particulate (CDFA 2010). Because of these issues, air quality regulations in the San Joaquin Valley region are also strict. Growers are required to file a Conservation Management Plan to limit fugitive dust and PM10 emissions and pay an acreage-based fee (Hamilton 2006). In addition, growers also must obtain an open burning permit, which raises pruning and orchard removal costs.

In the Sacramento Valley, about 30 percent of the air pollution comes from stationary sources including agricultural operations. The remaining 70 percent are from mobile sources, which include on-road and off-road motor vehicles (FRAQMD 2016). The Sacramento Valley is classified as a “moderate nonattainment” area for particular matter, and a “severe nonattainment” area for ozone, especially around the Sacramento metropolitan area. Some of the air quality regulations in the Sacramento Valley are limited to reducing emissions from animal facilities. Additional regulations limit agricultural field fumigations and require special field fumigation emissions permits from growers. Burning permits are required for agricultural burning and may be obtained from agricultural commissioners at a cost.

4.6 Pesticide Regulations

Regulation of pesticide application in California stems from concerns about human health and worker safety and the environment. Registration of pesticides is administered by the Department of Pesticide Regulations (DPR) under the California EPA. In addition to approval by the U.S. EPA, pesticides are subject to an additional review and testing process, which may take several years and cost several million dollars (Ollinger and Fernandez-Cornejo 1998). California DPR also regulates application of pesticides. A Pest Control Adviser (PCA) license is required to make recommendations for commercial pesticide use, and an applicator’s license is required for any application of pesticides for agricultural use. The PCA license and applicator’s license require between 20 and 40 hours of continuing education credits for renewal, the PCA license also requires a bachelor’s degree and requirements of college-level course work in biological sciences, crop health, production systems and pest management methods. A permit is required for each site where pesticides are applied, and each individual pesticide application is registered with the CA DPR by submitting a Pesticide Use Report form.

The EPA Worker Protection Standard (WPS) of 1993 is a federal law that regulates worker safety to reduce the risk of pesticide poisoning and injuries to pesticide handlers and other agricultural workers exposed to pesticides. California DPR includes several regulatory requirements in addition to the WPS. These include more frequent training, more extensive training curriculum, full respiratory protection program equivalent to Cal/OSHA, stricter restricted-entry intervals, larger buffer zones and reduced application rates for soil fumigants, written hazard communication program, mandated outreach and educational activities among workers, and blood testing for pesticide handlers.

4.7 Consumer Health and Safety

The main focus of regulations specific to consumer health and safety is preventing the contamination of food products by foodborne illnesses and harmful chemical residues. Some of the regulations on the use of pesticides also originate with consumer safety in mind, but also fall under environmental regulations, and were therefore summarized in the previous section. This section provides an overview of costs specific to regulations that aim to prevent foodborne illnesses.

4.7.1 Foodborne Illness

The Leafy Greens Products Handler Marketing Agreement (LGMA) was established in 2007 in response to the September 2006 E.coli outbreak in Salinas Valley spinach. A study by Hardesty and Kusunose (2009) found that the cost of LGMA compliance to growers averaged $13.60 per acre. The costs of modifications vary among farms of different size and are summarized below in Table E.8. Larger operations have lower regulatory costs reflecting economies of scale in lettuce production. The same study found that the total food safety compliance costs for lettuce growers average $100 per acre.

Table E.8: Leafy Greens Products Handler Marketing Agreement compliance costs

Farm Revenue Range	Regulatory Cost
	$ per acre
Under $1 million	$14.82
$1 million – $10 million	$18.05
Over $10 million	$8.29
Average	$13.60

Source: Hardesty and Kusunose (2009). Costs are in 2009 dollars.

There is a limited literature that quantifies the crop-specific costs of food safety compliance, and most studies estimate the regional costs of a food safety outbreak. Ribera et al. (2012) estimate that the farm-level losses and marketing losses of food-borne illness outbreaks. Farm gate losses are from sales at the farm and marketing losses are from changes in consumer demand as a result of the outbreak. Table E.9 summarizes the findings of the study.

Table E.9: Economic cost of food illness outbreaks

Farm Revenue Range	Farm cost	Marketing cost
	$ in millions	
Lettuce	12	63
Tomatoes	28	89
Muskmelon	5.8	20.7

Source Ribera et al. (2012). Costs are in 2012 dollars.

The Food Safety Modernization Act (FSMA), passed by Congress in 2010 and signed into law in 2011, requires the adoption of prevention-based controls by food facilities. FSMA requires food facilities to evaluate the hazards in their operation and to implement and monitor effective measures to prevent contamination. FSMA also requires FDA to adopt science-based standards for the safe production and harvesting of fruits and vegetables to minimize the risk of serious illness or death. The annual costs of compliance for domestic farms are estimated to be around $459.6 million (FDA 2013). Efforts to prevent food-borne illness so far have been industry-driven, and even with requirements mandated by FSMA, the food safety standards already voluntarily adopted by most growers will be stricter than FSMA requirements, which may limit the industry compliance costs.

4.7.2 Pesticide Residue

Pesticide residue is both an environmental and food safety concern. The Food Quality Protection Act of 1996 (FQPA) amended previous legislation to focus on new ways to determine and mitigate adverse health effects of pesticides. The most common approach to limit pesticide exposure is to ban certain pesticide application on certain crops. Methyl bromide and organophosphates are two recent examples, in addition to calls for more environmentally friendly integrated pest management (IPM) protocols (Hamilton 2001).

The total costs to the industry from the methyl bromide (MeBr) ban in 2001 were estimated to exceed $25 million for strawberry growers, or about 25 percent of estimated industry returns in that year (Carter et al. 2002). The main economic impacts of the regulation were in the form of foregone profits from sales, from reduced season length ($10.4 million), added labor, machinery, and other costs from longer fumigation periods ($10 million), and added fumigation costs as a result of switching to a new fumigation process and inability to fumigate with methyl bromide in the inner buffer zones ($5.6 million).

Metcalfe et al. (2002) examined the economic cost of banning organophosphates (OP), which affected a number of specialty crops. Their study accounts for alternative pesticides and pest management strategies available to the growers, such as the use of other pesticides, beneficial insects, and adoption of IPM protocols. They estimated an upper and lower bound on the cost of the ban. Table E.10 summarizes the findings of the study.

Table E.10: Per-acre change in cost of organophosphates ban

Crop	Low	High
	$ per acre	
Alfalfa	27	70
Almonds	72	206
Broccoli	65	87
Carrots	0.11	0.69
Cotton	56	56
Grapes	32	163
Lettuce, Head	64	107
Lettuce, Leaf	87	129
Oranges	119	256
Peaches & Nectarines	24	82
Strawberries	141	189
Tomatoes, Fresh	9	44
Tomatoes, Processed	16	16
Walnuts	56	135

Source: Table 5 in Metcalfe et al. (2002). Costs are in 2002 dollars.

4.8 Transportation

Regulatory compliance costs to specialty crop distributors are difficult to identify because most distribution businesses are diversified across crops and industries. Furthermore, distribution is linked to both primary production and processing, so who bears the cost of a new regulation is determined by the relative supply and demand elasticities for these linked industries. That is, a regulation targeted at distributors will be partially (or fully) passed-through to some of their suppliers.

One important regulation which affects distributors in California is the California Global Warming Solutions Act (AB32) of 2006. AB32 mandates reduction of greenhouse gas (GHC) emissions to 1990 levels by 2020. This translates to a reduction of about 15 percent below status quo levels.

Approximately 92 percent of surface transportation for fruit and vegetables in California is by truck. California has more stringent transportation regulations than other states. The California Truck and Bus Regulation, adopted in 2008, requires trucks and buses that operate in California to be upgraded to reduce emissions. As of January 1 2012, trucks are required to have particulate matter filters to meet the new requirements, with replacement of old engines beginning in January of 2015. By 2023 most trucks and buses are required to have 2010 model year engines or equivalent.

Paggi et al. (2012) surveyed agricultural transport companies and found that 45 percent of respondents list the California Air Resources Board (CARB) regulations as a serious regulatory concern, with 21 percent of respondents specifically listing truck and trailer regulations. Preliminary estimates show that, if left unchanged, current CARB regulations would increase the costs of transportation by about 30 percent over the next decade, in real terms, and truck and trailer regulations would increase transport costs by about 19 percent.

5. Primary Survey of Regulatory Costs

Stakeholders in the local specialty crop value chain were surveyed to determine the effects of the regulatory environment including regulatory costs, complexity, duplication, and conflicts. Regulatory surveys were conducted from October 2015 to April 2016 and survey respondents include specialty crop growers, processors, and distributors in the Sacramento Region including El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba Counties.

Qualitatively, survey respondents offered a range of responses when asked about regulatory compliance. Some treat regulations as a fact of life and a cost of doing business similar to any input cost. Others report feeling that agriculture bears an undue regulatory burden and that California's agricultural industry is at a disadvantage compared to farmers, processors, and distributors in other U.S. states and in other countries. Some regulatory areas affect businesses up and down the specialty crop value chain. For example, at least one grower, processor, and distributor note they have hired an employee specifically to manage food safety regulatory issues. When applicable, similarities in responses based on operation size or commodity were identified.

As of April 13, 2016, a total of 31 individuals completed the survey. However, not all respondents completed all parts of the regulatory survey and the total number of complete regulatory cost surveys is 25. The 25 complete responses are included in the summary statistics presented in this section.

5.1 Regulatory Costs

Specialty crop growers, processors, and distributors in the Sacramento Region were asked to identify regulatory areas with the greatest impact on their business based on possible financial, operational, and managerial impacts. Each sector was given a list of potential regulatory areas to reflect relevant regulations for each sector. Each respondent was asked to identify and rank the top four regulatory areas. Other regulatory areas not in the top four were not ranked. Table E.11 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop growers, processors, and distributors (jointly). For example, 41 percent of specialty crop producers, processors, and distributors surveyed reported that food safety was one of their top four regulatory compliance concerns. The following sections describe the response for each of the specialty crop sectors individually.

Table E.11. Proportion of regulatory areas ranked in the top 4 by specialty crop industry

Regulatory Area	Response
Food Safety	41%
Occupational Hazards and Safety	41%
Immigration Reform	36%
Water Allocation	36%
Water Quality	36%
Air Quality	32%
Pesticide Application	32%
Employee Regulations	27%
Health Care	23%
Pesticide Registration	14%
Technology	14%
Transportation	14%
Nutrition Labeling	9%
Waste Disposal	9%
Other (Liability insurance)	5%

5.1.1 Producers

Specialty crop growers were presented with eleven options for regulatory areas (as shown in Appendix C.1) and asked to rank the top four areas of concern based on their possible financial, operational, and managerial impacts. Twelve producers were surveyed.

Table E.12 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop growers. No survey respondents identified land use, waste disposal, or wildlife protection as a top regulatory area. Since growers were only asked to identify and rank the top four areas, this does not mean that regulations in these areas do not affect growers. Rather, it shows that these areas are relatively less important that the others included on the list.

Table E.12: Proportion of regulatory areas ranked in top 4 by specialty crop producers

Regulatory Area	Response
Pesticide Application	100%
Air Quality	57%
Immigration Reform	57%
Occupational Hazards and Safety	57%
Water Allocation	57%
Water Quality	57%
Pesticide Registration	43%
Technology	43%
Food Safety	29%
Other	14%

At least one survey respondent listed the following regulatory areas as the most significant: air quality, immigration reform, occupational hazards and safety, technology, water allocation, other (health care). These top regulatory areas identified by growers reflect the top current concerns in the industry: labor and water. Immigration reform and occupational hazards and safety are key regulations affecting farm labor supply in California. Water availability uncertainty is an ever-present threat to the viability of farming. Although the Sacramento region generally enjoys better water availability than areas in the San Joaquin Valley, growers cited it as a top regulatory concern.

Overall, the most frequently identified regulatory area is pesticide application. Fumigants are specifically mentioned as pesticides with significant regulatory costs for both pesticide application and pesticide registration, and this is of particular concern for nurseries. Among the occupational hazards and safety concerns for specialty crop growers are worker health and heat stress compliance. Sixteen percent of growers' surveyed (two responses) cited occupational hazards and safety compliance, and heat stress compliance in particular, as the number one regulatory area. Other labor issues noted by growers include paid time off costs, piece-rate tracking, and tracking overtime hours, particularly when employees are switching between activities at a vertically integrated operation.

5.1.2 Processors

Specialty crop processors were presented with ten options for regulatory areas (as shown in Appendix C.2) and asked to rank the top four based on their possible financial, operational, and managerial impacts. Nine processors were surveyed.

Several processors ranked fewer than the maximum of four regulatory areas due to lack of significance. Others said the regulatory areas were "all the same" or wrote "none" next to the list of regulatory areas. Table E.13 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop processors.

Table E.13: Proportion of regulatory areas ranked in top 4 by specialty crop processors

Regulatory Area	Response
Employee Regulations	67%
Food Safety	44%
Water Allocation	44%
Immigration and E-verify	33%
Water Quality	33%
Nutrition Labeling	22%
Byproduct Waste Disposal	22%
Health Care	22%
Occupational Hazards and Safety	22%
Air Quality	11%
Other	0%

The most mentioned regulatory area is employee regulations. Two-thirds of respondents note it is among the top regulatory areas. Workers' compensation and tracking piece-work are frequently noted in the surveys. In addition, labor shortages and the need for a legal system for farm workers were also mentioned. Regulations that were identified by processors include food safety, health care, immigration and E-Verify, water allocation, and water quality. All of the survey respondents who marked food safety as an important regulatory area noted the Food Safety Modernization Act as the primary food safety concern. These include smaller processors and processors of relatively low hazard products that have not previously been subject to food safety stipulations from buyers. While food safety is a concern for smaller producers, health care is only reported as a top four regulatory area for larger firms. One large food processor reports hiring part-time and seasonal employees through a temp agency to circumvent requirements under Affordable Care Act. Wineries note that water discharge is a significant cost, and they also deal with storm water discharge permits and high regulatory fees for water quality compliance in their vineyards.

5.1.3 Distributors

Specialty crop distributors were presented with six options for regulatory areas (as shown in Appendix C.3) and asked to rank the top four based on their possible financial, operational, and managerial impacts. Four distributors were surveyed.

Not surprisingly, the most significant regulatory area for distributors was transportation. Among the Transportation costs mentioned are hours of service limitations, diesel exhaust fluid regulations, and U.S. Department of Transportation compliance. Food waste disposal was not reported as a concern for any distributors. Table E.14 summarizes the percent of each regulatory cost category ranked in the top four by all specialty crop distributors.

Table E.14: Proportion of regulatory areas ranked in top 4 by specialty crop distributors

Regulatory Area	Response
Food Safety	75%
Occupational Hazards and Safety	75%
Transportation	75%
Air Quality	50%
Health Care	50%
Other	50%
Immigration and E-verify	25%
Food Waste Disposal	0%

In addition to transportation, 75 percent of distributors surveyed identified food safety and occupational hazards and safety as top regulatory areas. The other regulatory area included several write-in responses. A broadline distributor noted the cost to meet liability insurance requirements for large institutional buyers was burdensome. In addition, a farm product transportation company reported water quality is among its top four regulatory areas because of the costs associated with storm water pollution control.

5.2 Regulatory Complexity

Specialty crop growers, processors, and distributors were additionally asked: "How would you describe the complexity of the regulatory environment?" They were provided four possible responses to the question including very complex, complex, somewhat complex, and not complex. Table E.15 summarizes the percent of survey respondents who responded for each option. Roughly nine in ten survey respondents reported that the regulatory environment is either very complex or complex. No respondents characterized the regulatory environment as not complex.

Table E.15: Degree of complexity of the regulatory environment

Complexity	Response
Very complex	50%
Complex	38%
Somewhat complex	13%
Not complex	0%

There were some interesting differences between producers, processors, and distributors, although with the limited sample size these results should be viewed with caution. Over half of the specialty crop processors stated that the regulatory environment is very complex. Two out of five distributors found the regulatory environment is complex.

Anecdotally, some survey respondents reported that regulations are so complex they are not able to fully comply with them or they are certain they are overlooking a regulatory requirement and will not find out what it is until they are fined. Respondents reported a need to be well-versed in water regulations. One respondent reported that it is challenging to determine appropriate compliance efforts because of inconsistent responses provided by staff at regulatory agencies.

5.3 Regulatory Duplication

To determine the extent of duplication of effort among regulatory agencies, specialty crop growers, processors, and distributors were asked: "Have you found duplication of effort among federal, state, and local regulatory agencies?" They were asked to select from among three available options including: a lot, some, and none. Table E.16 summarizes the results of the survey. Half of survey respondents report they have found some duplication of effort among federal, state, or local regulatory agencies.

Table E.16: Extent of duplication of effort among regulatory agencies

Duplication	Response
A lot	29%
Some	50%
None	21%

Survey respondents were also asked to provide examples of regulatory duplication. One respondent who reported “none” for the regulatory duplication question noted that regulatory agencies have come a long way to streamline and consolidate reporting processes. However, a different survey respondent reported survey duplication, specifically the U.S. Department of Agriculture (USDA) surveying for information that farms have already provided to the County Agricultural Commissioner Office. Another respondent notes the U.S. Environmental Protection Agency (EPA) and the federal Occupational Safety and Health Administration (OSHA) have many redundancies, but did not specify what they are. Other respondents cited redundancy among OSHA and the California Division of Occupational Safety and Health (Cal/OSHA). One respondent lists the agencies with employee protection mandates: OSHA, Equal Employment Opportunity Commission (EEOC), the Office of Federal Contract Compliance Programs (OFCCP), and Department of Fair Employment and Housing (DFEH).

Duplication of efforts in food safety was reported numerous times. Redundancy is specifically reported among the federal Food and Drug Administration (FDA) and California Department of Public Health’s (CDPH) Food and Drug Branch (FDB). For air quality, duplication of effort between the California Air Resources Board (CARB) and local air quality management district’s (AQMDs) was reported. A nonspecific report of duplication related to nutrition labeling was also reported. Water was repeatedly named as a regulatory area with duplication of effort, though the only specific regulation mentioned is U.S. EPA’s recent Waters of the United States (WOTUS) rule.

5.4 Regulatory Conflicts

Specialty crop farmers were also asked about conflicts in policy goals among regulatory agencies. They were asked to answer Yes or No to the question: “Have you found conflicts in policy goals among federal, state, and local agencies?” The response is mixed, with just under half of respondents stating they have found conflicts in policy goals among federal, state, and local agencies and just over half stating they have not.

6. Summary

The costs of regulatory compliance are a significant burden to agricultural producers in California, but many of these regulations also provide an economic benefit. This study has reviewed the available literature to establish a range of regulatory costs to producers, processors, and distributors. This study has also summarized the results of a survey of 25 specialty crop producers, processors, and distributors. The Sacramento Valley is the focus of the study, but many analyses use data from the San Joaquin Valley. It follows that the estimates presented here apply to a much broader area. There were three main findings from this literature survey: (i) quantifying the cost of individual regulations for specific crops is complex and difficult, (ii) limited research on processor and distributor regulatory costs exists, and (iii) specialty crop businesses find the regulatory environment to be complex with overlapping management agencies and goals.

It is difficult to quantify regulatory costs because detailed and proprietary financial data are required to estimate the additional cost imposed by a regulation. For example, without detailed accounting it is difficult, if not impossible, to estimate the cost of management time required to fill out forms, learn about new regulations, and participate in informational meetings. The economic analyses reviewed in this study provide a careful analysis of the direct and indirect costs of regulatory compliance.

There is very limited research on regulatory compliance costs to processors and distributors. This is, in part, the result of some of these costs being passed-through to the producers. Processors and distributors are typically diversified operations and it is difficult to identify the cost of one specific regulation. Another finding in the literature is the importance of regulatory uncertainty. Regulatory uncertainty is described qualitatively, but not quantified.

The duplication of efforts by the controlling agencies and the lack of a centralized information source for regulatory compliance create significant indirect costs for agricultural producers. In addition, some of the direct regulatory costs, especially those related to labor laws and water and air quality, are much higher than in other states, and have caused some labor-intensive facilities such as dairies to consider relocation elsewhere. Many of the studies reviewed in this report focused on state regulatory issues, and less has been done to evaluate the impact of federal and local regulatory bodies, which also have significant regulatory power. Many of these policies overlap which creates confusion and increases regulatory costs to the businesses.

Future work could consider:

- Completing a “meta-analysis” of the literature survey results. This could involve a benefits transfer-type approach where San Joaquin Valley regulatory costs are adjusted to fit conditions in the Sacramento Valley.
- A primary analysis of the cost of regulatory uncertainly. This is an intuitive and widely-cited cost to business, particularly processors and distributors, which is not quantified in the current literature.
- Further work on the differences in costs of regulatory compliance among farms by size would show how the changing regulatory environment would affect the regional economy.

  - Most of the studies summarized consider average costs of production. However, regulatory costs are unequally distributed among facilities of different sizes. Smaller operations are likely to spend a larger share of their operating income on regulatory compliance, although not necessarily for all areas of regulation.
- An extended analysis that includes a survey of pending and future regulations that are likely to affect specialty crops in the Sacramento Valley.

7. References

Armenta, F., et al. (2005), Plaintiffs and Respondents, v. OSMOSE, INC., Defendant and Appellant, Court of Appeal, Second District, Division 6, California.

Bianchi, M. and T. Harter. (2012), Nonpoint Sources of Pollution in Irrigated Agriculture, University of California Division of Agricultural and Natural Resources Publication 8055, Available at: http://groundwater.ucdavis.edu/files/136268.pdf.

California Department of Pesticide Regulation, (CA DPR). (2012), Reduced Volatile Organic Compound Emissions Field Fumigation Methods, Available at: http://www.cdpr.ca.gov/docs/legbills/rulepkgs/12-001/text_final.pdf.

California Enviromental Protection Agency, (CA EPA). (2014), Central Valley Regional Water Quality Control Board, Establishment of a Central Valley Salt and Nitrite Management Plan. Public Workshop and CEQA Scoping Meeting Information Document, Available at: http://www.waterboards.ca.gov/centralvalley/water_issues/salinity/salt_management_efforts/cvsalts_2013aug28_ceqa_staffrpt.pdf.

California Enviromental Protection Agency, (CA EPA). (2016), Irrigated Lands Regulatory Program—Apply to Join a Coalition Group, Available at: http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/app_approval/#srw.

California Department of Food and Agriculture, (CDFA). (2010), Air Quality and Agriculture, Available at: https://www.cdfa.ca.gov/agvision/docs/Air_Quality_and_Agriculture.pdf.

Carter, C., J. Chalfant, and R. Goodhue. (2002), Economic Analysis of the January 2001 California Department of Pesticide Regulation Regulations on Strawberry Field Fumigation, Report prepared for the California Department of Food and Agriculture, Available at: https://arefiles.ucdavis.edu/uploads/filer_public/2014/03/20/cdfajuly22.pdf.

Carter, H., R. Coppock, M. Kreith, I. Rodriquez, and S. Smith. (1996), Voices of California Farmers: Effects of Regulations, Davis, CA, UC Agricultural Issues Center.

Feather River Air Quality Management District, (FRAQMD). (2016), Feather River Air Quality Management District. State and National Area Designations. Available at: http://www.fraqmd.org/Area%20Designations%20-%20Info.htm.

Gonzales v. Dountown LA Motors, LP. (2013), California 2nd District Court of Appeal.

Hamilton, L. (2001), IPM in the Salad Bowl: Is It Cost-Effective? Selected Paper, American Agricultural Economics Association Annual Meeting. August 5–8, Chicago, IL., Available at: http://ageconsearch.umn.edu/bitstream/20621/1/sp01ha05.pdf

Hamilton, L. (2006), Comparing California's Cost of Regulation to Other States: A Case Study Approach for Agriculture, Final Report, CISSC Project Number 49958, California Institute for the Study of Specialty Crops, Available at: http://ageconsearch.umn.edu/bitstream/121622/2/016HamiltonRegulatoryGrant120206.pdf.

Hardesty, S. and Y. Kusunose. (2009), Growers' Compliance Costs for the Leafy Greens Marketing Agreement and Other Food Safety Programs, University of California Small Farm Program Research Brief, UC Davis, Available at: http://sfp.ucdavis.edu/files/143911.pdf.

Howitt, R., D. MacEwan, and J. Medellin-Azuara. (2011), Drought, Jobs, and Controversy: Revisiting 2009, Agricultural and Resource Economics Update 14(6), Available from: http://giannini.ucop.edu/media/are-update/files/articles/V14N6_1.pdf.

Hurley, S. (2005), A Synopsis of the Regulatory Environment Affecting California Specialty Crops, Report prepared for the California Institute for the Study of Specialty Crops, Available at: http://digitalcommons.calpoly.edu/agb_fac/58.

Hurley, S. and J. Noel. (2006), An Estimation of the Regulatory Cost on California Agricultural Producers, Selected Paper presented at the American Agricultural Economics Association Annual Meeting, July 23–26, 2006, Long Beach, California, Available at: http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1045&context=agb_fac.

Hurley, S. and J. Noel. (2006), A Regional and Industry Analysis of the Regulatory Environment Affecting Agricultural Producers in California, Selected Paper presented at the American Agricultural Economics Association Annual Meeting, July 23–26, 2006, Long Beach, California, Available at http://digitalcommons.calpoly.edu/agb_fac/46/.

Hurley, S., R. Thompson, C. Dicus, L. Berger, and J. Noel. (2006), Analysis of the Regulatory Effects of California Specialty Crops: An Examination of Various Issues Impacting Selected Forest Products, Tree Fruit, Nut, and Vegetable Crop Industries, Report prepared for the California Institute for the Study of Specialty Crops, Available at: http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1046&context=agb_fac.

Johnston, W. and A. McCalla. (2004), Whither California Agriculture: Up, Down, or Out? Some Thoughts about the Future. Giannini Foundation of Agricultural Economics, Special Report, Available at: http://escholarship.org/uc/item/4232w2sr.

McCullough, M., J. Noel, L. Hamilton, R. Howitt, and D. MacEwan. (2016), Economic Impacts of Off-Road Mobile Agricultural Equipment Emission Reduction Strategies on the Agricultural Sector in the San Joaquin Valley. Draft Report, Prepared for the California Air Resources Board, 30pp.

Metcalfe, M., B. Williams, B. Hueth, B. Van Steenwyk, D. Sunding, A. Swoboda, and D. Zilberman. (2002), The Economic Importance of Organophosphates in California Agriculture, Available at: https://www.cdfa.ca.gov/files/pdf/organophosphatescaagriculture.pdf.

Michael Cardenas, et al., Plaintiff(s), v. McLane Foodservices, Inc., et al., Defendant(s). (2011), United States District Court, C.D., California, 796 F.Supp.2d 1246.

Noel, J., M. Paggi, and F. Yamazaki. (2013), The Impact of California Regulatory Compliance Costs on California Orange Producer Profitability, Earlier version of the report is available at: http://globalag.net/wordpress/wp-content/uploads/2012/12/Regulatory-Study-Oranges.pdf.

Noel, J. and M. Paggi. (2012), Regulatory Compliance Cost Analysis Case Studies of California and Arizona Iceberg Lettuce Production and California and Florida Strawberry Production, Center for Agricultural Business, unpublished report.

Ollinger, M. and J. Fernandez-Cornejo. (1998), Sunk Costs and Regulation in the U.S. Pesticide Industry, International Journal of Industrial Organization, 16: 139-68.

Paggi, M., J. Noel, and F. Yamazaki. (2009), Regulatory Compliance Costs and California, Specialty Crop Producers Profitability. Report presented at the Western Agricultural Economics Association Annual Meeting, Available at: http://www.fresnostate.edu/jcast/cab/documents/Regulatory%20Compliance%20Costs.pdf.

Paggi, M., J. Noel, F. Yamazaki, S. Hurley, and M. McCullough. (2012), An Analysis of California Agricultural Transportation: Origins, Destinations, Modal Competition and Industry Perspectives, Selected Fresh Fruits and Vegetables, Available at: https://www.fresnostate.edu/jcast/cab/documents/1An%20Analysis%20of%20California%20Agricultural%20Transportation.pdf.

Paggi, M., F. Yamazaki, L. Ribera, R. Knutson, J. Anciso, M. Palma, and J. Noel. (2010), Comparative Producer Costs of GAP and GHP Standards: Can the Playing Field Be Made Level? Presented at the 115th Joint EAAE/AAEA Seminar, September 15–17, Freising, Germany, Available at: http://ageconsearch.umn.edu/bitstream/116406/2/3C-1_Paggi_etal.pdf.

Resnick, J. and P. Moody. (2014), Western Growers University Piece-Rate Compliance Workshop, Available at: https://www.wga.com/sites/wga.com/files/resource/files/WG%20Piece%20Rate%20Compliance%20Workshop.pdf

Ribera, L., M. Palma, M. Paggi, R. Knutson, J. Masabni, and J. Anciso. (2012), Economic Analysis of Food Safety Compliance Costs and Foodborne Illness Outbreaks in the United States, HortTechnology 22 (2): 150–56.

Rubin, Y., D. Sunding, and M. Berkman. (2007), Hilmar Supplemental Environmental Project, Report submitted to the California Regional Water Quality Control Board Central Valley Region, Volume I, Available at: http://www.ce.berkeley.edu/sites/default/files/assets/users/rubin/HilmarSEP_Vol_I.pdf.

Sexton, R., J. Medellin-Azuara, and T. Saitone. (2015), The Economic Impact of Food and Beverage Processing in California and Its Cities and Counties, Report prepared for the California League of Food Processors, Available at: http://clfp.com/documents/economic_impact_report/CLFP_FINAL_Report_1_29_15.pdf.

Sunding, David, N. Ajami, S. Hatchett, D. Mitchell, and D. Zilberman. (2009), Economic Impacts of Reduced Delta Exports Resulting from the Wanger Interim Order for Delta Smelt, Working Paper, Department of Agricultural and Resource Economics, UC Berkeley, Available from: http://ageconsearch.umn.edu/bitstream/51558/2/CUDARE%201083%20Sunding.pdf.

Teran, S. (2013), California Illness Prevention Campaign. Final Performance and Evaluation Report, Submitted to the California Department of Industrial Relations, Available at: https://www.dir.ca.gov/dosh/HeatIllnessCampaign/Heat–Illness-Campaign.Evaluation–Report.Summer–2012.pdf.

United States Food and Drug Administration, (FDA). (2013), Food Safety Modernization Act Facts, Available at: http://www.fda.gov/downloads/Food/GuidanceRegulation/FSMA/UCM359258.pdf.

Appendix F. Communication of Outcomes in Regional Economic Impact Studies

1. Introduction

Studies of regional economic impacts examine the effects of a program, regulation, or other event on the level of economic activity in a given area. It is important to identify the best ways to present the typical outcomes of such studies to facilitate the understanding of key findings by government, industry, or other participants, and to promote adoption of main recommendations. The ERA team examined studies of regional economic impact with a particular emphasis on studies that use the IMPLAN model.

2. Communicating Outcomes from Economic Impact Studies

The IMPLAN model is to estimate regional economic impacts by government agencies, trade groups, private industry, and academic researchers. The primary outputs of the IMPLAN model are multipliers that measure the amount of total economic activity that results from an industry spending an additional dollar in the local economy. The multipliers show the direct, indirect, and induced impacts from a one-dollar increase in direct output by the corresponding sector. The economic interpretation of the multipliers is not necessarily intuitive to an audience who is not familiar with economic input-output analysis. A useful impact report must present the results in way that highlights the key findings and allows the audience to absorb the main takeaway message, especially if the purpose of the analysis is to motivate a specific action or highlight areas of special consideration for local government bodies. At the same time, reports should also include the level of detail that may be useful to a technical user for further modeling and analysis.

Economic studies that use the IMPLAN model range from analysis concerned with economic impact of a single industry in a specific region (for example, MFK Research LLC 2005 reviews the wine industry in Napa County), to complex custom models of multiple industry sectors and regional economies (for example, Hackett et al. 2009, Sexton et al. 2015, Howitt et al. 2015). Two examples highlight the difficult task of synthesizing complex information for a broad audience.

The first example is a study of the impact of commercial anglers in California. This study used survey data on operating costs to develop an input-output economic model of California commercial fishing operations (California Ocean Fish Harvester Economic model, or COFHE) (Hackett et al. 2009). The analysis was funded by the California Department of Fish and Game. While the model and the results are very detailed and potentially useful, there is very little big-picture analysis, no executive summary, and no graphical presentation of the outcomes, which makes it difficult to establish the main conclusions of the report or to understand the structure of the commercial fishery industry and its connection to the state economy. A typical output table from this report is presented in Example F.1. The report is rich in data, but the results are difficult for non-technical readers to interpret.

Example F.1: Summary Output Table

Table 5. Total Annual Costs by CA Coastal Region and Operational Configuration (in 2006 $)*

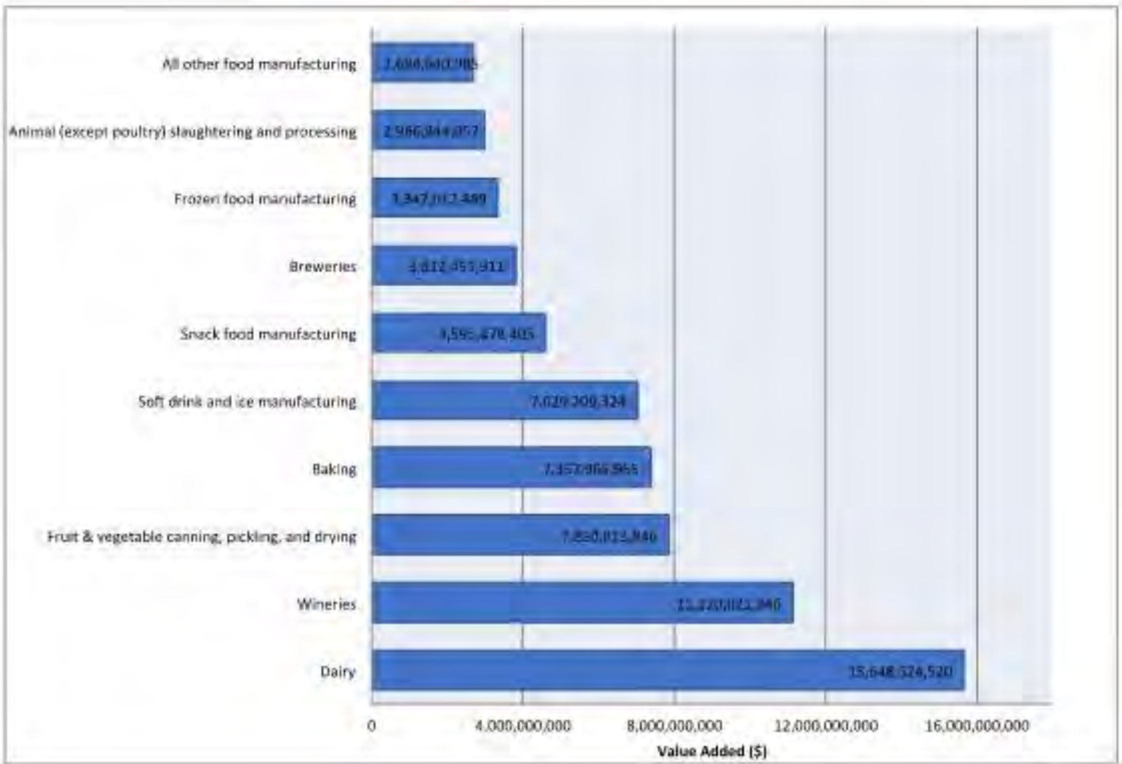
Northern California

OC	Fixed Costs	Variable Costs	Total Costs
Dungeness Crab - Medium and Large Vessels	5,798,289	5,590,307	11,388,596
Trawl - Northern	701,997	2,087,711	2,789,708
Salmon & Dungeness Crab - Medium and Large Vessels	1,236,866	855,733	2,092,599
Salmon	648,720	356,049	1,004,770
Nearshore & Groundfish Trap	466,918	371,906	838,824
Dungeness Crab - Small Vessels	164,043	512,210	676,253
Longline	345,868	181,424	527,293
Sea Urchin	300,923	202,887	503,811
Hook & Line Live	295,453	198,612	494,064
Hook & Line	208,089	169,596	377,685
Salmon & Albacore	145,021	94,886	239,907
Prawn Trap	79,819	36,372	116,191
All Other	47,938	67,028	114,966
Total	**10,439,945**	**10,724,723**	**21,164,668**

Source: Table 5 in Hackett et al. 2009.

A better example can be found in a report prepared for the California League of Food Processors on the economic impact of food and beverage processing in California (Sexton et al. 2015). Like the commercial angler analysis, this study presents estimates of the multiplier impacts generated by the food and beverage processing industry in California. The outputs of the analysis are presented in a tabular format similar to Example F.1. However, before each summary table the authors provide intuitive graphics that summarize the key results. Figures are used to highlight the important results and tables provide additional details, making it easier for technical and non-technical readers to digest the results of the analysis. Example F.2 illustrates an example summary figure from the report.

Example F.2: Summary Output by Sector



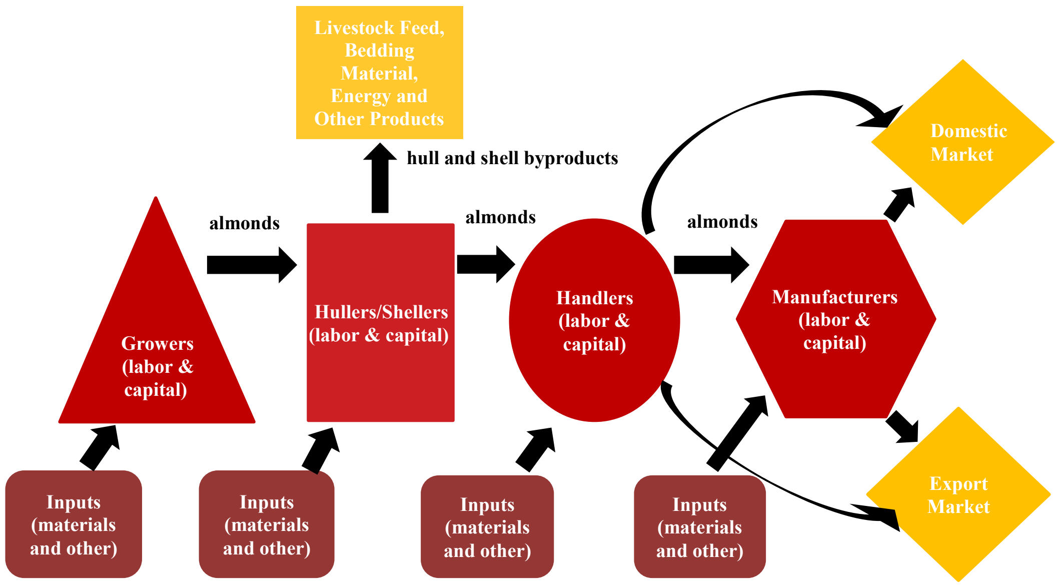
Source: Figure 2 from Sexton et al. 2015.

2.1 Example Approaches to Presenting Economic Impact Study Results

It is useful for the reader if the economic impact analysis presents figures that characterize the flow of inputs and outputs in the industry(ies) being studied. This helps readers that are unfamiliar with the industry visualize the economic web, and at the same time, sets the stage for summarizing the economic impact results. Example F.3 illustrates an example from a recent report prepared for the California Almond Board. Almond production and post-harvest handling is a complicated process with many linked businesses and industries. The flow chart is a simple yet useful display of the industry linkages.

Example F.3: Industry Flow Chart

Figure 1.1: Flow of almonds and other inputs through the production and marketing chain



Source: Figure 1.1 from Sumner et al. 2015.

Example F.4 illustrates a flowchart from another study of California agriculture focusing on the economic impact of drought. Instead of a complicated industry representation, the authors use a flow chart to convey the complex modeling framework used for the analysis. Again, this visual representation adds another way for the reader to understand the process used to generate the output estimates. The font, shapes, and colors shown in Examples F.3 and F.3 could arguably be improved, but they clearly convey the key components of the analysis.

Example F.4: Input-Output Modeling Flow Chart

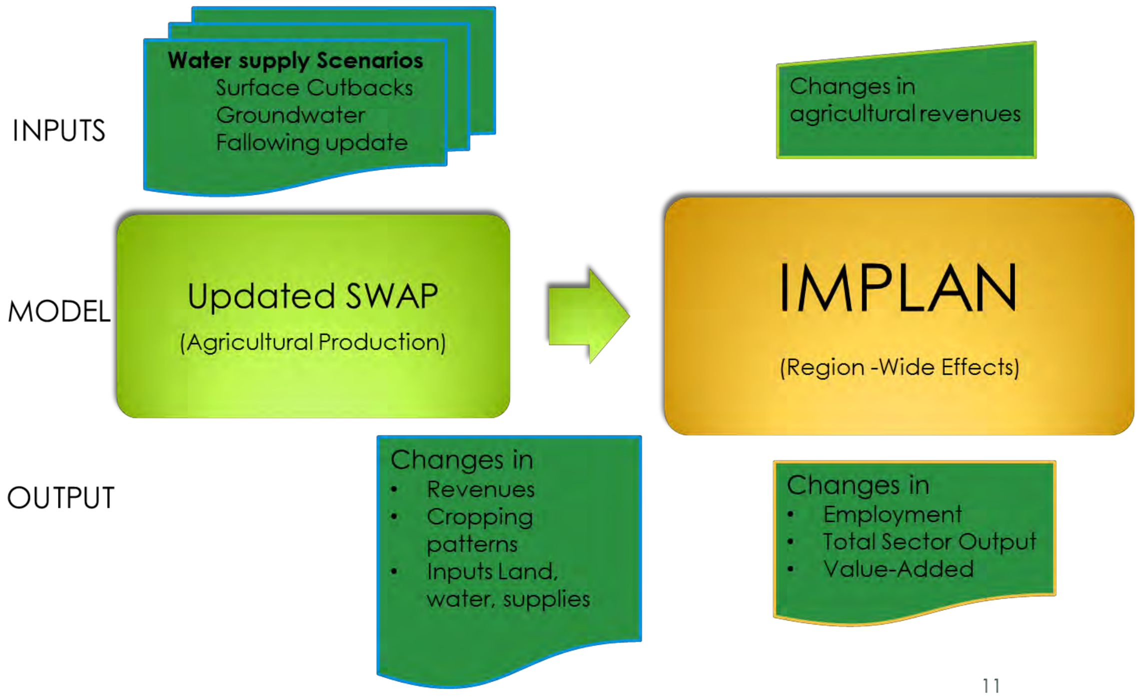


Figure A-2. Interaction of SWAP and IMPLAN modeling with inputs and results

Source: Figure A-2 from Howitt et al. 2014.

Using a flowchart to illustrate the industry linkage and modeling framework is a useful first-step in a summary report. The next, and more important, task is to convey the results of the analysis. Impacts are typically reported in terms of jobs, tax revenues, output value, and value added. As discussed previously, a table is the most common method for summarizing economic impact analyses, but tables are difficult to interpret. Example F.5 illustrated another impact summary table from a report on the economic impact of the wine industry. This table is clearly formatted and easy to read but the reader may be overwhelmed with the range of impacts presented in a single table.

Example F.5: Economic Impacts Table

THE IMPACT OF WINE, GRAPES AND GRAPE PRODUCTS ON THE AMERICAN ECONOMY 2007

HIGHLIGHTS

FULL ECONOMIC IMPACT OF US WINE, GRAPES AND GRAPE PRODUCTS ON THE AMERICAN ECONOMY

$ 162 Billion[1]

	ECONOMIC IMPACT
Full-time Equivalent Jobs	1.1 million
Wages Paid	$ 33 billion
Number of US Wineries[2]	4929
Number of Grape Growers	23,856
Grape Bearing Acres	934,750
US Winery FOB Revenue	$ 11.4 billion
Retail and Restaurant Share of Revenue from Sales of US Wine	$9.8 billion
Distributor Share of Revenue from Sales of US Wine	$2.7 billion
Grape Sales	$3.5 billion
Retail Value of Table Grape Sales	$3 billion
Retail Value of Raisin Sales	$560 million
Retail Value of Grape Juice and Juice Product Sales	$2.8 billion
Number of Wine-Related Tourist Visits	27.3 million
Estimated Wine-Related Tourism Expenditures	$3 billion
Federal Taxes Paid	$9.1 billion
State and Local Taxes Paid[3]	$8 billion

Source: MKF Research LLC. 2007.

Another way to summarize the results of an economic impact analysis is to show the economic multipliers. The reader can quickly review the direct, indirect, and induced effects. On the other hand, these tables are also difficult to interpret for non-technical readers. Thus, as discussed in the following section, figures are useful ways to supplement the information in the tables. Examples F.6 and F.7 illustrate multiplier tables from the economic impact analysis of the California almond industry.

Example F.6: Industry Economic Impact Multipliers

Table 1.1: California Statewide Almond Impact Multipliers

Multiplier	*Growing*	*Hulling Shelling*	*Handling*	*Manufacturing*
Value of Output	*$ of output for economy per $1.00 output by Almond sector*			
Direct Effect	1.00	1.00	1.00	1.00
Indirect Effect	0.37	0.48	1.12	1.38
Induced Effect	0.50	0.47	0.53	0.33
Total Effect	1.87	1.95	2.65	2.71
Value Added	*GDP($) per $1.00 of output*			
Direct Effect	0.52	0.60	0.17	0.10
Indirect Effect	0.21	0.31	0.68	0.43
Induced Effect	0.32	0.30	0.34	0.21
Total Effect	1.04	1.20	1.19	0.73
Employment	*Jobs per $1 million of output*			
Direct Effect	2.86	5.96	0.67	1.12
Indirect Effect	3.23	2.94	7.89	4.18
Induced Effect	3.23	3.02	3.44	2.11
Total Effect	9.31	11.91	12.00	7.42

Source: Input-output multipliers were generated in IMPLAN using revenue and costs information provided by industry sources.

Source: Table 1.1 from Sumner et al. 2015.

Example F.7: Industry Grower Impact Values

Table 1.2: Statewide Economic Impacts of California Almond Growers, 2012-2014[1,2]

	2012	**2013**	**2014**
		$1,000,000	
Value of Grower Output			
Direct Effect	$4,863	$5,828	$7,315
Indirect Effect	$1,809	$2,167	$2,720
Induced Effect	$2,434	$2,917	$3,662
Total Effect	$9,106	$10,913	$13,697
Value Added			
Direct Effect	$2,515	$3,014	$3,782
Indirect Effect	$1,011	$1,211	$1,520
Induced Effect	$1,533	$1,837	$2,305
Total Effect	$5,058	$6,061	$7,608
Employment		Number of jobs	
Direct Effect	13,893	16,649	20,897
Indirect Effect	15,692	18,806	23,603
Induced Effect	15,704	18,819	23,620
Total Effect	45,289	54,274	68,120

Source: Values were estimated by UC AIC staff by applying input-output multipliers generated in IMPLAN and using revenue and costs information provided by industry sources.
[1]Each year reported reflects the almond crop year and not calendar year.
[2]Values for 2014 crop year are estimated based off of crop volume and value projections provided by industry sources.

Source: Table 1.2 from Sumner et al. 2015.

3. Visualizing the Results of Economic Impact Analyses

Flowcharts and tables are essential for describing the results of an economic impact analysis, but they are difficult for the non-technical reader to interpret. Using graphics in combination with the main set of results presented in tabular form can make it much easier to understand the key findings of the analysis. One or to visually appealing graphics in the executive summary of an economic impact report can greatly improve readability, and in turn, allow the report to reach a much broader audience.

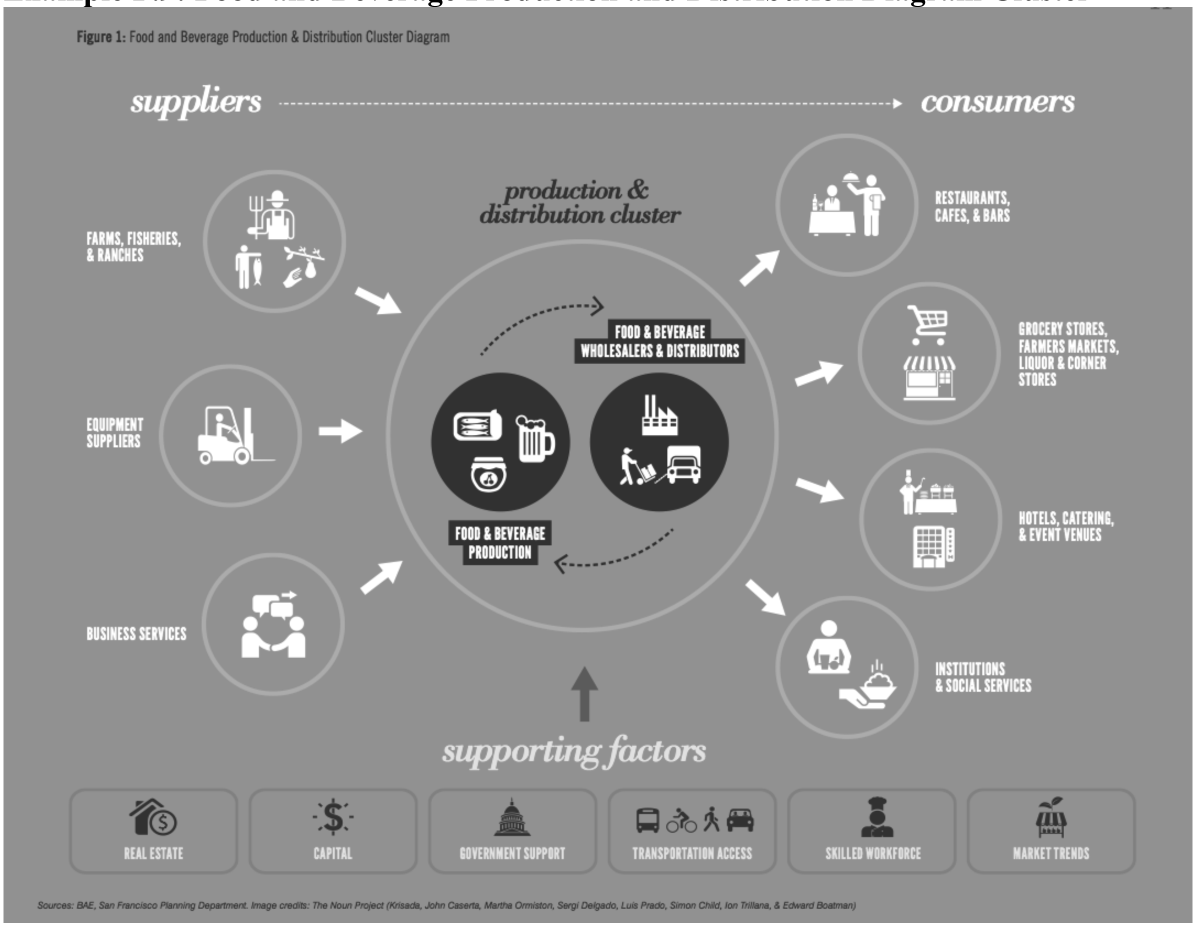
Example F.8 illustrates a figure that is part flowchart and part impact summary. It shows the inputs and outputs for the San Francisco food system. The reader can quickly see that the system includes production and distribution sectors, and the number of employees/businesses in each sector.

Example F.8: Economic Impacts of the Food and Beverage Sector in San Francisco

Source: San Francisco Planning Department. 2014.

Example F.9 illustrates another figure from the San Francisco food and beverage study. This example does not include any impact numbers and instead focuses on illustrating the flowchart of the industry. Examples F.8 and F.9 combined paint a clear picture of the San Francisco food system.

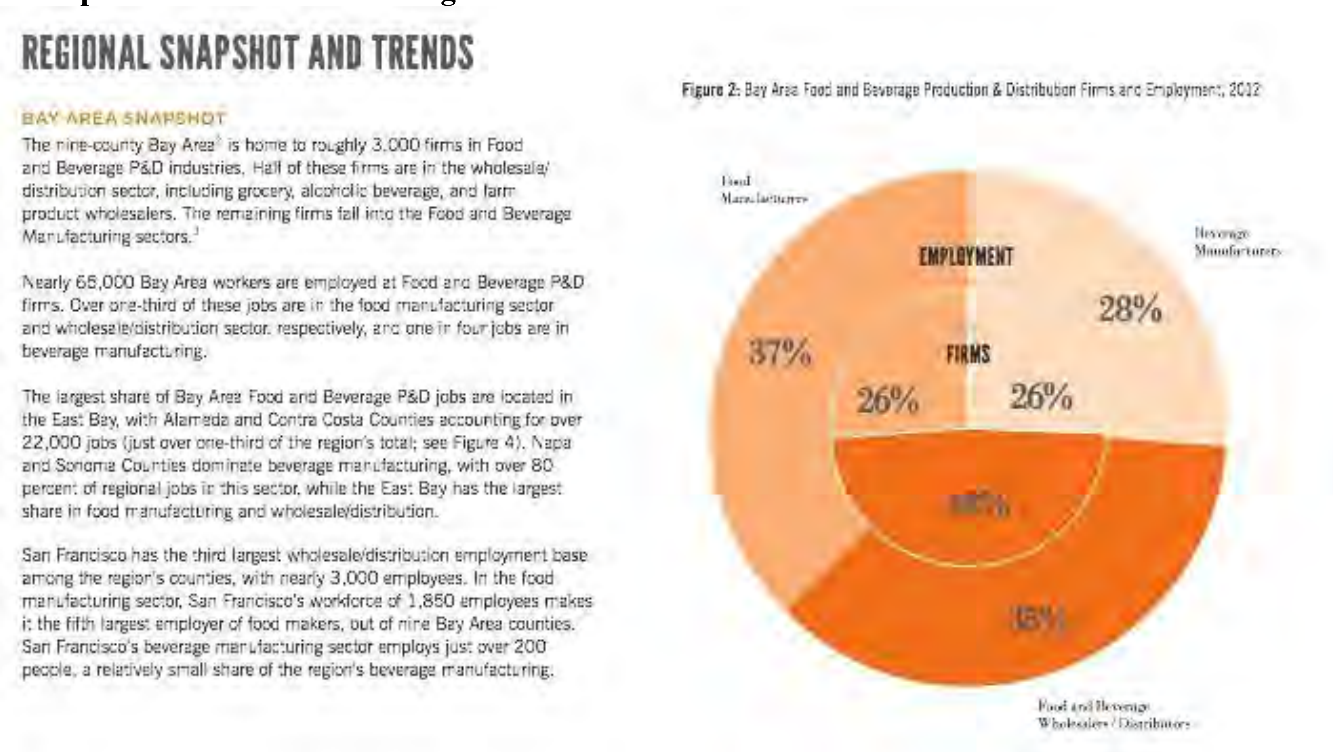
Example F.9: Food and Beverage Production and Distribution Diagram Cluster



Source: Figure 1 from San Francisco Planning Department. 2014.

Finally, Example F.10 illustrates another figure from the same San Francisco study that includes an economic impact summary positioned alongside explanatory text. The pie chart on the right allows the reader to quickly visualize the distribution of employment and firms among different sectors of the food system, and the text on the right provides an interesting narrative. This presentation allows the reader to quickly view information in the pie chart, and if they are interested, they can read the text on the left to get more details. A combination of graphics and short paragraphs is a useful way to summarize the components of a specific industry impact and provide interesting background information that might not fit in a figure.

Example F.10: Food and Beverage Production and Distribution



REGIONAL SNAPSHOT AND TRENDS

BAY AREA SNAPSHOT

The nine-county Bay Area[2] is home to roughly 3,000 firms in Food and Beverage P&D industries. Half of these firms are in the wholesale/distribution sector, including grocery, alcoholic beverage, and farm product wholesalers. The remaining firms fall into the Food and Beverage Manufacturing sectors.[3]

Nearly 66,000 Bay Area workers are employed at Food and Beverage P&D firms. Over one-third of these jobs are in the food manufacturing sector and wholesale/distribution sector, respectively, and one in four jobs are in beverage manufacturing.

The largest share of Bay Area Food and Beverage P&D jobs are located in the East Bay, with Alameda and Contra Costa Counties accounting for over 22,000 jobs (just over one-third of the region's total; see Figure 4). Napa and Sonoma Counties dominate beverage manufacturing, with over 80 percent of regional jobs in this sector, while the East Bay has the largest share in food manufacturing and wholesale/distribution.

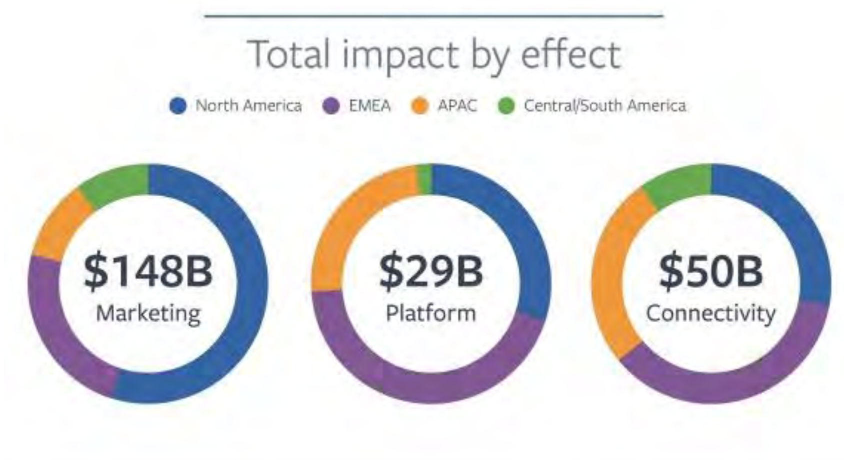
San Francisco has the third largest wholesale/distribution employment base among the region's counties, with nearly 3,000 employees. In the food manufacturing sector, San Francisco's workforce of 1,850 employees makes it the fifth largest employer of food makers, out of nine Bay Area counties. San Francisco's beverage manufacturing sector employs just over 200 people, a relatively small share of the region's beverage manufacturing.

Figure 2: Bay Area Food and Beverage Production & Distribution Firms and Employment, 2012

Source: Figure 2 from San Francisco Planning Department. 2014.

Another approach is to use very simple charts with key results. Example F.11 shows a figure from an analysis of the economic impact of Facebook. In this approach, the authors use a simple graphic with bright colors to illustrate the total economic impact by region and sector. Details found in the multiplier tables are suppressed in favor of presenting only the total impact. This approach may be preferable if the intended audience does not need to see the technical details.

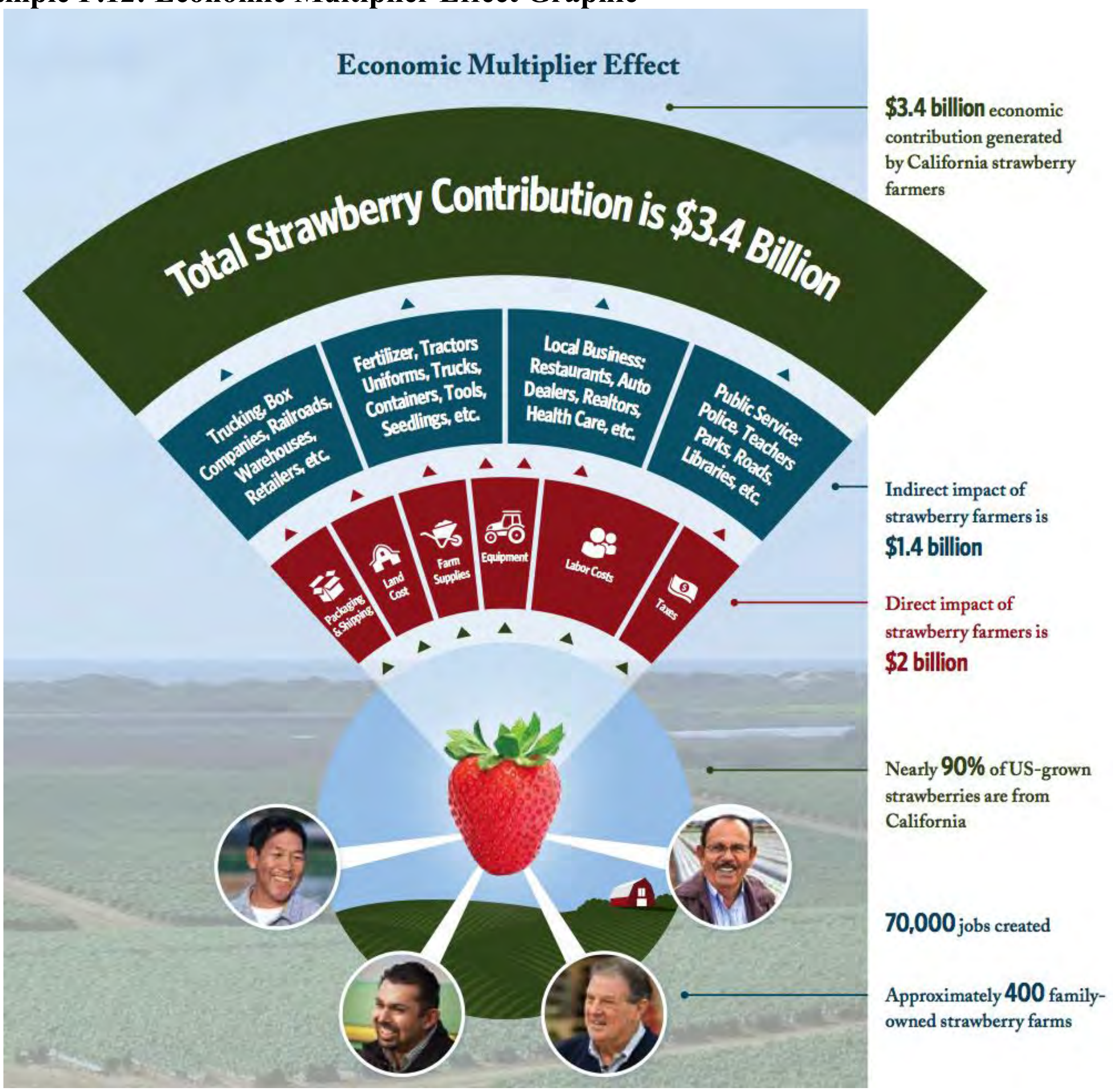
Example F.11: Disaggregated Economic Impact for Facebook



Source: Deloitte. 2015.

In addition to figures, flowcharts, and tables, there are a number of visually appealing graphics used in economic impact reports which combine various technical and non-technical results of the analysis. For instance, Example F.12 illustrates how an economic multiplier can be presented graphically from a study of the contribution of the California strawberry industry. The graphic shows the components of each sector (horizontally) and the components of the multiplier (vertically) used to generate the total economic impact.

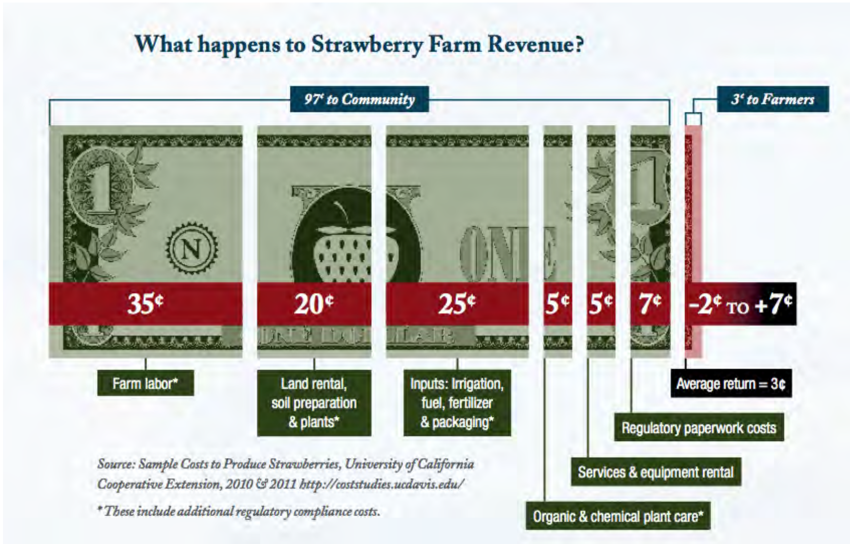
Example F.12: Economic Multiplier Effect Graphic



Source: California Strawberry Commission. 2014.

Example F.13 illustrates a revenue breakdown from the same study which illustrates how money lows within the strawberry industry. This is a useful way to illustrate input expenditures within a given sector of the economy.

Example F.13: Revenue Breakdown

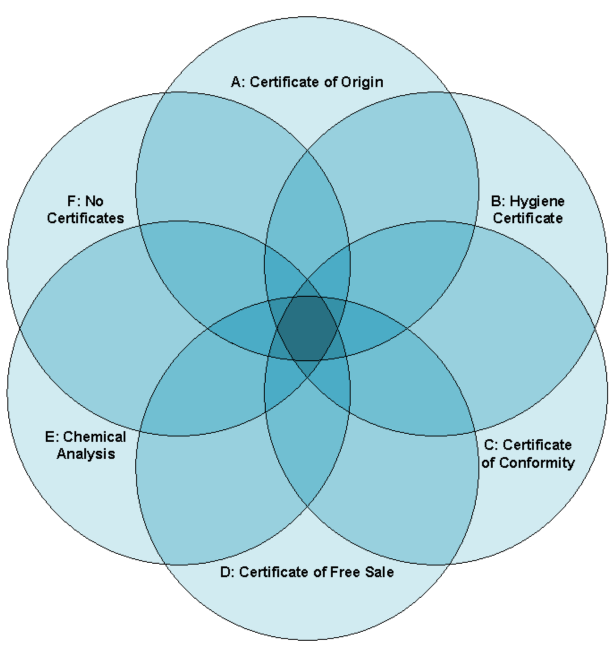


Source: California Strawberry Commission. 2014.

Another component of the study conducted by the ERA team on behalf of SACOG was to survey growers on the cost of regulatory compliance. The key finding of the study is that the California regulatory environment is complex, costly, and often redundant. Example F.14 illustrates one way to use quasi-Venn Diagrams to depict the wine certification regulations in the Asia-Pacific Economic Cooperation (APEC) regulatory forum. It is an example of how overlapping regulatory jurisdictions can be illustrated for specialty crop producers in California.

Example F.14: Overlapping Regulatory Jurisdictions

Diagram of the Certification Requirements in APEC



Australia: F

Brunei: No importation of alcohol beverages

Canada: A (The individual provinces require business and/or agent registration paperwork)

Chile: E (Only for bulk shipments (density, alcohol content, TA, VA, RS, total dry extract, sulfites, chlorides))

China: A

Chinese Taipei: A (Not required, but encouraged (sulfur dioxide, methanol, lead))

Hong Kong: B (not required, but encouraged), F

Indonesia: C, D, E (Either Certificate of Conformity or Certificate of Free Sale, but not both)

Japan: B, E

Malaysia: A

Mexico: A, B, D, and sometimes E

New Zealand: F

Papua New Guinea: F

Peru: A, D, E

Philippines: B, D, E

Republic of Korea: F

Russia: A (not required, but recommended), B, C, D and E (Required to get Certification of State Registration; Hygiene Certificate replaced by Certification of State Registration; Certificate of Conformity replaced by Declaration of Conformity)

Singapore: A, B, E, F (Not required, but encouraged))

Thailand: A

USA: C, E (None required for EU and WWTG grape wines)

Vietnam: E

Source: Asian Pacific Economic Corporation (APEC) Sub Committee on Standards and Conformance, APEC Committee on Trade and Investment. 2011.

4. Summary

The purpose of the analysis and the intended audience will dictate the format of the final report. A literature survey of recent economic impact studies finds that there are several common approaches to providing clear and concise results. In particular, conveying the results of an impact study requires judicious use of flowcharts, tables, figures, and graphics. Using graphics to provide an overview of the industry and to map out the analysis is great for setting the scene for the analysis. Similarly, using a figure to summarize the key findings can help the reader better grasp the outcomes and to focus on key points of interest. Providing additional details in text and tables can add to the depth of the report without confusing the key messages.

5. References

Asian Pacific Economic Corporation (APEC) Sub Committee on Standards and Conformance, APEC Committee on Trade and Investment. (2011), APEC Wine Regulatory Forum Report.

Applied Development Economics, FoodPro International, Inc., DH Consulting, Hatamiya Group. (2013), Regional Agricultural Infrastructure Project Initial Cost Estimate Analysis: Sacramento Valley Food Hub, SACOG.

Applied Development Economics, Inc. in partnership with Foodpro International, Inc., Hatamiya Group, DH Consulting. (2014), Sacramento Region Food Hub Feasibility Analysis, A project of the Rural-Urban Connections Strategy (RUCS).

California Strawberry Commission. (2014), Sustaining California Communities, Economic Contributions of Strawberry Farming.

Economic & Planning Systems, Inc, (EPS). (2016), UC Davis Economic Impact Analysis.

Deloitte. (2015), Facebook’s global economic impact.

Frank, Rimmerman + Co. LLP. (2013), The Economic Impact of Illinois Wine and Wine Grapes.

Full Glass Research. (2015), The Economic Impact of the Wine and Wine Grape Industries on the Oregon Economy.

Google Economic Impact Report. United States. (2015).

Hackett, S., D. Hansen, D. King, and P. Elizabeth. (2009), The Economics Structure of California’s Commercial Fisheries, Humboldt State University and King and Associates, Inc., A report in fulfillment of Contract P0670015, California Department of Fish and Game.

Howitt, Richard, J. Medellin-Azuara, D. MacEwan, J. Lund, and D. Sumner. (2014), Economic Analysis of the 2014 Drought for California Agriculture, UC Davis Center for Watershed Sciences, UC Agricultural Issues Center, ERA Economics, Davis, CA.

Howitt, Richard, J. Medellin-Azuara, D. MacEwan, J. Lund, and D. Sumner. (2015), Economic Analysis of the 2015 Drought for California Agriculture, UC Davis Center for Watershed Sciences, UC Agricultural Issues Center, ERA Economics, Davis, CA.

MKF Research LLC. (2007), The Impact of Wine, Grapes and Grape Products on the American Economy.

MKF Research LLC. (2005), Economic Impact of Wine and Vineyards in Napa County, Prepared for Jack L. Davies Napa Valley Agricultural Land Preservation Fund and Napa Valley Vintners.

Nevada Governor's Office of Economics Development. (2014), Applied Economics, Economic Impact of Tesla on Washoe and Storey Counties.

Sumner, D., W. Matthews, J. Medellin-Azuara, and A. Bradley. (2015), The Economic Impacts of the California Almond Industry, A Report Prepared for the Almond Board of California, UC Agricultural Issues Center.

Sexton, R., J. Medellin-Azuara and T. Saitone. (2015), The Economic Impact of Food and Beverage Processing in California and Its Cities and Counties, Report funded by the California League of Food Processors.

San Francisco Planning Department, (SFPD). (2014), Makers & Movers, Economic Cluster Strategy, Recommendations for San Francisco Food & Beverage Manufacturers & Distributors.

Sacramento Area Council of Governments. (2010), Sacramento Region Local Market Assessment: Current Conditions and Innovations Summary.

Stonebridge Research. (2008), Economic Impact of the Napa Valley Wine Industry.

Tully & Young Comprehensive Water Planning. (2009), Background Report on Sacramento Area Water Resources. Prepared for the Sacramento Area Council of Governments Rural-Urban Connections Strategy.

U.S. Economic Impact Report. (2015), British Petroleum.

Walla Walla Community College in cooperation with the City of Walla Walla. (2011). A Study of the Economic Impact of the Walla Walla Regional Wine Cluster as a Basis for Development of an Economic Development Plan for the Walla Walla IPZ.

Wine Institute, California Wine Profile. (2014).

Researching Markets for Beginning Specialty Crop Growers

Prepared for the California Farm Academy Incubator Program Development

Scott Cosca and Gail Feenstra

UC Sustainable Agriculture Research & Education Program (SAREP)
Agricultural Sustainability Institute
UC Davis

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INTRODUCTION

With the average age of farmers in the U.S. nearing 60 and a growing interest and appreciation for sustainable local food, there is a need to encourage, support and educate a new generation of farmers. Access to affordable land, capital and water in California are incredibly difficult, the barriers to entry for new, less-experienced farmers are very high. The California Farm Academy (CFA)—a program of the Center for Land Based Learning in Winters, CA—is taking steps to address this need with a seven month hands-on training program and a farm business incubator that offers subsidized land for beginning growers to gain practical experience.

In addition to developing the toolkit for on-farm production, beginning farmers need to become familiar with potential markets for their products. Direct-to-consumer channels (farmers markets, CSAs, etc.) are great beginning growers and offer flexibility in quantity, price and (to some extent) quality. Nonetheless, they require considerable time investment and, especially with farmers markets, offer no sales guarantees. Plus in the Sacramento area, there are already a substantial number of farms doing direct-to-consumer sales, saturating the market. Thus, as beginning farmers grow and assess their operations, they might want, or need, to consider grocery stores, wholesale distributors, and options for aggregating products, food hubs, etc. as other potential markets.

The purpose of this project is to gauge these other potential markets and identify key considerations for beginning farmers to develop and maintain relationships in a very competitive environment. In addition, we identify what sort of assistance and resources beginning farmers need to develop tools for market success.

The challenges and learning curves associated with direct to retail and wholesale markets can be steep for beginning farmers. There are a number of perplexing questions:

- How do I approach the buyers?
- How do I set prices? Will I make enough to cover costs?
- How much product should I promise? How does it need to be packaged and delivered?
- How do I negotiate quality standards? What about traceability issues?
- Do I need food safety certification?
- Are there ways to set my produce and farm apart and preserve the farm identity and character?

With these questions in mind, this report aims to “de-mystify” these markets and give beginning farmers some idea of whether or not, and how, they might approach those types of buyers.

SCOPE

This marketing study explores alternatives to direct-to-consumer market channels for beginning growers of fresh produce in the greater Sacramento area, focusing on direct-to-grocery stores (wholesale direct) and wholesale distributors. The primary objectives of the project were to assess:

- Market potential, interest in purchasing from beginning farmers
- How to include the farmers' story; importance of a label
- How beginning farmer publicity might occur
    - Use of promotions for particular farmers or farms, perhaps seasonally
- Key conditions retailers need in order to purchase from small growers, especially how to "break into" this market without much track record and with, possibly, small volumes.

Additionally, we inquired with each produce buyer about emerging potential market channels (institutions, corporate offices, other) that beginning farmers might consider—especially those interested in supporting local farms and that may be able to highlight the farmer's story.

METHODOLOGY

The first phase of the project involved identifying and interviewing regional produce buyers—primarily grocery stores, wholesalers, and other new or creative wholesale marketing channels. We focused on businesses likely amenable to supporting beginning and possibly small farmers based on their location (Sacramento or Bay Area), website descriptions and farm-identified advertisements. We then conducted semi-structured interviews with the produce manager or buyer from all willing businesses. Our questions focused on sourcing practices, expectations, advertising and past relationships with beginning and possibly small farmers. In total, we interviewed fourteen produce buyers and one non-profit representative partnered with an area hospital.

INTERVIEWS

14 Produce Buyers

- 9 Grocery Store representatives (Greater Sacramento Area)
- 3 Wholesale Distributors (2 in Sacramento and 1 in San Francisco)
- 2 Food Hubs (Capay Valley and San Francisco)

6 Sacramento Area Farmers

- Varied experience (2 – 20+ years)
- Varied size (1-200 acres)
- 5 diversified vegetables, 1 specialty grain

The second phase of the project involved interviewing beginning farmers about their experience with these markets and the successes and challenges they have had sustaining relationships with grocery stores, wholesalers, and other market channels. The main purpose of this phase was to discuss the key findings identified in the first phase, hear farmers' perspectives on market potential and get an overview of what markets they've approached, why and, with the benefit of hindsight, whether they might have tried things differently. Also, to slightly expand our scope we included specialty grain production in our farmer interviews. In total, we interview six area farmers of varied experience and size.

Because we have such a limited sample size, we do not consider our results to be generalizable; rather, they reflect a snapshot of the regional market at this point in time. That said, we do feel some common trends emerged that are important for beginning farmers in any region to keep in mind when evaluating and approaching markets. It is also worth noting that we did not interview any restaurants, but still feel this is a very important market channel for beginning farmers.

FINDINGS

Overview

Overall, our interviews indicated definite possibilities for beginning farmers in Sacramento and Bay Area wholesale direct (grocery stores) and distributor markets. The primary challenges for any farmer approaching these markets is meeting the quality and quantity expectations and food safety and liability insurance requirements. In addition, these markets are very competitive—even in the "local" category—making entry very difficult. Beginning farmers will need to differentiate themselves by ensuring exceptional quality or with a unique product niche to get their foot in the door. And, beyond that, there is still a risk for beginning growers getting priced out of wholesale markets by more efficient growers.

All produce buyers stressed the importance of **quality, consistency and communication** as key conditions for beginning farmers to successfully start and maintain on-going relationships with buyers. Additionally, they emphasized that farmers need to know market prices and, crucially, have an idea of what prices they need to make their business viable.

*All produce buyers stressed the importance of **quality, consistency and communication** as key conditions for beginning farmers*

All produce buyers also expressed interest in various ways of carrying and highlighting the farmer's story. They emphasized the farmer maintaining an active presence as the face and voice of the farm, including possible in-store demonstrations.

The farmers interviewed identified similar challenges and advised new farmers to start slow and establish a few strong relationships, being careful not to overpromise and paying careful consideration to the difficulty of meeting retail/wholesale quality week in, week out. They also acknowledged the difficulty of meeting quality standards. By and large, both produce buyers and farmers felt that beginning farmers should probably start with direct-to-consumer markets. Direct-to-consumer markets are much more forgiving as beginning farmers work out the solutions to early challenges with microclimates, learning what to promise and when, how to pack and grade, and so on. Struggling to fill orders or not delivering on what was promised early on in a retail or wholesale relationship can jeopardize future sales with not only that buyer but possibly others as well.

The remainder of the report expands on these findings and attempts to faithfully convey the nuance and variability of the interviews while still offering general knowledge and trends that beginning farmers might find informative and useful. Our findings proceed with discussions on overall market potential by market type: direct-to-grocery stores, the wholesale distribution, and other market channels. After the market discussion, we present general findings on publicity and labeling, key conditions identified by produce buyers, tips and considerations for approaching buyers. The first sections predominately reflect produce buyers perspectives and a final section adds the farmers' perspectives.

Market Potential

Direct-to-Grocery Stores

The direct-to-grocery, or wholesale direct, market segment offers great potential for beginning and small farmers. With the growing interest in the "Buy Fresh, Buy Local" campaign[1], more and more consumers in the area are starting to look for local, farm-identified produce in their neighborhood grocery stores. Although consolidation continues to be the trend in the retail food providers—especially with the rise of Wal-Mart and fewer and fewer establishments controlling a larger percentage of market share—small, independent grocers in the Sacramento Area continue to thrive and often use high-quality, fresh produce and support for small, local farmers as a means of differentiating themselves from the larger supermarkets.

Among grocery produce buyers, the approximate proportion of current direct purchasing varied from nearly all (80-90% of all produce) to very little (<10% of all produce). Nonetheless, all buyers expressed interest in purchasing more direct, local product, even if that was not currently a large portion of their sourcing.

The primary benefits of the direct-to-grocery store channel for beginning farmers are the flexibility on volume requirements and food safety certifications. Of the independent grocers interviewed, only one required a certificate of liability insurance[2] and none required specific food safety certification at the moment.[3] The two grocery chains required a more extensive approval process. For Raley's recent "Living Local" produce program, producers are required to do a self-audit (using the Raley's checklist and an eventual visit from a Raley's employee), provide a C.O.I. (certificate of liability insurance) with Raley's added as additionally insured party and maintain a membership to an electronic file cabinet ($199 a year[4]). Whole Foods, a national grocery chain, requires an Everclean audit for food safety and a C.O.I.[5] and has all direct producers first get approved through their Regional Distribution Center (RDC).

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[1]In California, "Buy Fresh, Buy Local" is a Community Alliance of Family Farm's (CAFF) campaign to connect producers and consumers and help strengthen and promote sustainable local food systems. It is used here, however, as a reflection of the broader consumer movement toward supporting regional and local economies, especially with fresh produce.

[2] Although many of the stores did not specify certificate requirements, they may still expect the farm to carry limited liability insurance. And carrying some sort of policy (even if not up to $1 or $2 million) is worth considering for any farm selling through grocery stores and wholesale channels.

[3] The Food Safety Modernization Act may potentially shift these requirements.

[4] Interviewee expressed possible discounts for the Living Local program

[5] Unclear from interview if Whole Foods needs to be added as additional insured—no response from Regional Office.

DIRECT-TO-GROCERY STORES: HIGHLIGHTS

UPSIDE

- Relatively low volume requirements (variable, see table 1 in appendix)
- Less stringent food safety and liability insurance requirements (currently)
- Some flexibility in pricing for local products relative to market prices
- Potential to farm-identify and tell story through displays, demonstrations
- Possibility to establish long-term relationship and grow certain crops for the store

CHALLENGES

- Stores often already have established relationship for popular "local" products; more likely looking for very high quality or unique item
- In general, direct prices need to be in ballpark of price from distributor or wholesale
- Produce buyers need clear and effective communication from farmer
- Almost always require delivery to store

Volume Requirements

Importantly, none of the grocery store buyers set standards for volume requirements. The expectations did vary across grocery stores depending on the size of their produce display, whether or not the product would be farm-identified, potential advertisement opportunities and the number of stores to supply. Although we expected the bigger grocery chains to have higher volume requirements, they actually expressed more flexibility than some of the independent grocery stores and both Raley's and Whole Foods were very open to receiving direct deliveries to just one store. In fact, the produce buyer at the Davis Whole Foods recognized that it is often the farmers who set a minimum delivery amount in order to ensure it is worth their time and fuel to deliver. Nugget Markets, on the other hand, strives for consistency across the stores and prefers to have local growers sell through Nor Cal Foods, their primary distributor.

Pricing

By cutting out the distributor and delivery, the direct-to-grocery store channel offers slightly higher prices than farmers can expect on from wholesalers and distributors. Though, of course, this places the delivery responsibility on the farmer. When supplying multiple stores for a Raley's or Nugget, there is some possibility for delivery to the regional warehouse or cross-docking but in general, direct grocery store sales require delivery to the stores and likely some coordination with the store on scheduling deliveries.

"Your stuff has to be priced at what the market can accept. You can't be so out of line just because it seems special. Or just because you grow it, that it deems a higher price."

– Nugget Markets

Several buyers and stores also offer a slight premium for local and organic produce, although we did not gather consistent figures. Many buyers stressed that prices need to be in the ballpark of what they could get from their distributor or regional supplier. One independent grocery store buyer emphasized that price differential without a clear quality difference is very problematic. Raley's also expects prices to be close, but said they had slightly more flexibility with unique items and certified organic produce.

"We try to stay as close to market value as we can. But if it is a unique item than we can get away with it. If it's a little different than we can change things up."

– Raley's

Quality

Along with price, all of the grocery store buyers identified quality as a major hurdle for beginning growers—and for any small, local grower. While most stores expect farmers to conform to published USDA standards for pack and grade, determining quality still has a strong subjective component: "you know it when you see it." All the grocery stores that buy local and direct do so to ensure high quality, fresh produce and their customers expect that quality every time they come to the store. Thus, several produce buyers expressed that farmers should either leave seconds on the farm or find other market channels. They also stressed the importance of differentiating between farmers' market quality and retail/wholesale quality. Blemishes are often acceptable at farmers markets but rarely will meet standards for retail and wholesale, with the occasional exception of some heirloom produce.

Though the direct-to-grocery store channel is fairly short from farm-to-shelf, several buyers stressed the importance of shelf life and post-harvest handling. None of the buyers had specific temperature requirements for receiving produce,[6] but they did identify shelf life—and communication with farmers when product is not holding up—as a crucial component of the relationship. Moreover, one buyer indicated that customers constantly rifle through their produce display and the produce needs to withstand that kind of abuse.

Finding a Niche

Another challenge that emerged in almost all interviews was the saturated local market. With a lot of established and reputable local farms in the Sacramento area, most of the grocery stores already have long-standing direct relationships with farmers for popular local products like heirloom tomatoes, eggplants and leafy greens. Often, the grocery store only needs one or two farms to supply their whole display for particular products all summer. They are not going to abandon trusted relationship just to try someone new. Several buyers stressed the importance of a farmer having something unique or of unsurpassed quality to help initiate relationships. One option is to approach produce buyers before

[6] Although some of Raley's new producers online material suggests that they do, indeed, monitor arrival temperatures, the buyer we interviewed indicated that the direct-to-store deliveries do not have such requirements.

planting and ask what they might be interested in, but be very clear not to expect a contract (see Approaching Buyers section).

Specialty Produce

The few specialty markets interviewed were very interested in building relationships with local growers for specialty produce. For instance, Corti Brothers (specialty Italian market) feels there is a lot of potential for items like spring nettle, hard neck garlics, etc. Oto's Markeplace (specialty Japanese market) identified many items—Japanese cucumbers, long beans, kokabu, kabocha, shungiku, gailon, etc.—they would be interested in buying locally if they could find a consistent producer. Currently, they buy the specialty products through the Oakland produce market, but are very interested in supporting local farmers and procuring very fresh produce.

"Like Japanese turnips […] mizuna. Shangiku, which is basically like chrysanthemum leaves. […] These kinds of things they do well for us. And they move. As well as kokabu, a Japanese turnip. Those are the kind of things that we aren't always able to get all the time. Local spinach with the roots."

– Oto's Marketplace

Specialty ethnic produce is a great potential niche for beginning farmers, but requires some trial and error in the field and lining up those production possibilities with the market. Based on our small sample size and phone calls, we found that interest in local product and price flexibility is very store specific.

Overall, there is a lot of potential for beginning farmers to explore the direct-to-grocery store market, though it can be difficult to initiate relationships. All the buyers expressed interest in establishing long-term relationships and developing reciprocal trust in which they have faith in the quality and timing of a farm's produce. From that point on, they are more likely to work with a farm throughout the year, encourage and support the farm to try some new or specialty products just for their store and do in-store farm identification, profiles and demonstrations.

Wholesalers and Distributors

Small, beginning growers may believe the wholesale distribution market channels are completely dominated by large, industrial farms and requiring such high volumes and low prices that they simply cannot compete. Yet, all the wholesalers interviewed stressed that this is just a partial view of the market and encouraged small and beginning farmers not to completely dismiss wholesalers as potential outlets. Wholesale distributors are always seeking ways to set themselves apart from other distributors. For those interviewed, a strong local, organic supply to sell to restaurants and grocery stores may help with that unique competitive niche. With that said, it is important to note that there is little downside for the produce buyer to "express interest" and beginning farmers need to be very cautious in approaching these markets.

WHOLESALERS & DISTRIBUTORS: HIGHLIGHTS

UPSIDE

- All wholesalers/distributors interviewed encouraged beginning and/or small farmers not to completely disregard wholesale markets
- Generally, they can move large volumes of product.
- Depending on location and amount of product, some will pick-up at farm.
- All buyers interviewed definitely looking to build long-term relationships with farms

CHALLENGES

- Price: often competing with terminal market prices and large, cost-efficient producers.
- Establishing initial relationship can be difficult
- Postharvest handling crucial: Could be up to a week before product hits shelves.
- More difficult to farm identify/carry story to grocery shelf or restaurant table (but possible)

Volume Requirements

None of the three wholesale distributors identified specific volume requirements and thresholds and all were open to the possibility of smaller volumes. That said, one buyer stated that they worked with everyone from large farms to 25-acre farms in Winters, CA. So, very small (i.e. ½ - 5 acre) diversified vegetable operations likely will have trouble maintaining enough production for entering and maintaining long-term relationships with these wholesalers. But as beginning farms find access to more land or slowly expand their production, they may think about exploring wholesale markets. There is the potential to move more volume, possibly mixed pallets at a time. Once the relationship is established, selling at least some of their production to a wholesaler may help reduce risk for farmers thinking about or starting to plant more acreage. One wholesale distributor, Veritable Vegetable, operates on a model of supporting diversified growers throughout the season as much as possible.

In addition, two of the three wholesale distributors do occasionally pick-up from farms, though it is fairly rare with their smaller producers. Having a diversified product selection and the ability to fill a mixed pallet is very helpful for both sales and pick-up. Generally,

"With really small growers, we've found that a diverse amount of offerings is great. Because I might not be able to fit you in—say buy a pallet of romaine from you—but I can buy four boxes of this, four boxes of that, four boxes of something else. Enough to make it worth our while to stop a truck there."

– Veritable Vegetable

smaller producers need to be on, or close to, established routes and need to have a loading dock or forklift and enough space for a delivery truck to turn around. Also, organizing a pick-up adds to the investment and risk for the buyer so if the pack and quality is not up to standards, it will certainly jeopardize potential future sales.

"Breaking In"

With terminal markets and brokers bringing in produce from global markets, it can be difficult for any grower to start selling to a wholesale distributor. Moreover, all the wholesalers interviewed pride themselves on supporting the local food system and thus, already have established relationships with small to mid-sized farms in the area, especially the Capay Valley. They are still interested in talking with any new producer, but beginning farmers should be aware of the competitiveness of the market and consider what makes their farm and product different before approaching wholesale buyers. For instance, two of the three wholesalers specifically pointed out that they really do not need any more heirloom tomatoes—unless the quality is truly unparalleled.

Having specialty and niche products are great ways for growers to help initiate a relationship and wholesalers are more likely to try something on a trial basis when they cannot get it anywhere else. Again, carrying unique products helps set the wholesaler apart in the competitive world of produce distribution. Two of the interviewees recounted success stories of producers bringing in small quantities of unique items. Veritable Vegetable, a primarily organic purveyor, unexpectedly found some organic jicama—apparently a very difficult item to find organically—on the front seat of a truck farmer trying to move marginal quality tomatoes. With their strong demand for organic jicama, they were willing to take the farmer on as a producer and even tried to support him by buying his other products as much as possible. Nor-Cal Produce similarly highlighted recent purchases of small quantities of mulberries and golden raspberries as success stories with smaller producers. Produce Express, a regional produce distributor, has a farm-identified sales program primarily for restaurants and caterers that deals in smaller volumes than the distribution warehouse.

Pricing

The complexity and constant flux of wholesale produce market pricing is certainly a challenge and source of discouragement for beginning growers. There are plenty of online resources for current wholesale prices (see Resource Guide in Appendix). However, 2 of the buyers stressed that there is no substitute for calling around to regional produce houses. Regional markets for products vary and the online tools for organic pricing are less developed. All 3 wholesalers were open to receiving such calls and offering information to beginning growers. They suggested that other wholesalers and distributors are generally transparent about current prices. When products are not branded as local, farmers need to keep in mind that they are competing with the large growers throughout the state, and globe, and may not be able to compete. When they are trying to sell through the farm-identified wholesale channels, they are still competing with established local farms. In the Sacramento area this includes established farms like Capay Organic, Full Belly Farms, Terra Firma, etc.

One buyer adamantly discouraged undercutting the market just to get a foot in the door and start a relationship. While the temptation to try and move product at a loss when a farmer has excess or cannot find a home for ripe, ready-to-go produce is strong—especially if this might help establish a relationship with a buyer— it dumps product on the market for everyone else and is not a successful long-term strategy. Moreover, it does not help build trust with the buyer.

POST-HARVEST HANDLING

Any farmer approaching wholesale distributor markets must have very solid post-harvest handling practices, which often requires infrastructure. There are a lot of online resources available for handling procedures, tempature, timing and equipment (see resource guide), but here are a few critical considerations:

- Must be able to remove field heat. Need access to cold storage or the ability to pick at night.
- Some products need to be iced or hydro-cooled after packaging and before delivery
- Handling procedures require produce shipments cannot touch floor, or even a truck bed. Need to be placed on a pallet.

Post-Harvest Handling

Proper post-harvest handling is a crucial component for wholesale and distributor markets and a possible constraint for beginning farmers. Because products may sit on the distributor shelf for a couple days and then take a few days in transit, it may be up to a week before it hits the shelves of the retailer or restaurant. And, even then, it needs to hold up on the retail shelf for a couple days and then in the consumer's fridge for a couple of days. Thus, following proper post-harvest procedures is crucial to maintain a long-term relationship in this market channel. First and foremost, this requires removing the field heat from products. Beginning farmers probably need access to a cold storage facility or have the ability to pick at night if they want to pursue wholesale buyers. Moreover, some products (e.g. corn, broccoli) require icing and farmers may need to own or have access to that type of equipment. While only one buyer expressly stated that they check temperatures on product arrival, it is a common industry standard. The Raley's grocery store chain pamphlet material indicated similar standards, but the "Living Local" program representative stated that they do not have such stringent standards for direct deliveries.

Product shelf life is a crucial component of direct-to-grocery store sales as well, but the shorter supply chain adds a layer of flexibility. Several produce buyers stressed that farmers should always pay close attention to shelf life, and possibly keep a box in their fridge or cold storage to see how well it is holding up. In addition, they need to recognize that even when produce leaves their farm in great shape, it may not look nearly the same when it reaches the final location. Thus, openness to receiving and acting upon feedback about quality is crucial in any relationship. Moreover, farmers may have to adjust harvest ripeness and possibly even varietals in wholesale channels to extend product shelf life.

Other Market Channels

The recent rise of food hubs (facilities for aggregating regional products) and farm-to-institution sales both potentially enable restructuring of produce distribution channels to support small, local farmers. While the definition of a food hub is still contested, they usually refer to enterprises "facilitating the aggregation, storage, processing, distribution, and/or marketing of locally or regionally produced food products" (Barham 2011, p.6)[7]

There is a considerable amount of exploratory research on the feasibility of regional food hubs from area non-profits, counties and the USDA (see Resource Guide in the appendix) and beginning farmers should definitely be aware of these movements as potential future market channels even if there are not tangible outlets in their area at the moment. Farm-to-institution programs in hospitals and schools that source local produce are also increasing throughout the nation. We identified a few innovative, existing market channels in the area to interview for this project: two very different food hub models and one interview with a statewide non-profit closely involved with local sourcing projects at area hospitals.

Good Eggs

The unique food hub with online sales model of Good Eggs recreates the feel of farm-to-consumer through a farm-specific online marketplace. Customers select produce, dairy, meat and other value-added products from the farm's online profile—called the "webstand"—and constantly updated availability list. Farmers deliver to Good Eggs' San Francisco warehouse where Good Eggs packages each customer's order and deliver it. With a model that aggregates products, they have no volume limitations on either end; however, with farmers required to deliver, the quantity needs to be big enough to make it worthwhile for the farmer. They do have quite a few farmers in the Sacramento area, so there are definite possibilities for shared deliveries.

If the frequent deliveries are not a problem, Good Eggs is a great potential outlet for small or beginning farms looking to build a name and reputation in the Bay Area. The farms are able to manage availability, control their "webstand" profile and also set their own prices. Good Eggs simply takes a standardized transaction fee off of each purchase. Thus, farms can connect directly with the customers. Website interactions perhaps lack some of the authenticity of in-person, face-to-face connections such as at a farmer's market; however, the farm-identified sales can help spread a farm's name through the greater San Francisco food world and possibly lead to other relationships.

[7] Barham, J. (2011). Regional Food Hubs: Understanding the scope and scale of food hub operations. Washington, DC: USDA AMS

There are still a few challenges for farmers in the Good Eggs model. In addition to the deliveries, Good Eggs also require a one million dollar limited liability policy with Good Eggs added as an additional insured party. Depending on the farmer's policy, this can be cost prohibitive. One farmer stated that adding Good Eggs onto his policy would have cost about $500 and, for him, simply was not worth it for the amount of expected yearly sales (F04). Also, the farmer needs to manage the webstand and predict and set availabilities and prices. The Good Eggs team is eager to help facilitate the process and make it as seamless as possible, but it still requires a time commitment and flexibility from the famer. Furthermore, like all market channels, their buyer stressed quality as a crucial component of their decision to work with new growers.

GOOD EGGS

Good Eggs is a food hub model that sells and delivers farm-identified produce, meat, dairy and value-added products through online orders. Currently they are in the SF Bay Area, Los Angeles, New York (Brooklyn) and New Orleans.

OPPORTUNITIES

- Farm profile is placed front and center in the online marketplace, so lots of exposure and possible future connections in Bay Area.
- No start-up cost to register, so relatively low risk.
- Set your own prices and can command a premium (Good Eggs takes a flat fee).

CHALLENGES

- Requires frequent deliveries into city of San Francisco.
- Farm needs to manage online web-stand with availability and prices
- No guaranteed or set amount of produce. Everything purchased by consumer in a just-in-time model, but able to set ceilings on availability.

Capay Valley Farm Shop

The Capay Valley Farm Shop (CVFS) is a majority producer-owned rural food hub that coordinates produce from over 40 farms in the Capay Valley and sells through a CSA, institutions and wholesale distributors. By aggregating diversified products and maintaining a strong local identity, they are able to reach a broad array of markets otherwise inaccessible to many of the producers, namely institution, distributors and corporate offices. Moreover, by taking on all of the distribution, marketing and delivery, the Farm Shop frees up the farmers to focus on farming. And the CVFS also maintains a website and a strong farm-identity presence throughout the chain.

The CVFS sources almost exclusively from the Capay Valley for their CSA baskets, supplementing only a few grains from outside the area. That said, they actively work with and support beginning growers in the area and some of the other market outlets or partnerships may be a possibility for farmers outside the Capay Valley.

Farm-to-Hospital

The farm-to-hospital channel is a slowly emerging market, recognizing that many healthcare organizations are highlighting the importance of diet and fresh produce. That said, our interviewee—who works for a non-profit that helps facilitate local healthcare produce sourcing—stated that the direct-to-hospital channel is very small. The vast majority of produce sourcing in hospitals happens through wholesale distributors and is likely to remain that way with the structure of liability insurance. Thus, farm-to-hospital presents very similar challenges to the rest of the wholesale/distributor market.

We still identified some possibilities for beginning and small or mid-size growers in this market segment. For instance, farm aggregators—e.g. Coke Farms out of San Juan Bautista and the Capay Valley Farm Shop—play an active role in providing produce for area hospitals. Also, there are some opportunities in fresh-cut processing and providing unique sizing to fit hospital standards but there are considerable challenges with this market and it may not be the best first step for beginning farmers.

Farm-to-School

Farm-to-School is another potential institutional route for beginning farmers, and may have more potential for direct sales and flexibility in volume than the Farm-to-Hospital channel. We did not include any school districts in our study but Ohmart's (2002) study of pilot salad bar programs in Yolo and Ventura County indicated successes in the payment logistics, consistency of ordering and delivery and low additional costs for farmers to supply school districts. That said, farmer's did not see demonstrable increase in income (though they were all established farms) and cited administrative hurdles as another challenge. For more information on current Farm-to-School trends, see: http://www.sarep.ucdavis.edu/sfs/programs

Publicity and Labeling: Telling the Story

Marketing and Promotion

None of the buyers interviewed identified a distinct premium for the beginning farmer story beyond local or organic. That said, several grocery store buyers felt that their customers are interested in any direct farmer story and highlighted several possibilities for farm-specific promotion. Most of the display and promotion takes place in stores and are initiated by the produce manager. Moreover, all the grocery stores encouraged the possibility of in-store demonstrations as a great way for farmers to advertise their stories and connect with both store customers and staff. In wholesale

"Pick your farm name right. Pay attention to that because it is something you are going to live with for a long time and it has a real opportunity to help you tell your story. So really invest the energy and time to think that through."

– Wholesale Buyer

channels, carrying the farm story throughout the supply chain is slightly more difficult, but all the distributors interviewed certainly do farm-identify and value that relationship. In fact, one wholesaler (Produce Express) distributes farm availability sheets to restaurants and acts as the middleman in a direct-to-restaurant chain.

Websites, social media and online presence also came up in several of the interviews. Two stores do online profiles of their local farm suppliers and also provide links to farm websites and social media profiles. In addition, the innovative virtual food hub, Good Eggs, is entirely an online marketplace and farms are required to maintain a profile and up-to-date availability—which helps strengthen the consumer-to-farm link and allows consumers to build relationships with specific farms.

Labeling and Logos

Overall, on-farm labeling was not considered crucial for beginning growers looking to develop retail and wholesale relationships. While buyers indicated that anything reinforcing the farm story in the marketplace is helpful, several felt that box logos and labeled twist-ties were probably not worth the expense—or, at least, should not be a high priority for beginning farmers just starting out. Several grocery stores did, however, mention that they often use labeled packaging boxes to help build displays, especially if they are farm-identifying the product in the store.

Farmers selling farm-identified produce to grocery stores may want to consider discussing this possibility with the produce buyer or manager. Placing sticker logos on boxes is often a cheaper alternative to printed labeled boxes.

Although beginning farmers may not want to invest a lot of initial resources in labeling, one buyer stressed the importance of spending time developing a logo and name for the farm. This can often be an afterthought for a farm trying to get going, but quickly becomes a part of the farm's identity and ideally has enough meaning to the farmer that it is something they are excited about representing them in the marketplace. There is

Labeled boxes are often used to create produce displays. While they may not be the most cost-effective first step for a beginning grower, down the road they can be very useful to reinforce the farm and brand.

similar potential with the logo, which can help symbolize the personality of the farm.

Ready-to-Purchase Packaging

In a few instances, ready-to-purchase packaging came up as a possible avenue for marketing produce. Both Nugget and Good Eggs cited successes with that type of packaging, specifically, for mandarins and greens. For the mandarins, the recent "cutie" craze and convenience of picking up a multiple pound bag of citrus in the store, led to 3-pound packages of mandarins. These size packages are an opportunity for the farm to brand their farm name with a logo in the consumer's mind and associate it with that product at that time of year. However, most beginning farms may not be able to invest in the infrastructure and packaging or have the volume to make that sort of packaging worthwhile. For greens, it may be a different story. Packaging leafy greens and salad mixes on-site also adds additional documentation and requires a third-party GAP audit.

Labeled, ready-to-purchase bags are also great marketing possibilities, especially in with fruits and leafy greens.

Demonstrations and Display

Most retailers recommended sharing the farm story in as many avenues as possible and emphasized that the farmer speaking about his/her respective farming practices, history, etc. is the best way to convey their story to the consumer. From that standpoint, in-store demonstrations are the most direct way for farmers to share their story in grocery stores. And it provides the opportunity to connect with the store staff as well as the consumers. In-store demos are, however, very time intensive and results may be a bit intangible, so farmers must be really invested in developing that market.

All grocery stores interviewed already do some demo days, and are open to and excited about the prospect of doing more. Fresh fruit is often the best demo product, but the stores expressed interest in doing more vegetables—including raw, cooked or accompanied with other products (dips, salsas, etc).

Two buyers cautioned against sending someone affiliated or employed by the farm and not particularly familiar with the farming practices or stories. In addition, several buyers noted that demos are not at all a required component of the relationship and really depend on the farmer's personality and interest in doing them.

A few grocery store buyers—even when buying farm-identified products through wholesale distributors—do posters and extensive profiles in store at various times, but have to know that they will get the product for a long enough period of time to make it worthwhile to create the displays. While they use the logo and may ask for pictures or a few words about the farm story, for the most part, the produce display and profile is the domain of the store and produce manager.

Once farmers have an established relationship and know their produce is farm-identified in the store, they can ask about in-store advertisement possibilities. Independent grocers with smaller produce displays are still open to some form of display with popular products, but cited space as a major limitation.

A hanging farm profile of Terra Firma Farms in the Davis Nugget Market produce department. These types of farm profiles are usually created by the produce or marketing department at the store and only after a consistent relationship has been established. However, having a few possible pictures and a brief farm summary on hand can be very helpful and expedite the process.

Websites and Online Presence

Websites are a cheap, cost-effective strategy for branding a farm and providing a visual story for buyers—direct customers and produce buyers alike—but overall were not considered a necessity by produce buyers. In fact, the level of interest in online presence seemed to depend on that establishment's level of online marketing. Some grocery stores and wholesalers do describe their sourcing practices on the website with a map or brief description of the farm. In that instance, having a website link can help customers learn more about the farm. Additionally, one buyer brought up social media and facebook as a great tool and a way that they advertise farms and provide a narrative for customers. The Good Eggs virtual marketplace requires the greatest online presence—as all sales occur through the "webstand"—and the clearest opportunity to advertise a farm's story online.

Key Conditions for Maintaining Market Relationships

Maintaining productive, fruitful relationships with produce buyers requires setting and meeting clear expectations. As one produce buyer stated, beginning farmers simply need to "deliver upon what they say they are going to deliver" (R01). This is especially important early on, as a few bad orders can derail a farm's reputation in the area. All produce buyers identified the same key conditions—often using the exact same language—for beginning farmers to thrive in wholesale sales[8]: **quality, consistency, and communication.**

Quality

All the produce buyers interviewed for our study stressed that understanding, maintaining and consistently delivering retail/wholesale level quality is crucial for any farmer looking to develop relationships. Several highlighted that beginning farmers must learn the difference between farmer's market quality, where a few blemishes may be acceptable, versus the standardized aesthetic that buyers and customers expect in retail settings: "So a lot of times, one of the big issues I have with the little farms […] is there is a difference between retail quality and what will sell for you at the farmers market"(R02). Several buyers strongly encouraged sending pictures when a farmer is not sure if the product meets the buyer's standards rather simply packing it and hoping for the best. The specialty and independent grocery stores often use consistently high-quality produce as a way to help build a relationship with their customers and want their customers to be able to expect the same level of quality each time in the store. Moreover, they want very standardized quality within each order so customers do not dig through the produce searching for the best product.

"So a lot of times, one of the big issues I have with the little farms […] is there is a difference between retail quality and what will sell for you at the farmer's market."

– Sacramento Natural Food Co-op

All buyers indicated that beginning farmers need to familiarize themselves with USDA pack and grade standards, from typical box size, "case" weight (or number of product per box, as with a lot of fruit), to product sizing and grading. That said, while the majority of the direct-to-retail and, especially, wholesale market expects very standardized, interchangeable pack and grade, several buyers indicated that there are slight variations and encouraged farmers to ask buyers about their respective expectations.

FRESH PRODUCE: PACK & GRADE

Most wholesale direct and distributor sales follow standardized USDA Pack and Grade for fresh produce (see resource guide) and most pricing information comes in the standard pack unit(s). However, there is still some slight variability depending on the store so be sure to check with the buyer before delivery.

[8] This includes direct-to-grocery stores, which is technically selling "wholesale" although this report differentiates it from selling to wholesalers or distributors because the requirements are often different.

Consistency

In addition to simply meeting quality standards, all buyers emphasized that quality needs to remain consistent throughout the growing season. This implies maintaining consistently clean packs, consistent produce sizing, and consistent quality. Most of the buyers interviewed stated that they understand quality or sizing can suffer toward the end of the season, but feel that farmers need to pull it off their availability list at that point rather than promise something they cannot deliver.

Many buyers additionally stated that once they have seen a farm consistently deliver and know what they are going to get at the store, the relationship could become a little more flexible on purchasing arrangements and delivery timetables. Additionally, they are more inclined to sit down with that farmer before the next growing season and talk about planting decisions, and possibly encourage the farmer to plant some unique produce or varietals just for the store. Overall, we found that consistently delivering clean, quality product is the best way to secure long-term market relationships.

Communication

Maintaining an effective line of communication came up in each interview—be it phone or email. Clearly communicating how much product the farmer will have, for how long and when it can be delivered, is crucial—and then following through. All the grocers source from a combination of wholesale distributors (including NorCal Produce, Produce Express, and Veritable Vegetable) and direct from farmers. They need to have some idea what to expect from a direct delivery so they can adjust their wholesale purchases. This is especially important with the smaller independent grocers like Corti Brothers and Taylors Market. Moreover, all buyers expect clear communication channels when something unexpected happens in the field and the farmers cannot deliver the quality or quantity. They also want to see a productive feedback loop when quality or pack is not up to standards. Several buyers empathized with the on-farm difficulties, and also recognize that sometimes a farmer takes on new employees or interns and cannot be everywhere at once and things happen to compromise a shipment. So long as a farmer is willing to listen to the feedback from buyers and make clear strides to adjust for the next order, the buyers are willing to continue working with that farmer.

Basically, buyers need to have produce 24-7, 365 days a year and it needs to meet the quality expectations of their customers. This is a big logistic puzzle for any buyer, be it a distributor or a grocery store, and farmers' simply need to recognize that the easier they make it on the buyer through clear communication, the more productive their relationships will be.

Approaching Produce Buyers

While each produce buyer and organization has their own idiosyncrasies, we did identify a few common threads on the sort of information they look for in the first approach or conversation. Also, for beginning farmers a little hesitant to make a first approach, it is important to reinforce that every buyer interviewed was very interested in speaking to and possibly developing relationships with new farmers.

Additionally, most expressed an interest in encouraging and helping new, beginning farmers thrive in the retail/wholesale market channels.

First Meeting

Ideally, the produce buyers like to know the following: what type of product a farmer will have, how much, for how long and when it will be ready. Moreover, several buyers noted that they like to hear about future plans and what kind of long-term relationship a farmer is looking to develop. Is the farmer looking to continue the relationship the following season? Is he/she planning to grow and will have more product?

Prospective seasonal availability sheets are also good to give to the buyer as they demonstrate a level of planning, provide the buyer with something to help forecast, and they leave a document with the farm's name on it to help reinforce the relationship. Approximate price ranges can be also be helpful to gauge if the relationship is even a possibility for both parties.

Product in Hand

All buyers indicated that they would not make a first-time purchase without product-in-hand. So, anytime a producer is looking to make a final sale, they need to bring in several samples. Most likely, the farmer will want to do this a few times as the product is getting close to being ripe so they have some time to coordinate sales. This is also a good time to ask if the buyer has any pack and grade preferences that vary from the USDA market standards.

APPROACHING PRODUCE BUYERS CHECKLIST

I. Know your story
   - What makes your farm unique?
   - What can you grow?
   - What are your future plans?

To do: Possible one-page handout profiling the farm and your story.

II. Know the market outlet
   - About how much product do they move? Or how big is the produce department?
   - Do they carry any farm-identified produce?
   - What prices can you expect? How do they compare to your break-even.

To do: Track down comparison prices for location or market type.

III. Know what you want to sell
   - Even in an exploratory meeting, have some products in mind
   - Think about when products will be available and how much you are looking to sell.

To do: Bring a seasonal availability sheet.

IV. Know the quality expectations.
   - Make sure you feel comfortable with wholesale/retail quality and required pack standards.

To do: Bring product in hand if looking to make a sale.

Setting Prices

All buyers stressed the importance of farmer's setting clear prices and knowing a break-even price before trying to make a sale. Several buyers also stated that they prefer to see the price written out, so having some sort of availability/price sheet can be very helpful. Thus, knowing the costs from seed to delivery is a crucial first step in pricing. This can often be difficult for beginning farmers still getting a feel for their operation (not to mention the unpredictability of water or other costs). However, from the buyers' perspective, this is a necessary part of building the relationship.

With that price in mind, buyers identified several routes for determining current market prices. There are several online resources for current terminal market pricing (see resource guide), however a few buyers indicated that these resources are less developed and consistent for organic pricing. The consensus from the produce buyers interviewed is that there is no substitute for calling wholesalers, distributors and calling or visiting grocery store buyers to gauge current prices. All wholesale buyers indicated they are very open to receiving and answering pricing inquiries. When visiting grocery stores, farmers should keep in mind that the retail mark-up is generally around 30-40%.

Two other important pricing considerations emerged in the interviews. One wholesale buyer adamantly discouraged farmers from undercutting the market in order to get their foot in the door. In addition, several buyers expressed that farmers need to know what makes their product unique— the quality, the story, farming practices, the location, organic certification, or some combination should be clearly communicated. Having a way to both articulate and demonstrate this unique character helps allow the farmer to differentiate their product from the rest of the market, and partially set their own prices. There is often more pricing flexibility in the direct-to-grocery store channel than selling to wholesale distributors.

"What to Grow"

The majority of the buyers expressed some concern about farmers approaching them before planting and asking what they might be interested in buying. While all were open to talking before the product is ready, or even before planting, and understand this is a helpful way for the farmer's to gauge the market, several did not like to be asked explicitly "what should I grow?" Buyers, in general, do not want to set any expectation that they will definitely buy the product before knowing the quality, timing, price, etc. Furthermore, the buyers prefer to see a farmer come to the table with an idea of what they can grow based on experience, climate and soil.

"And so that is something I really don't enjoy is when people ask me what to grow. What I say is do your research. What grows well in your area? What do you grow well? What are all your neighbors growing? It is a big one. If all your neighbors are growing it, then it is probably not the best thing to grow."

– Veritable Vegetable

All that said, almost all the buyers expressed an interest in unique or specialty items and are open to talking about and exploring those sorts of products, but generally want to see that a farmer can deliver before getting too involved. Additionally, most of the buyers are open to talking with farmers about the kind of things they are often need—just so long as it is very clear during the conversation that they are not making any guarantees to purchase when the product is ready.

Based on our interviews, approaching buyers before planting has some positives and negatives. On the one hand, it is a great way for farmers with limited exposure to the marketplace to get acquainted with the language of the industry and the possible market opportunities—and buyers in our interview recognized that fact and all were willing and interested in having those types of conversations. On the other hand, several were adamant that they did not want to give the impression of promising to buy sight unseen. So, in general, the more planning and homework a farmer can do on what they can grow and want to grow, the more productive an early conversation with a buyer.

Follow Up

Several buyers recounted experiences of farmers approaching them once and then never following up. Thus, beginning farmers looking to build a relationship need to be proactive and stay in contact. After an exploratory first meeting, farmers should ask the buyer how soon they want to be contacted before the product is ready. In addition, it is important to touch base on how they like to be contacted (email, phone), when (wholesaler and distributors generally work early in the morning), and how often as the relationship develops.

Farmer Perspective

The second phase of our project involved interviewing beginning farmers in the area to get a sense of their experience with direct-to-grocery, restaurant, and wholesale markets, the challenges they've faced, and any advice they might have for new farmers looking to pursue those markets. Throughout the interviews, we identified four important threads for new farmers to consider in approaching markets: be **cautious** in approaching any wholesale market, **start slow** and focus on a few initial relationships, **do not overpromise** and have to be constantly scrambling to make sure you will have enough product to fill orders and **understand the quality** standards for retail wholesale markets as well as individual restaurant expectations.

FARMER PERSPECTIVE

Important consideration for beginning growers exploring wholesale direct or distributor markets:

- Be cautious
- Start slow
- Do not overpromise
- Understand quality standards

Wholesale Caution

An experienced, diversified farmer in the area strongly emphasized that beginning farmers should be very cautious in exploring wholesale markets for a number of reasons. First and foremost, these markets are very competitive and beginning farmers will be competing with more experienced, bigger and more efficient producers. This completion holds especially true in the wholesale distributor markets, where prices fluctuate rapidly and bigger farmers are far more capable of taking a hit and weathering a period of low prices.

Additionally, this farmer echoed the sentiment that one should never expect any sort of formal agreement from a produce buyer. From his perspective, produce buyers have very little to lose in expressing interest, and will often say things like “I never get enough purple carrots or de tapo melon.” Those statements should not be considered even an informal purchasing agreement, and a beginning farmer should not necessarily plant that product with only that specific buyer and sale in mind (though it still might be a good product to pursue).

Moreover, even the flexibility of direct-to-grocery store markets can be challenging. The relative demand of these stores for niche products can potentially be very small—i.e. less than a 200 ft. bed—and beginning farmers should carefully consider the field management perspective before entering any relationships.

Start Slow

The majority of the farmers interviewed highlighted the importance of starting slow, and building a few strong relationships to start. Wholesale and retail relationships are hard to maintain for any farmer, especially beginning farmers, and focusing on just a few initial relationships can help ensure the quality, communication and consistency needed for these relationships to thrive. With just a few outlets, the farmer will likely need to have some other direct-to-consumer outlet for the rest of the farm produce. All of the farmers in our study cited farmers’ markets as a great supplemental (or primary) avenue in this type of arrangement.

In fact, one farmer worked on a farm where overextending and selling to too many grocery stores and restaurants played a strong role in forcing the farm out of business. In retrospect, he felt that establishing very productive relationships with just a few grocery stores, or finding a partner restaurant to take diversified produce and tailor their menu to the farm would have potentially helped sustain the farm. These sorts of partnerships may be challenging to find and establish, and require a lot of proactive legwork on the part of the farmer. Yet, if done right, the relationships can thrive.

Additionally, while direct-to-grocery store sales and wholesale sales generally require less time than sitting at a farmers’ market or coordinating a CSA, they still almost always require delivery. Thus, two of the farmers stressed having to think about opportunity costs when driving around for a bunch of small deliveries—it may not be worth the time investment. Flexible and low volume requirements can definitely help small farmers get their foot in the door, but overextending the amount of deliveries can also be a detriment.

Don’t Overpromise

Two of the farmers also stressed the importance of not overpromising on orders. Retail and wholesale quality can be tough to maintain. It requires consistently delivering week in, and week out, and scrambling to fill orders can cause a lot of anxiety and stress. Moreover, scrounging for enough chard, kale, radishes, etc. to fill an order can take a lot longer when there is very little left on the farm. The time spent may not be cost-effective. This will all vary by farmer and farm, but are worth considering for any beginning farmer pursuing retail and wholesale relationships.

Most buyers are not interested in one-offs or one week of deliveries and are not going to try a new producer when they already have established relationships. So finding a small, low risk entry point where a beginning farmer can consistently deliver and slowly build a relationship is key.

Specialty Grains

With several 2014 California Farm Academy students interested in specialty grains for either primary production or as a rotation crop, we also decided to interview a specialty grain producer operating on about 30 acres in the Sacramento Valley and self-milling and cleaning in the Sierra Foothills. Although we don’t have the buyer perspective to compare, the grain farmer listed a considerable number of challenges in specialty, small-scale grain production: the price of professionally cleaning small batches, the amount of and expense of harvesting equipment, price of packaging/labeling for direct sales, and limited consumer knowledge and interest for some specialty grains in the CSA model.

Overall, the farmer has not found a well-developed demand for local grain—or at least, not enough of a demand to command the sort of prices he needs for a profitable enterprise. However, he does see potentially for grains in rotation on diversified farms, especially when equipment is shared, or a few farms pool together for professional cleaning. Burgeoning organizations such as the North Coast Grain Growers Network and the Community Grain Project (Bay Area) are possible resources for that sort of collaboration.

CONCLUSION

This project hopes to convey a brief set of insights and a toolkit for beginning farmers as they start thinking about if, when and how to start approaching non direct-to-consumer market channels. Overall, the challenges and barriers of selling produce wholesale may not be the best place to start for beginning farmers still learning the intricacies of their soil, feeling out their business plan and growing accustomed to the time frames and unexpected character of each season's harvest. That said, if they do decide to pursue those markets at some point, they should start with just a few commitments and make sure those relationships get off on the right foot. As beginning farmers grow and get a little more experience, there is a lot of potential to explore direct-to-grocery store, wholesale distributor channels and other innovative outlets. Moreover, there is potential to carry and highlight their story in these markets—and a lot of grocery stores and even distributors in Sacramento and the Bay Area are looking to advertise that story.

Basically, a farmer trying to establish relationships with any type of produce buyer needs to be able to confidently answer a few key questions: Do I have a very clear idea of what the buyer expects from me in terms of quality, quantity, timing and price and can I deliver it? Can I maintain the relationship and provide consistent deliveries? And do I have a clear line of communication that I can maintain with the buyer and address any questions or concerns that emerge? And, if looking to farm-identify, do I have a clear, articulate picture of my farm's story and what makes it unique?

Once a grower feels confident and comfortable with all these questions, there are a lot of avenues to explore in wholesale direct and distributor markets in this region. From our interview results, the markets appeared more flexible—especially in volume—than we initially expected and most of that flexibility depends upon strong relationships with individual produce buyers. So becoming comfortable communicating with produce buyers and learning the rhythm and language of the industry is a crucial first step in finding and developing market niches to fit their operation.

Finally, in the research process on this project, we were continually struck by the importance of communicating with other farmers in the area. There is a wealth of experience to draw on, and other farmers can provide a sense of what markets may be too saturated or tough to break into, what kind of prices to expect, or where they have found a successful niche. In addition, there may be opportunities for aggregating product with other small farmers, cooperative cold-storage, group GAPs to meet food safety requirement and so on. Basically, the more conversation and brainstorming a beginning farmer has around marketing channels and possibilities the better.

APPENDIX

Table 1: Summary of Grocery Stores and Buying Requirements

Organization	Type	Volume*	Other Requirements	Comments
Nugget Markets	Independent Grocery, 9 stores	High	No	Prefers to buy through NorCal, not a lot of direct relationships.
Sac Ntl Foods Coop	Independent Grocery	Mid	Organic	Buys 80% direct, but already have lots of established relationships so probably need a unique product.
Corti Brothers	Independent Grocery	Low	No	Appreciates flexibility/quick deliveries early in relationship.
Taylor's Market	Independent Grocery	Low	No	Price needs to be reasonably close to NorCal, clear communication and follow-up.
Whole Foods (Davis location)	Supermarket - National	Low-mid	Everclean audit, COI	Can deliver direct to just one store. Especially looking for unique/specialty fruits. Davis location has small produce section, Roseville more likely to try new things.
Lorenzo's Market	Independent Grocery	Low	COI	Produce manager not the produce buyer. Open to buying local, but need clear communication from growers (has been a challenge in the past).
Raley's	Supermarket - CA, NV	Low-mid	iCiX compliance: COI, Food Safety self-audit	Actively looking for more direct growers to join the "Living Local" program (w/in 50 miles of store). Some cost to joining iCiX and paperwork involved but encourage growers to build a relationship
Oto's Marketplace	Independent Grocery	Low	No	Open to supporting local as much as possible, but not as interested in organic. Definitely looking for specialty Asian vegetables.

Table 2: Summary of Wholesale Distributors, Aggregators and Hub

Organization	Type	Volume	Other Requirements	Comments
Produce Express	Wholesale	Mid	No	Open to buying for the warehouse or for farm-identified sales to restaurants.
NorCal Produce	Wholesale	Mid-High	COI, Primus certification for food safety	Looking to buy local, organic and unique items but need high-quality and decent volumes (unless a very rare product).
Veritable Vegetable	Wholesale	Mid-High	No food safety, possible COI	Have lots of established relationships, so probably need something that sets your product apart (distinct, quality, variety). Try to build strong, ongoing relationships with farms.
Good Eggs	Virtual Foodhub	Low	COI - 1 million coverage	Online direct sales with lots of potential for publicity, marketing. Have to deliver to SF frequently.
Capay Valley Farm Shop	Aggregate	Low	No	Interesting model to reach wholesale and CSA
Area Hospitals (CAFF/Kaiser Permanente)	Institution	High	Food Safety, C.O.I	Very stringent requirements for hospitals, though lots of interest in buying local and organic. Strong relationship with aggregates like Coke Farm.

Online Resource Guide

General Resources

Community Alliance with Family Farmers (CAFF) Marketing Tool Chest: A comprehensive (174 pages) marketing toolkit developed by the Community Alliance for Family Farmers with SWOT analysis, tip sheets for different marketing channels, food safety resources, organic certification, etc.: http://caff.org/wp-content/uploads/2013/11/ToolChest_032714-WQ.pdf

farmsReach Marketing and Sales toolkit: Very useful set of online resources covering a broad range of topics for the beginning farmer—just need to do a free registration for farmsReach. On the marketing end, tons of useful links including a handy, free "produce pack guide" adapted from the Family Farmed *Wholesale Success* publication: http://www.farmsreach.com/welcome/marketing-sales/

ATTRA NCAT offers a long series of tip sheet for marketing, among other things. For all the marketing tip sheets: https://attra.ncat.org/marketing.html

"Selling to: Grocery Stores"
"Selling to: Wholesale Buyers at Terminal Markets"

UC Sustainable Research and Education Program (SAREP) "Breaking into selling wholesale" webpage has a lot of interesting information on values-based supply chains, creating farm profiles, tip sheets for different markets and general marketing advice.
http://asi.ucdavis.edu/sarep/sfs/breaking-into-selling-wholesale

"Marketing for Beginning/Small Farmers" from extension and organizations around the nation:

- Northeast Beginning Farmers Project: "Going to Market"
  http://nebeginningfarmers.org/2012/12/22/4-going-to-market/
- NC State "Growing Small Farms Program": Marketing to Independent Retailers
  http://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-marketingretailers/
- University of Kentucky, Cooperative Extension: "Marketing Fresh Produce to Food Retailers (grocery stores): http://www.uky.edu/Ag/CCD/marketing/grocers.pdf

NC "Growing Together," a collaborative, 5-year project amongst many different partners in the state of North Carolina seeks to bring more locally-produced food into mainstream markets. They have a lot of great resources and ongoing research that are useful even for producers outside the state.

Practical tools, walk-throughs and webinars for producers:
http://www.ncgrowingtogether.org/for-producers/

Interesting research on supply chains and local-to-mainstream markets:
http://www.ncgrowingtogether.org/research/

Produce News

Several terminal markets and individual wholesale distributors publish brief online newsletters on market trends. They can be very helpful for quick updates and staying in touch with the wholesale market as you contemplate prices and the best markets to approach, or avoid, as you plan. Moreover, they can help you familiarize with the some of the industry language.

***Fresh News,* San Francisco Wholesale Produce Market**: Bi-weekly publication of the terminal market in San Francisco.
http://www.sfproduce.org/news.html

Veritable Vegetable: Bi-weekly produce notes with an emphasis on the organic market.
http://www.veritablevegetable.com/produce-notes

Produce Express: Bi-weekly market outlook.
http://produceexpress.net/local-farm-to-table/m-o.html

The Produce News*:* Online and print publication covering global produce news.
http://www.producenews.com/

Pricing

There are many online sources for current wholesale pricing. However, the market fluctuates very quickly and can vary regionally, so definitely consider calling a few wholesale distributors in your area and asking for some current figures. As for direct-to-retail, visit some stores and get a general idea, subtracting the 30-40% markup. Or try and find out what they are paying from the wholesale distributor (many small independent grocery stores that buy direct supplement with one or two distributors).

The **USDA Agricultural Marketing Service (AMS)** publishes up-to-date price reports from terminal markets throughout the country—and archives prices back to 1998. Customizable reports for region, crop, etc. For fruits and vegetables:
https://www.marketnews.usda.gov/mnp/fv-home

The organic pricing report for the USDA is slightly less developed and often less reliable. Another option is the **Rodale Institute**, which offers conventional v. organic price comparisons. The conventional pricing comes from the USDA and the organic prices come from large wholesale distributors and sales agencies that specialize in organic produce:
http://rodaleinstitute.org/farm/organic-price-report/

University of Tennessee Guide for Direct Farm Marketing:
"A General Guide to Pricing for Direct Farm Marketers and Value-Added Agricultural Entrepreneurs"

Government of Alberta pricing overview
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex1141

Pack and Grade Standards

USDA Pack and Grade Standards:
http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateV&navID=FreshFruitandVegetableGradeStandardsandManuals&rightNav1=FreshFruitandVegetableGradeStandardsandManuals&topNav=&leftNav=&page=SCIResource&resultType=&acct=sci

farmsReach Produce Pack Guide (adapted from *Wholesale Success* familyfarmed.org):
http://asi.ucdavis.edu/sarep/sfs/vbsc-files/3-what-to-do-to-sell-to-the-buyers/INFOSHEET_ProducePackGuide.pdf

"Understanding Packaging and Specifications for Wholesale Markets": A webinar sponsored by NC Growing Together, NC Cooperative Extension and Southern SARE.
https://www.youtube.com/watch?v=F5ZrcKx3TZY

Food Safety and Policy

With the impending Food Safety Modernization Act and regulatory climate, Food Safety is certainly an important consideration for any marketing plans. There are a considerable amount of online and in-person resources available to farmers looking to navigate the process, from deciding if they need a third-party audit to developing standard operating procedures (SOPs). This is by no means a comprehensive list but offers some good starting points.

The **California Alliance for Family Farms (CAFF)** has a Food Safety Program and currently offer GAP training, resources and workshops at little or no cost until December 2015.

CAFF Food Safety Blog: http://foodsafetycaff.blogspot.com/

CAFF's GAPs resources: http://caff.org/programs/foodsafety/gaps/

CAFF also worked with a group of organic farmers and Cooperative Extension to develop an acceptable set of basic GAPs for such farms:
http://caff.org/wp-content/uploads/2012/06/CAFF-GAPs-July-2010.pdf

UC Small Farms program also has a lot of great resources compiled: http://sfp.ucdavis.edu/food_safety/
Manual: http://sfp.ucdavis.edu/files/143901.pdf

Group GAP might offer an avenue for small producers to collaborate and reduce the cost and difficulty of GAP certification. In a GroupGAP, an umbrella entity such as a food hub or support organization establishes BMPs and a quality management system. Each producer is still required to develop qualifying SOPs, but not every farm gets audited each year.

Currently, USDA AMS and the Wallace Center at Winrock International have a Group GAP pilot program. Here is their "Introduction to Group Gap":
http://static1.squarespace.com/static/520ed291e4b066a62d157faa/t/54d25dd2e4b0cd9033a2e516/1423072722034/01.12.15+Introduction+to+GroupGAP.pdf

For the full report and assessment of the pilot program: https://static1.squarespace.com/static/520ed291e4b066a62d157faa/t/5234bd14e4b0adf633e2c780/1379187988780/Group+Gap+Pilot+Project+Report.pdf

California Leafy Greens Marketing Agreement (CA LGMA)

General Website: http://www.caleafygreens.ca.gov/
Commodity Specific Guidelines:
http://www.caleafygreens.ca.gov/sites/default/files/01.20.12%20CALGMA%20GAPs%20-%20metrics.pdf

Food Safety Modernization Act (FSMA)

FDA website: http://www.fda.gov/Food/GuidanceRegulation/FSMA/default.htm

UC Center for Produce Safety:

https://cps.ucdavis.edu/

ALBA Food Safety Compliance Guide

http://www.albafarmers.org/pdfs/ALBA_FoodSafetyBroch_ENG%20final.pdf

Specialty Crops

UC Small Farms program has an extensive section on some specialty crops that have been successful in California—from blueberries to specialty Asian vegetables. Some of their "specialty" crops (e.g. strawberries) may no longer be considered niche products, but there is definitely a lot of useful information on for small farmers looking to explore specialty produce.

Check out their website for tips on what to grow and how to market it: http://sfp.ucdavis.edu/

The USDA Alternative Farming Systems Information Center (AFSIC) publishes a long "list of alternative crops and enterprises for small farm diversification." It could be a useful tool for brainstorming. There are also a lot of good links to various small farm and diversification publications:
http://afsic.nal.usda.gov/list-alternative-crops-enterprises-small-farm-diversification

Packaging

Here are some companies that supply the Northern California region with packaging materials:

- Feather River Packaging: http://www.featherriverpackaging.com/home.html
- Orbis Corporation: http://www.orbiscorporation.com/
- Uline: http://www.uline.com/
- Reynolds Packaging: http://www.oakpackaging.com
- Vegetable Growers Supply Company: http://www.veggrow.com/
- Denham Plastics LLC: http://www.denhamplastics.com

One-page Fact Sheets for Retailer/Wholesalers Interviewed

To create a tool for future CFA beginning farmers, we summarized interviews into a one-page sheet identifying the requirements, challenges and opportunities associated with each retailer and wholesaler. Importantly, these should not be considered a definitive reflection of the organization or necessarily an exact summary of their requirements and standards—especially as some of these requirements may change over time. Rather, they are a summary of our interpretation of each of the interviews. Hopefully they can provide some guidance for beginning farmers exploring the regional market.

Sacramento Natural Foods Co-op

SACRAMENTO NATURAL FOODS CO-OP

LOCALLY OWNED SINCE 1973

Description

Co-operatively owned grocery store with a large produce section and strong commitment to supporting local and sustainable agriculture. Buy mostly direct from farmers (around 80-90%) and fill in the rest from Veritable Vegetable. Require organic certification and farm-identify produce and distance from co-op.

Location

1900 Alhambra Boulevard, Sacramento, CA 95816

Contact Information

General: (916) 455-2667
Produce Director: Kerri Williams
kwilliams@sacfoodcoop.com

Requirements

Food Safety: None required
Liability Insurance: None required
Volume: No specific requirements, but need to be able to fill a fairly large produce display. Product dependent.

Challenges

- Require organic certification.
- Already have longstanding relationships for most popular items. Probably need something unique—or else tremendous quality—to get in the store.
- Have high quality standards and need to product to hold up well on shelf, even with lots of handling/abuse by customers.
- Need very clear, effective communication for a successful long-term relationship.

Opportunities

- They strive to support the local food system as much as possible, and farm-identify nearly all the produce with both farm name and distance from co-op.
- Place premium on local food, so can pay slightly above wholesale/market prices in direct sales.
- Have a large produce section for an independent grocer and can move a good deal of product.
- Encourage opportunities to connect with customers and store through demos, events, lunches, etc.

Nugget Markets

Description

Independent, family-owned (Stille Family) grocery stores with 9 locations in the greater Sacramento area. Focus on high-quality produce. Advertise "local" (within 100 miles) and often specific location. Mostly purchase through Nor Cal Produce (Sacramento wholesaler).

Location(s)

Greater Sacramento Area

Contact Information

Buying Office: (530) 669-3300
Director of Produce and Floral:
Adam Bazarnik
530-669-3347 (office)
916-548-5651 (cell)
Adam.Bazarnik@nuggetmarket.com

Requirements

Food Safety: None required—though if buying through NorCal Produce, need third-party certification (Primus).
Liability Insurance: None required when buying direct.
Volume: Rarely buy direct to just one store, so generally need enough volume to supply all 9 stores. From there, varies by crop. If the product is going to be farm-identified, they expect multiple deliveries and need firm time-table for display or ad.

Challenges

- Relatively high volume requirements for a small grower to supply all nine stores. Do occasionally buy just for one store, so still worth approaching.
- Very high quality standards, sometimes a limiting factor.
- Prefer to buy through NorCal Produce to have a “gatekeeper” for quality. Small percentage of produce purchased direct from growers.

Opportunities

- From a small grower perspective can move a lot of volume if you have it.
- Once relationship is established, will profile farms in store with posters and pictures, do demo days and provide space to grow the brand and advertise.
- Good reputation for quality produce and attentive customer base.

Taylor's Market

Description

Independently-owned specialty grocery store in Sacramento that opened in 1962. Gourmet meat department, specialty groceries and a fresh produce department. Also have an affiliated restaurant next-door called "Taylors Kitchen."

Location

2900 Freeport Boulevard
Sacramento, CA, 95818

Contact Information

General: 916-443-6881
Produce Buyer: Bruce Kushida

Requirements

Food Safety: No certification required currently.
Liability Insurance: No certificate (COI) required.
Volume: No requirements, and can take small volume deliveries.

Challenges

- Prices need to be competitive or in the ballpark of Nor-Cal produce.
- Buyer needs consistent communication, follow-up and clear delivery schedule; needs to be "hassle-free."
- High-quality standards; all number 1s.
- Buyer would prefer something unique—small produce section and doesn't move that much chard, kale, etc.; instead, maybe herbs or unique fruit varietal.
- At the moment, don't have an established "local" sales label; but are open to advertising by farm with good relationships

Opportunities

- Are looking to buy local and don't have tons of established relationship, so definitely room for more direct suppliers if conditions are met.
- Small produce section and can take small volumes—though they do need consistent deliveries over a period of time (at least a few weeks) to make it worthwhile.
- They have a companion restaurant next door that orders through the produce department.
- Will do demos and occasionally some signs (small produce section so not tons of room)

Corti Brothers

Description
Independently-owned, specialty Italian market in Sacramento founded in 1947. They have a storied reputation as a specialty market and a good-sized produce section.

Location
5810 Folsom Blvd, Sacramento, CA 95819

Contact Information
General: (916) 736-3800

Produce Buyer: Howard Cream
(916) 736-3804

Requirements
Food Safety: No certification required currently.
Liability Insurance: No certificate (COI) required.
Volume: No specific volume requirements. Can handle relatively low volumes.

Challenges
- They already have existing direct relationships for a lot of popular summer crops (e.g. heirloom tomatoes).
- They need consistent communication and clear delivery schedule and expectations so produce manager can coordinate wholesale orders.
- Looking for high-quality produce and want to try a good selection of samples before buying.

Opportunities
- Strong customer demand for local produce, so always on the lookout for new suppliers.
- Will take half-cases/lower volumes.
- Farm-identify in store and are open to doing demonstrations.
- Possible price premium for local items.
- Possibility to build relationship and supply niche/specialty items (e.g. spring nettles, hardneck garlic varieties)

Raley's

Description

A supermarket chain with 139 locations (includes Raleys, Bel-Air and Knob-Hill) in California and Nevada. Their new "Living Local" program advertises family farms within 50 miles.

Location

Many stores around Sacramento and Bay Area.

Contact Information

General: (800) 925-9989
Living Local Program: Gary Ruggiero
gruggier@raleys.com
(408) 718-4529

Requirements

Food Safety: GAP self-audit required (forms available online)
Liability Insurance: Require certificate (COI) with Raley's added as additional insured.
Volume: No specific requirements.

Challenges

- Certification requires audit approval and paperwork uploaded to iCiX: can be time-consuming and annual fees of $199 for iCiX (though possible discount for "Living Local")
- High quality standards.
- Price needs to be in the ballpark of market prices from distributors—more of a premium for organic and local.

Opportunities

- They are looking to expand their local section with the "Living Local" program and build long-term relationships.
- Low volume requirements and can tailor relationship with just one store.
- Also, there are opportunities to move volume and provide the regional center/multiple stores.
- They farm-identify with "Living Local" and work with growers to build and advertise their story in the store with displays, posters, and demonstrations.

Whole Foods

Description

Gourmet supermarket that prides itself on high-quality, fresh and often organic produce. Many locations in the area and do buy direct from farmers on a single store basis.

Location(s)

5 stores in the Sacramento area: Davis, Sacramento, Roseville, Folsom, Napa
10 stores in Bay Area
Davis: 500 1st St, Davis, CA 95616

Contact Information (Davis)

General: (530) 750-2266
Produce Buyer: Adam Wilson
adam.wilson@wholefoods.com
Regional Distribution Center
6035 Giant Road, Richmond, CA 94806
(510) 662-3580

Requirements

Food Safety: Everclean audit required (third-party).
Liability Insurance: Certificate of limited liability insurance (COI) required
Volume: No specific requirements and can take on small volumes (especially in Davis).

Challenges

- Everclean audit process for food safety.
- Don't require organic certification, but strongly encouraged.
- The Davis location already has established relationships with the mid-size Capay Valley farms and a small produce section; need to somehow differentiate your product.
- Price needs to be close to what store gets from Regional Distribution Center.
- Encourage organic certification.

Opportunities

- Definitely interested in expanding and advertising local, farm-identified produce from the area.
- With enough volume, potential to supply the Regional Distribution Center.
- Will promote farms in the store with signs, displays and demo days.
- Very interested in specialty fruits (e.g. tayberries, ollaliberries, unique citrus)
- Customer base willing to pay premium for high-quality, fresh, local produce.

Oto's Marketplace

Oto's Marketplace

Description

Independent grocery store in Sacramento opened in 1959. Specialize in Japanese foods, along with other Asian products and have farm fresh produce "brought in by local farmers." Also have homemade bento boxes and sushi.

Location

4990 Freeport Blvd, Sacramento, CA 95822

Contact Information

General: (916) 424-2398
Produce Buyer: Duane Kushida
http://otosmarketplace.com/1/

Requirements

Food Safety: No certification required (currently).
Liability Insurance: No certificate of insurance (COI) required.
Volume: No volume requirements—often looking for smaller volumes.

Challenges

- Do not have a strong customer demand for just organic—but definitely try to support local growers.
- While they don't have volume requirements—and often deal in small volumes—want consistent deliveries and to build relationships.

Opportunities

- Very interested in buying local and will farm-identify with name and occasionally poster or sign.
- Also looking for local specialty Asian vegetables. E.g. Japanese cucumbers, long beans, kokabu, kabocha, shungiku, gailon etc.
- Potential market for non-industry standard pack on some items: daikon with greens, spinach with the roots, etc.
- They are looking to build long-term relationships with farms.
- Will do demos with fresh fruit, specialty Asian vegetables.

Produce Express

Description

Wholesale produce distributor based out of Sacramento. Strong advocates of "Buy Fresh, Buy Local" and have many established relationships with local farms.

Location

2630 5th Street, Sacramento, CA 95818

Contact Information

Office: (916) 446-8918
Sales Representative: Jim Mills
(916) 825-9004 (mobile)
jimmills@produceexpres.net

Requirements

Food Safety: No certificate required, but expect farm to take care of it
Liability Insurance: No certificate required, but expect farm to take care of it
Volume: No set formula, but need some volume for a period of time; not looking for one-off deliveries

Challenges

- They need a finished product—packed, graded and labeled
- More volume required to fit in the warehouse
- Have a good idea of the price you can offer; if looking to supply the warehouse you will be competing with market prices
- Helpful to have a unique, interesting product—probably not interested in anymore heirloom tomatoes
- Growers needs to be flexible and not expect any guarantees—competing with the market whether it's conventional produce houses or local, organic from the Capay Valley

Opportunities

- Will work with diversified growers throughout the season
- Supply 1200 restaurants in the greater Sacramento area, so can move volume
- Some customers interested in sourcing local, farm-identified produce—and order from farm-specific availability lists

Nor-Cal Produce

Description

Wholesale produce distributor based out of Sacramento that supplies high quality produce to many area grocery stores. Family-owned and operated business for over 40 years.

Location

2995 Oates St, West Sacramento, CA 95691

Contact Information

General: (916) 373-0830
Organic Buyer: Fran Lewis
fran@nor-calproduce.com

Requirements

Food Safety: Primus certification required (third-party)
Liability Insurance: Limited liability insurance required (COI) with Nor-Cal added
Volume: No specific requirements

Challenges

- High quality standards, and need consistency in pack
- Require great post-harvest handling—probably need cold storage
- They need clear and consistent communication on pricing and availability
- Have established local relationships in the Capay Valley and will not give those up just to try something new
- Slight flexibility with pricing—especially in organic—but needs to be very competitive with market prices

Opportunities

- They are always looking for local, unique, top-quality produce to set them apart from other distributors
- Can move high volume from a small grower perspective
- Move local produce 365 days a year, so open to relationship throughout the growing seasons
- Encourage prospective growers to come in, take a tour and make sure quality standards are clear

Good Eggs

Description

Food hub that sells and delivers farm-identified produce, meat, dairy and value-added products through online orders. Currently in the SF Bay Area, Los Angeles, New York (Brooklyn) and New Orleans.

Location (Bay Area)

630 Tennessee St, San Francisco, CA 94107

Contact Information

General: (415) 483-7344
sfbay-makers@goodeggs.com
Foodmaker Team Member: Darren Yondorf
(415) 766-9588
darren@goodeggs.com

Requirements

Food Safety: No certification required currently – subject to change in the near future.
Liability Insurance: Limited Liability Insurance of over 1 million, with Good Eggs added as additionally insured party.
Volume: No specific requirements.

Challenges

- Requires frequent deliveries into city of San Francisco.
- Farm needs to manage online web-stand with availability and prices—however, plenty of support provided by Good Eggs staff.
- No guaranteed or set amount of produce. Everything purchased by consumer in a just-in-time model, but able to set ceilings on availability.

Opportunities

- Orders are confirmed 36 hours prior to delivery, so some time to plan harvest and delivery
- Able to command a premium for farm-identified, local produce.
- No start-up cost to register, so relatively low risk.
- Profile is placed front and center in the online marketplace, so lots of exposure and possible future connections in Bay Area.
- Ability to “sell” farming practices and story through the online profile.

Veritable Vegetable

Description

San Francisco based wholesale distributor of certified organic produce. Committed to forging strong relationships with growers, vendors and other organizations to actively improve the sustainable food system.

Location

1100 Cesar Chavez St, San Francisco, CA 94124

Contact Information

General: (415) 641-3500
http://www.veritablevegetable.com/
Buyer: Bianca Kaprielian
(415) 550-4847
bianca@veritablevegetable.com

Requirements

Food Safety: No certification required (currently)
Liability Insurance: Not sure, possible certificate
Volume: No specific requirements, but not likely to take on very small volumes unless it's a unique product

Challenges

- Competing with market prices
- Have established, existing relationships for most products—probably need very high quality or unique product to start a relationship
- Need good post-harvest handling to ensure product will hold-up throughout the supply chain
- Consistency in pack and quality
- Strongly encourage organic certification
- If they are picking up: need enough volume to make it worthwhile, but can be a mixed pallet

Opportunities

- Wide customer and vendor base, especially in Northern California
- Once relationships are establish, they try to support the grower as much as possible throughout the season
- They do have a market for number 2s, so can move lesser quality product but need clear communication to make it work
- Appreciate diverse offerings from smaller producers

Capay Valley Farm Shop

Description

The Farm Shop is a community-owned organization that aggregates produce from 40 farms in the Capay Valley, selling and distributing through a CSA, institutions and wholesale accounts.

Location

P.O. Box 581, Esparto, CA 95627

Contact Information

General: (530) 383-9022
info@capayvalleyfarmshop.com
President: Thomas Nelson
thomas@capayvalleyfarmshop.com
(530) 796-4160 land
(530) 867-4926 mobile

Requirements

Food Safety: No audit or certificate required (currently)
Liability Insurance: No certificate required. Farms receive umbrella insurance through Farm Shop.
Volume: No defined requirements.

Challenges

- For CSA box, must be in Capay Valley—they aim to serve local grower base
- Requires good, ongoing communication with the farm shop and some coordination/cooperation among area farmers.
- Commitment to high-quality pack

Opportunities

- Interesting model for collection of farms growing variety of produce, meat, grains to reach broader markets—aggregated CSA, direct-to-office, wholesale
- Brands and advertises both the region and the farm
- Online presence can help connect consumers to farm through the Farm Shop
- Pick-up from farms
- Farm Shop manages sales relationships—farmer can just focus on farming

Class Exercise 8/28/2014: Approaching Buyers

Objective

The aim of this exercise is to practice a mock approach of a produce buyer using the business plans you've been developing. While each buyer has their own idiosyncrasies, we did identify a few common threads on the sort of information they look for in the first approach. Change the exercise to tailor your specific crop or market as needed—while the approach to a fruit/nut processor or shipper is probably a little different, some of the principles may carry over.

Some considerations:

- Buyers are open to, and encourage, talking before product is ready, but they may expect a little more clarity than simply asking "what should I grow." They worry about setting an expectation that they will definitely buy that product before knowing quality, timing, price, etc. That said, they are definitely open to talking about unique crops and varietals. Just be clear that you are not expecting a guarantee.
- Approximation of how much product you'll have, for how long and when it will be ready.
- Future plans: are you looking for a long-term relationship, planning for growth, etc.
- Almost always need product in hand for first sale.
- Have a good idea of the prices you need to get to cover costs—prospective availability sheet definitely helpful.
    - For wholesale markets: Less flexibility in pricing. But, especially with organic produce, call around to a few wholesalers and get an idea the current rates (this can help rule out wholesale as well).
    - For direct-to-retail: Slightly more flexibility, depending on store and how much they advertise local and farm-specific produce. Note that some stores do not expect a price premium for local in store—definitely worth visiting before-hand to get a feel for the store.
- Be sure to ask how they like to be contacted (email, phone), how often during the season and then follow up.
- Ask if they have any unique pack and grade expectations.

Exercise

1. Divide into groups of 4.
2. Split up into roles: One person making approach, one produce buyer and two observers to provide feedback.
3. If you want, identify a particular organization to approach from the fact sheets. Otherwise, just use a vague category: Wholesaler, Grocery Store, Food Hub.
4. Take a few minutes to prepare.
    a. Produce buyer and observers review possible questions on the back of this sheet. Definitely feel free to brainstorm and jot down other questions.
5. Conduct mock meeting: Think of the meeting as an in-person first approach with or without product in hand.

Some sample questions for produce buyers

- Tell me about your farm.
- What are you growing?
- How much are you looking to sell here?
- When do you expect it to be ready this year?
- And for how long will you be harvesting it?
- What days of the week and time can you deliver?
- What kind of quality are you expecting?
- What kind of pack do you plan to deliver? Do you already have boxes?
- Are you looking for a long-term relationship? Will you have more product in the future?
- What kind of food safety standards do you have in place?
- Do you have limited liability insurance? Could you add us as additional insured party? (if required)
- (retail) Do you have a logo that you'll use on packing boxes, or that we could put on display?
- (retail) Are you interested in doing demos

Post-harvest handling:

- Do you have cold-storage? Or the labor flexibility to harvest at night or really early in the morning? Does your product need to be iced (i.e. corn)? If so, do you have the equipment or an arrangement with someone to use their machine?

Interview Guide for Retailers/Wholesalers

SOURCING PRACTICES, CONDITIONS AND EXPECTATIONS

First, I would like to ask you a few quick questions about your sourcing practices. The aim is to help inform beginning growers trying to enter into the market and develop relationships with retailers.

1. **Do you buy directly from growers? What about local growers? Any small growers?** *(find out what "small" means to them in terms of volume of product or acreage of farm)*

   1 a) If you do not buy directly from growers, why not?

   1 b) What would it take for your store to purchase directly from growers?

2. **What do you look for in new relationships with growers? Any specific criteria?** *(Prompts to find out about: volume, quality, liability insurance, food safety certification)*

3. **Are you willing to work with a diversified grower through the seasons, as the crops change? If so, how do you negotiate that process?** *(contracts, planting decisions, timing)*

4. **What has worked well in past relationships with small, local growers?**

5. **What are some challenges you've had in relationships with small, and/or new growers?**

6. **Are there any other key conditions a *beginning* grower should think about?**

ADVERTISING AND BRANDING

We are also trying to gauge the potential value of promoting the beginning grower story in the retail marketplace. And how that story might be promoted and labelled.

7. **Do you advertise the "local" brand in-store? Is so, how? I not, why not?**

8. **How large a percentage of your fresh produce is branded as "local"?**

9. **Do you receive a price premium for the "local" produce? [Do growers?]**

10. **Do you advertise products from specific farms? Why or why not?**

11. **Do you think customers might be interested in the beginning grower story? If so, what aspects of it?** *(young, small, non-corporate, etc.)*

12. **Would any sort of labeling or logo help promote that story?** *(and specific packaging)*

13. **Do you ever do in-store events with growers? If so, has it been a helpful form of publicity for the store and the growers?**

<u>WRAP-UP</u>

14. **Do you have any other comments or advice to beginning growers trying to enter into retail markets?**

15. **Can you suggest any other market channels that might be interested in sourcing and advertising products from beginning farmers?** *(institutions, corporate offices, health-care organizations, senior centers, etc.)*

16. **Would it be okay for the program director to contact you about developing relationships with CFA graduates?**

Interview Guide for Farmers

<u>Experience Selling Produce</u>

1. **Where do you sell your product currently?** *(Get approximate percentage breakdown)*

2. **If you have, or do, currently sell retail/wholesale, how did you initially start that relationship?**

3. **If you have wanted to break into retail/wholesale markets but have had difficulties, what were some of the challenges?**

4. **What has worked well in relationships with retailers/wholesalers?**

5. **What sort of challenges have you had in those relationships?**

6. **How long have you been farming?**

7. **What do you grow? Is there anything you had to stop growing because you could not find a market for it?**

<u>Marketing and Branding</u>

8. **Have you tried to invest time and resources into branding your farm and story? Why or why not?**

9. **What ways have you gone about sharing your story? What has worked well? (***online, farmers markets, demos w/retailers)*

10. **Do you do any logos or labeling on packing boxes, twist-ties, etc.? Why or why not?**

11. **Do you get better prices for labeled products? More volume demand?**

12. **Any other advantages from labeled products? Direct contact from consumers?**

<u>Lessons about what works for small, beginning farmers</u>

13. **From your experience, what are the top 1 or 2 things that beginning farmers should be aware of when selling to retailers? Wholesalers?**

14. **Would you do anything differently?**

Center for Land-Based Learning
CALIFORNIA FARM ACADEMY
5265 Putah Creek Road, Winters, CA 95694 530.795.4146
jennifer@landbasedlearning.org maureen@landbasedlearning.org sara@landbasedlearning.org

Farm Business Incubator: Final Report

Lease term: January 1, 2015____ – December 31, 2015____
Name: __Jay Cuff (Hearty Fork Farm)________

DATA

✓ Updated Crop Plan

crop – variety – direct seeded / transplanted - amount planted – first& last plant date - first & last harvest date - total amount harvested

How would you rate the success of each crop? low 1 2 3 4 5 high

What were some production practices that contributed to the performance of the crop?

SEE ATTACHED DOCUMENTS

✓ Income Statement

SEE ATTACHED DOCUMENT

✓ Markets

What markets did you sell your produce? Please be specific.

Country Club Plaza farmers' market (Sacramento)--5
Capitol Mall farmers' market (Sacramento)--3
Collins Farmstand (Davis)--4
Knights Landing Pop-Up farmstand (Knights Landing)--3
Ginger Elizabeth Chocolates (Sacramento)--5
INNA Jam (Berkeley)--5
June Taylor Jams (Berkeley)--4
Blue Chair Fruit Co. (Berkeley)--3
Katz Jams (Napa)--4
SpoonRocket—prepared meals (Berkeley)--4
Thistle—prepared meals (Berkeley)--4
Fat Face restaurant/food truck (Davis)--3
Kupros restaurant (Sacramento)--5
Hot Italian restaurant (Sacramento)—4
The Waffle Experience restaurant (Sacramento)--5
Fabian's restaurant (Fair Oak)--3
Magpie restaurant (Sacramento)--3
Grange restaurant (Sacramento)--4
Almanac Beer Co. (San Jose)--5

How would you rate the success of each market? low 1 2 3 4 5 high

See ratings above

What were some practices that contributed to the performance of the crop?

SEE ATTACHED DOCUMENTS

✓ Business Requirements

Example: producers license, insurance, etc.

Who required it, how & where did you get it?
Producer's Certificate—Solano County
Farm Insurance—State Farm (Sacramento)
Workers Comp Insurance—The Zenith (Roseville)
Payroll service—ADP
LLC filing—CA Secretary of State
Organic Certification—Yolo Certified Organic Agriculture (Woodland)

✓ Hours

What were your approximate hours worked per week for each month of the season?
JANUARY: 40 hours/wk
FEBRUARY: 50 hours/wk
MARCH: 60 hours/wk
APRIL: 60 hours/wk
MAY: 80 hours/wk
JUNE: 70 hours/wk
JULY: 70 hours/wk
AUGUST: 65 hours/wk
SEPTEMBER: 70 hours/wk
OCTOBER: 60 hours/wk
NOVEMBER: 50 hours/wk
DECEMBER: 40 hours/wk

NARRATIVE

✓ What was your plan at the start of the season? How did it change?
My plan at the start of the season was to produce tons of produce on all 8 acres of land available. I wanted to do most of the work myself, but I very quickly realized that I needed more help to have any kind of success. I had to rebuild my plan to include 4-6 employees. I hired late, however, and I got behind early, never fully catching up the rest of the year. When I did hire employees, costs skyrocketed, forcing me to be much more mindful of where I spent my money, and causing me to make cuts to different areas of my budget. My marketing plan suffered as well, since I wasn't able to dedicate enough time to marketing outreach. In the end I struggled until the end of the year.
With the addition of blackberries to my farm, my time became even more pinched with deliveries. I was spending too much time away from the farm, and my crops suffered as a result.
As the end of the year approached, I had to recreate a new plan for the next year, budgeting out my time and resources more appropriately. It was a difficult learning experience, but I feel more confident moving into the new year with a more solid, realistic plan for success.

✓ Which tools did you find most effective? Are there any tools you wish you had used?

I found that using a chisel plow (rather than a disc) in my fields was most effective, and I will be looking to purchase one in the very near future. I'm also looking for ways to decrease the amount of tillage I need to do overall, so minimal tillage is the goal for the future.
I would have liked to become more skilled in using the tractor for cultivation. I didn't feel confident enough in my tractor driving skills to do it this year, but I will improve next year.
A flame weeder would be nice. I need to figure out better, more efficient ways to manage weeds.

- ✓ What were successes this season? Please answer with regard to each of these categories:
  - Crops: *Hakurei turnips, Rutabagas, Napa cabbage, Herbs, Cherry tomatoes.*
  - Marketing: *Jam makers and small niche companies (private chefs, small value-added producers).*
  - Your business: *Through experience, learned how to better manage time. Also became a better employee manager. Didn't incur debt, so I feel fortunate enough to survive to the next year.*
  - Labor / Time management: *Very challenging, but I learned to make a better schedule for my own time as well as my employees' tasks. Better planning makes for a better year.*

- ✓ What were some unexpected challenges this season? Please answer with regard to each of these categories:
  - Crops: *Weeds were overwhelming, causing much crop loss. Weed control will be my primary focus moving forward.*
  - Marketing: *I didn't allow enough time for marketing. I need to get out and talk to more potential buyers (stores, other CSAs, small value-added producers).*
  - Your business: *Wasn't as prepared for the year as I should have been, and I got behind very early, constantly trying to catch up.*
  - Labor / Time management: *Labor was more expensive than expected, so I need to budget more for next year.*

- ✓ What will you do differently next season?
  Plan out my year better, *get off to an early start and stay ahead of the business. Understand that problems will crop up so I must budget extra time for any possible issues.*

- ✓ What were some life lessons as a beginning farmer in the CFA incubator program? What would you tell incoming incubator farmers?
  I learned that dealing with tremendous stress is a part of farming, and proper coping mechanisms will keep you sane. Understand that you are a small business owner first, and take care of all your business responsibilities (paperwork filing, taxes, marketing, regulatory obligations) as soon as possible. Don't get behind—it will catch up to you. Be patient with your crops while at the same time be very attentive. Make sure your fields are clean and your yields will become evidence of your attention. Farming, like much of life, is about building relationships. Take help when it's offered, offer help when you can. Be kind, caring, and considerate—it will pay off for you in the end.

Hearty Fork Farm Crop Ratings 2015

Crop	Variety	Success Rating (1 to 5)	Production practices that contributed to crop performance
Beans	Jade (Green)	4	Great producer, very popular at market. Will need to plant more next year. Weeds were an issue, need to keep clean. Need new trellising system (possibly use netting). Applied inoculant.
Beans, Fava	Windsor	n/a	First time I've planted Fava, a winter crop that is planted in November & harvested in spring of following year. Growth looks great so far.
Beets	Red Ace F1	5	Perennial favorite, always good. Keep well-watered to ensure proper bulb formation. Fairly resistant to disease. From experimentation with other varieties, this one seems like the best overall.
Beets	Golden Detroit	5	Great crop, grows well with relatively little attention, although sparse germination. Requires thicker seeding, lower yields than other beets.
Beets	Chioggia	5	Another winner, very few problems. Greens are perhaps the best of all the beets. Need relatively little attention.
Blackberries	Obsidian	5	Bumper crop of Obsidian berries this year. This is the earliest variety, sold 90% of crop to jam makers. Not organic. I work with Petrik Ag to control all fertilization & pest control issues. Berry infrastructure is failing after 7-8 years on these trellises, so some cost to repair poles & wires. More precise pruning this year produced larger yields for all berries.
Blackberries	Natchez	4	See above. Natchez are medium-sweetness berries that are meant to bridge the gap between early (Obsidian) & late (Triple Crown). Sold mostly at fresh market since they're not terribly popular with any jam makers. Easy to pick.
Blackberries	Triple Crown	5	See above. Best sellers.
Bok Choi	Shanghai Green (Baby)	4	Planted late, so not as successful as hoped. Several customers said they prefer baby size. Need more uniform fertilizer schedule next year.
Broccoli	Belstar F1	5	Great crop, very successful. I've tried other organic varieties, and Belstar seems to be the best. Good germination & very little loss. No pests.
Broccoli Raab	Spring Raab	1	A big bust. Direct seeded in early spring, crop never fully germinated. No harvest. Next year I'll use transplants.
Cabbage	Impala F1 (Green)	3	Good crop. Heads were a bit loose, probably due to overwatering & lack of consistent fertilizer. Monitor for next year.
Cabbage	Red Express	3	Heads didn't fully form as well as hoped. Lost quite a bit due to rot (because of heavy rain) late in the year. Plant earlier next year.
Cabbage	Kaboko (Napa)	5	Very successful. Possibly the best cabbage we produce. No pest issues, almost no loss. Great full-size heads.
Carrots	White Satin	1	Total loss. Did not germinate. Due to inattention, weeds overtook seedlings.
Carrots	Atomic Red	1	Total loss. Did not germinate. Due to inattention, weeds overtook seedlings.
Carrots	Solar Yellow	1	Total loss. Did not germinate. Due to inattention, weeds overtook seedlings.
Carrots	Cosmic Purple	1	Total loss. Did not germinate. Due to inattention, weeds overtook seedlings.
Carrots	Scarlet Nantes	4	Great crop. One of the most successful crops at farmers' market. Very successful this year, will continue with this variety into the future.
Cauliflower	Snowball	3	Good crop, but bolted too soon. Need to plant smaller numbers, but more successions. Harvest all just as they're ripe. Will not hold in field.
Cauliflower	Romanesco	5	Best cauliflower, possibly most popular winter crop. Did well with lots of rain. No pests. Harvested & sold all. Continue next year.
Chard	Rainbow	4	Succesful as always. Slightly lowered yield because dead leaves were not removed promptly. Otherwise great.
Cilantro	Cilantro	4	Another great crop. Fairly easy to grow, must keep well-weeded.
Cucumber	National Pickling	5	Great success. Needs more water & proper fertilization schedule next year to increase yields.
Cucumber	Marketmoore 76	4	More successful than expected. A change in variety from last year, this variety was much more pest-resistant & had higher yields. Will use again.
Cucumber	Armenian	5	One of our best crops. Huge hit at farmers' markets. Great performance even with less water this year. Yields were not as high as last year.
Cucumber	Lemon	5	Very popular. Fruits were small this year, must get more water & fertilizer next year.
Dill	Bouquet	4	Easy to grow & sell. Sold flowers for pickles. Always successful.
Eggplant	Rosa Bianca	2	Sort of a disaster. Some fruits, but due to lack of proper weeding, became overrun with pests. Also realized that I don't really like eggplant, so I will not be growing any in the future.
Fennel	Florence	3	Very good crop, but rated lower because I failed to plant enough to make it successful. Will plant more next year. Doesn't need much water.
Flowers	Several (WINTERS PLOT)	1	Total disaster. Did not take care of any flowers, lost them all. What a mess.

Garlic	CA Early White	4	Very good crop. Need to plant more next year. Also need to fertilize in early spring and no later. Otherwise may rot.
Gourds	Mixed (Ornamental)	2	Mildy successful, but I don't think I want to use valuable planting space for inedible crops used only for decoration.
Horseradish	Horseradish	1	Actually performed quite well, but I wasn't successful with marketing. Relatively easy to grow, needs moderate water. Next time I'll over-winter for better flavor.
Kale	Vates (Curly)	4	Good crop, but the leaves on this variety are a bit small. Have a large overstock of seeds, though, so I'll continue with it for next year. Must improve fertilization schedule (every 2-3 weeks).
Kale	Dino	4	Good staple crop. Will increase yields next year with regular fertilization schedule (every 2-3 weeks).
Kohlrabi	White Vienna	5	Very popular, great reception at market. Did very well in the field, no pests, harvested & sold entire crop. Keep up the good work!
Kohlrabi	Purple Vienna	4	Good crop, but because of lack of weeding, not all crop was harvested. Keep plants clean.
Leeks	King Richard	4	Stalks were a bit thin due to underwatering.
Melon	Galia	3	Harvested only a few fruits. Good crop but didn't water well. Be more attentive next year.
Melon	Cantaloupe	1	Did not harvest, fruits were extremely small or did not ripen properly. Underwatered.
Melon	Honeydew	1	Failed to germinate due to lack of sufficient water.
Melon	Crenshaw	1	Failed to germinate due to lack of sufficient water.
Onions	Cortland	1	Onion crop was a complete loss. Did not germinate. I attempted to direct seed all onions, but weather was uncooperative, weeding became impossible, and had to abandon crop. Will use transplants from now on.
Onions	Cabernet F1	1	Onion crop was a complete loss. Did not germinate. I attempted to direct seed all onions, but weather was uncooperative, weeding became impossible, and had to abandon crop. Will use transplants from now on.
Onions	Walla Walla	1	Onion crop was a complete loss. Did not germinate. I attempted to direct seed all onions, but weather was uncooperative, weeding became impossible, and had to abandon crop. Will use transplants from now on.
Onions	Valencia	1	Onion crop was a complete loss. Did not germinate. I attempted to direct seed all onions, but weather was uncooperative, weeding became impossible, and had to abandon crop. Will use transplants from now on.
Onions, Bunching	Evergreen	4	Always a good crop. Easy to grow. Need to keep weeded & watered, requires just a little fertilizer. No problems.
Onions, Bunching	Deep Purple	1	Crop was lost due to weed pressure.
Parsley	Italian	5	More popular than expected, produced longer into the fall than expected. A great addition to our selection. Evenly watered, must keep weeded.
Parsley	Moss Curled	4	Not as popular as Italian variety, but still performed well in the field. Keep weeded & watered.
Peas	Sugar Daddy (Snap)	5	Very successful. No need to fertilize. As long as they were evenly watered, plants performed splendidly. Applied inoculant.
Peas	Progress #9 (Shelling)	4	One of my favorite. No fertilization required. Applied inoculant.
Peas	Mammoth Melting (Snow)	4	Good looking plants with no fertilization. Consider smaller varieties. Applied inoculant.
Peppers	Jalapeno	4	Dependable great-tasting pepper. Yields were not as high as last year, mostly due to lack of weeding.
Peppers	Jimmy Nardello	3	First year for this pepper. Plants were healthy, but very little demand at market.
Peppers	Round of Hungary	2	This is usually a great seller, but plants did not germinate well and were weak when transplanted. Use greater care next year in the greenhouse.
Peppers	Ancho Poblano	3	Good, solid pepper, fairly good seller. Need to plant more next year. Fruits did not size up due to lack of proper fertilization & water.
Peppers	Anaheim	4	Best seller. Great, healthy plants. Consider more regular fertilization schedule next year.
Potatoes	Yukon Gold	1	Potatoes were neglected, weed pressure became too great, failed to hill properly, and crop was lost. Disappointing, but just need to keep on top of weeding next year.
Potatoes	Colorado Rose	1	Potatoes were neglected, weed pressure became too great, failed to hill properly, and crop was lost. Disappointing, but just need to keep on top of weeding next year.
Pumpkin	Black Futsu	4	Always a pretty pumpkin, gained a greater demand at market this year because of promotion from last year. Hearty plants, need more even watering to prevent oedema. Also attacked by rabbits. Perhaps look into fencing next year, if financially sensible.
Pumpkin	Casper	2	Plants were healthy and fruits were moderately-sized, but I realize I just don't care for white pumpkins. Another crop that is just for decoration, won't plant again next year.
Pumpkin	Jack Straw	4	Good-sized jack-o-lanterns. Don't sell well at market, but they looked great. Didn't water as evenly as I had planned, so a bit of oedema caused loss of about 1/4 of crop, weren't aesthetically pleasing.

Pumpkin	Kakai	3	Very healthy plants, but didn't plant enough of them! Seeds are always good fresh or roasted. Keep evenly watered.
Pumpkin	New England Pie	5	Very successful & popular. Some issues with rabbits & oedema, but for the most part all was harvested. Need to keep more evenly watered. Early and late crops allowed for pre-Halloween and Thanksgiving sales.
Pumpkin	Winter Luxury	1	Poor fruit formation, mainly due to severe rabbit damage. I also realized I just don't like the look of these pumpkins (thought they would be more dazzling). I'll stick to pie pumpkins in the future.
Radicchio	Rouge de Verona	1	Seeds did not germinate. This was an experimental crop, but by the time it was ready to harvest, became far too bitter due to unexpectedly warm weather in spring. Try again in the future.
Radishes	Cherry Belle	4	Very successful. Radishes are easy to grow as long as they are evenly watered. No problems.
Radishes	French Breakfast	4	Very successful. Radishes are easy to grow as long as they are evenly watered. No problems.
Radishes	Watermelon	5	Very popular. Do not harvest when less than tennis-ball size (smaller are too spicy), or greather than baseball size (get woody).
Radishes	Nero Tondo (Black)	4	Customers were intrigued, but sold very few. Very healthy & hearty plants. No problems. Same harvestable size as Watermelon radish.
Radishes	Alpine (Daikon)	5	These always look great. Much longer DTH than other radishes, but worth the wait. No need to fertilize, just keep evenly watered.
Rutabaga	Joan	5	Suprisingly popular. Did have some weed pressure that decreased yield. Will pay much closer attention to this crop next year.
Shallots	French Red	4	Very successful. Need to cut off water earlier to prevent rotting, but still harvested most this year. Also fertilized too late, no need to do so after early spring.
Spinach	Corvair	1	Seeds were very slow to germinate, and when they did we neglected to weed properly. Lost entire crop.
Squash, Summer	Cocozelle	5	Need to harvest when fruits are smaller (6"-8"). Good flavor. Were evenly watered so high yields.
Squash, Summer	Pattypan	2	Not a favorite. Heavily attacked by squash bugs, lost much of the crop. Be more vigilant next time.
Squash, Summer	Ronde de Nice	4	Delicious fruits on healthy plants early in season, but were ravaged by squash bugs. Need to get on the pests earlier.
Squash, Summer	Green Zucchini	4	Soid seller at market. Some squash bug loss, keep pest population down by picking & drowning them in early morning.
Squash, Summer	Yellow Crookneck	5	Very productive, most resistant to squash bugs, a great variety. No problems with this crop. Produced until late in the season.
Squash, Winter	Acorn	3	Hit by squash bugs, but still a lot of good fruit. Planted too far apart, which decreased potential yield.
Squash, Winter	Butternut	4	Good seller. Nice & healthy plants resisted squash bugs, were good producers late into the season. Plant more next year.
Squash, Winter	Delicata	5	Fantastic seller. Only problem was that I didn't plant enough!
Squash, Winter	Hubbard (Baby Blue)	2	Healthy plants were well-watered & fertilized. Again, didn't plant enough.
Squash, Winter	Lakota	4	Popular with adventurous customers. Didn't develop as fully as I had hoped (not as colorful) due to lack of water at critical growing stages. This plant grows slower, so needs it's own watering schedule well into fall.
Squash, Winter	Spaghetti	3	Solid standard. Flavor was intensified by less watering, but fruits were smaller. Still deciding on this one.
Tomatoes	Valencia (Orange)	4	Great producers but were late getting started. Need to be more vigilant in the greenhouse, keep on heat mat until ready to plant.
Tomatoes	New Girl	5	Great all-around tomato. Very healthy vines had good fertilization & even watering. I found that when plants are well-established, then water once a week for 12 hours. Improve flavor by backing off watering at the right time (water on the day just after previous harvest).
Tomatoes	Brandywine Pink (Heirloom)	1	Didn't get these trellised, watering was sporadic, all fruits cracked, did not harvest.
Tomatoes	Great White (Heirloom)	1	Didn't get these trellised, watering was sporadic, all fruits cracked, did not harvest.
Tomatoes	White Cherry	5	Very successful. Beautiful fruits got plenty of water (8 hours twice a week until fruiting, then 12 hours once a week). Will grow again next year.
Tomatoes	Sakura (Cherry)	4	Good producers, but these tomatoes are almost too small, even for cherries. Look for a different variety next year.
Tomatoes	Clementine (Orange Cherry)	4	Very pretty, cocktail-size tomatoes were super-healthy. Not as sweet as other varieties. Next year I'll try Sun Gold (requested by several customers).
Turnips	Hakurei	5	Our single best-selling item. Very hearty plants, fast-growing very little pest damage. Water 2 days before harvesting for best results.
Turnips	Purple Top White Globe	4	A good, hearty plant. Very productive & easy to grow. Keep well-weeded. Hard to fail with this crop.
Watermelon	Crimson Sweet	4	Best selling melon. Very sweet. Could have been sweeter if I would cut off water earlier. Need to water just once a week (on same day just after harvest), then they'll be sweeter for market the next week.
Watermelon	Babydoll F1	4	Very sweet, even with more water. Need to perfect my watering system for melons, but I'll try again next year.
Watermelon	OrangeGlo	3	Good melons, very sweet, but very difficult to tell when they're ready to harvest. I'll try a different variety next year. As with all melons, control water very closely.

Hearty Fork Farm Updated Crop Plan & Harvest Totals 2015

Crop	Variety	DS/TP	Amount Planted	First Plant Date	Last Plant Date	First Harvest Date	Last Harvest Date	Total Amt. Harvested
Beans	Jade (Green)	DS	800'	10-Apr	5-Aug	1-Jun	5-Oct	400 lbs
Beans, Fava	Windsor	DS	400'	1-Nov	1-Nov	--	--	--
Beets	Red Ace F1	DS	3000'	25-Feb	2-Oct	15-Apr	30-Dec	1200 lbs
Beets	Golden Detroit	DS	1800'	27-Feb	10-Oct	15-Apr	30-Dec	900 lbs
Beets	Chioggia	DS	1800'	27-Feb	10-Oct	15-Apr	30-Dec	1000 lbs
Blackberries	Obsidian	--	2000'	--	--	1-May	15-Jun	1700 lbs
Blackberries	Natchez	--	1000'	--	--	1-Jun	1-Aug	1800 lbs
Blackberries	Triple Crown	--	2400'	--	--	15-Jul	28-Aug	4500 lbs
Bok Choi	Shanghai Green (Baby)	TP	200'	2-Oct	2-Oct	10-Dec	30-Dec	100 lbs
Broccoli	Belstar F1	TP	1200'	8-Mar	6-Sep	1-May	30-Dec	150 lbs
Broccoli Raab	Spring Raab	DS	100'	2-Mar	2-Mar	--	--	--
Cabbage	Impala F1 (Green)	TP	800'	8-Mar	5-Sep	8-May	30-Dec	90 lbs
Cabbage	Red Express	TP	800'	9-Mar	5-Sep	15-May	30-Dec	80 lbs
Cabbage	Kaboko (Napa)	TP	1200'	9-Mar	9-Mar	1-May	29-May	120 lbs
Carrots	White Satin	DS	400'	10-Mar	10-Oct	--	--	--
Carrots	Atomic Red	DS	200'	10-Mar	10-Mar	--	--	--
Carrots	Solar Yellow	DS	400'	10-Mar	10-Oct	--	--	--
Carrots	Cosmic Purple	DS	200'	10-Mar	10-Oct	--	--	--
Carrots	Scarlet Nantes	DS	3000'	10-Mar	10-Oct	10-May	15-Oct	600 lbs
Cauliflower	Snowball	TP	1200'	4-Sep	4-Sep	1-Dec	30-Dec	210 lbs
Cauliflower	Romanesco	TP	800'	4-Sep	4-Sep	1-Dec	30-Dec	200 lbs
Chard	Rainbow	TP	800'	3-Mar	1-Oct	1-May	30-Dec	400 lbs
Cilantro	Cilantro	DS	400'	16-Mar	16-Mar	20-Apr	5-Jul	150 lbs
Cucumber	National Pickling	DS	600'	15-Apr	15-Apr	24-May	28-Aug	800 lbs
Cucumber	Marketmoore 76	DS	400'	15-Apr	15-Apr	24-May	28-Aug	400 lbs
Cucumber	Armenian	DS	400'	15-Apr	15-Apr	24-May	28-Aug	480 lbs
Cucumber	Lemon	DS	600'	15-Apr	15-Apr	24-May	28-Aug	300 lbs
Dill	Bouquet	DS	600'	15-Mar	15-Mar	1-May	20-Aug	85 lbs
Eggplant	Rosa Bianca	TP	400'	28-Apr	28-Apr	15-Jun	5-Sep	90 lbs
Fennel	Florence	DS	200'	8-Mar	8-Mar	15-May	10-Jul	110 lbs
Flowers	Several (WINTERS PLOT)	DS	5600'	1-Apr	5-Apr	--	--	--
Garlic	CA Early White	DS	1200'	5-Oct	5-Oct	15-Jun	15-Jun	300 lbs
Gourds	Mixed (Ornamental)	DS	200'	7-Jul	7-Jul	30-Sep	20-Oct	100 lbs
Horseradish	Horseradish	DS	50'	1-Mar	1-Mar	--	--	--
Kale	Vates (Curly)	TP	800'	12-Mar	1-Oct	20-Apr	30-Dec	400 lbs
Kale	Dino	TP	800'	12-Mar	1-Oct	20-Apr	30-Dec	450 lbs
Kohlrabi	White Vienna	TP	400'	29-Sep	29-Sep	1-Dec	30-Dec	210 lbs
Kohlrabi	Purple Vienna	TP	400'	29-Sep	29-Sep	1-Dec	30-Dec	185 lbs
Leeks	King Richard	DS	800'	4-Mar	3-May	1-Jun	10-Jul	290 lbs
Melon	Galia	DS	200'	5-May	5-May	10-Jul	10-Jul	75 lbs
Melon	Cantaloupe	DS	200'	4-May	4-May	--	--	--
Melon	Honeydew	DS	200'	4-May	4-May	--	--	--
Melon	Crenshaw	DS	200'	4-May	4-May	--	--	--
Onions	Cortland	DS	400'	3-Mar	3-Mar	--	--	--
Onions	Cabernet F1	DS	400'	3-Mar	3-Mar	--	--	--
Onions	Walla Walla	DS	200'	3-Mar	3-Mar	--	--	--
Onions	Valencia	DS	200'	3-Mar	3-Mar	--	--	--
Onions, Bunching	Evergreen	DS	1200'	1-Mar	1-Oct	5-May	1-Jul	250 lbs
Onions, Bunching	Deep Purple	DS	400'	1-Mar	1-Mar	--	--	--
Parsley	Italian	DS	400'	16-Mar	16-Mar	8-May	10-Jul	175 lbs
Parsley	Moss Curled	DS	400'	16-Mar	16-Mar	8-May	1-Sep	80 lbs
Peas	Sugar Daddy (Snap)	DS	400'	29-Feb	10-Oct	20-Apr	20-May	180 lbs
Peas	Progress #9 (Shelling)	DS	400'	29-Feb	10-Oct	20-Apr	20-May	110 lbs
Peas	Mammoth Melting (Snow)	DS	400'	29-Feb	10-Oct	20-Apr	20-May	175 lbs
Peppers	Jalapeno	TP	200'	25-Apr	2-May	1-Jul	23-Sep	80 lbs
Peppers	Jimmy Nardello	TP	200'	25-Apr	25-Apr	1-Jul	16-Sep	50 lbs
Peppers	Round of Hungary	TP	400'	25-Apr	25-Apr	15-Jul	16-Sep	80 lbs
Peppers	Ancho Poblano	TP	200'	25-Apr	25-Apr	15-Jul	23-Sep	90 lbs
Peppers	Anaheim	TP	400'	26-Apr	26-Apr	1-Jul	23-Sep	120 lbs
Potatoes	Yukon Gold	DS	600'	2-Feb	1-Sep	--	--	--
Potatoes	Colorado Rose	DS	400'	2-Feb	2-Feb	--	--	--
Pumpkin	Black Futsu	DS	200'	3-Jul	3-Jul	30-Sep	30-Oct	200 lbs
Pumpkin	Casper	DS	100'	7-Jul	7-Jul	1-Oct	30-Oct	100 lbs
Pumpkin	Jack Straw	DS	200'	7-Jul	7-Jul	1-Oct	30-Oct	400 lbs

Pumpkin	Kakai	DS	200'	7-Jul	7-Jul	1-Oct	30-Oct	200 lbs
Pumpkin	New England Pie	DS	600'	3-Jul	3-Jul	1-Oct	30-Oct	650 lbs
Pumpkin	Winter Luxury	DS	100'	3-Jul	3-Jul	1-Oct	23-Oct	100 lbs
Radicchio	Rouge de Verona	DS	100'	2-Mar	2-Mar	--	--	--
Radishes	Cherry Belle	DS	3000'	10-Feb	1-Oct	15-Mar	10-Nov	350 lbs
Radishes	French Breakfast	DS	1800'	10-Feb	1-Sep	15-Mar	10-Nov	300 lbs
Radishes	Watermelon	DS	1200'	10-Feb	1-Oct	1-Apr	30-Dec	420 lbs
Radishes	Nero Tondo (Black)	DS	1200'	10-Feb	1-Sep	1-Apr	1-Oct	350 lbs
Radishes	Alpine (Daikon)	DS	1200'	10-Feb	1-Sep	1-Apr	1-Oct	375 lbs
Rutabaga	Joan	DS	600'	2-Oct	2-Oct	1-Dec	30-Dec	240 lbs
Shallots	French Red	DS	400'	5-Oct	5-Oct	15-Jun	15-Jun	200 lbs
Spinach	Corvair	DS	800'	10-Feb	15-Oct	--	--	--
Squash, Summer	Cocozelle	DS	400'	5-Apr	5-Apr	1-Jun	5-Sep	600 lbs
Squash, Summer	Pattypan	DS	200'	5-Apr	5-Apr	1-Jun	28-Aug	200 lbs
Squash, Summer	Ronde de Nice	DS	200'	6-Apr	6-Apr	1-Jun	28-Aug	200 lbs
Squash, Summer	Green Zucchini	DS	400'	6-Apr	6-Apr	1-Jun	5-Sep	300 lbs
Squash, Summer	Yellow Crookneck	DS	400'	5-Apr	5-Apr	1-Jun	5-Sep	700 lbs
Squash, Winter	Acorn	DS	600'	1-Jun	1-Jun	15-Sep	5-Oct	380 lbs
Squash, Winter	Butternut	DS	600'	1-Jun	1-Jun	15-Sep	5-Oct	600 lbs
Squash, Winter	Delicata	DS	400'	1-Jun	1-Jun	15-Sep	5-Oct	250 lbs
Squash, Winter	Hubbard (Baby Blue)	DS	200'	1-Jun	1-Jun	15-Sep	5-Oct	100 lbs
Squash, Winter	Lakota	DS	200'	1-Jun	1-Jun	15-Sep	5-Oct	150 lbs
Squash, Winter	Spaghetti	DS	400'	1-Jun	1-Jun	15-Sep	5-Oct	250 lbs
Tomatoes	Valencia (Orange)	TP	400'	14-Apr	14-Apr	8-Jul	30-Sep	290 lbs
Tomatoes	New Girl	TP	600'	14-Apr	14-Apr	8-Jul	30-Sep	500 lbs
Tomatoes	Brandywine Pink (Heirloom)	TP	200'	14-Apr	14-Apr	--	--	--
Tomatoes	Great White (Heirloom)	TP	200'	14-Apr	14-Apr	--	--	--
Tomatoes	White Cherry	TP	200'	14-Apr	14-Apr	23-Jun	23-Sep	300 lbs
Tomatoes	Sakura (Cherry)	TP	200'	14-Apr	14-Apr	23-Jun	23-Sep	220 lbs
Tomatoes	Clementine (Orange Cherry)	TP	200'	14-Apr	14-Apr	23-Jun	23-Sep	350 lbs
Turnips	Hakurei	DS	1200'	25-Feb	2-Oct	15-Apr	30-Dec	700 lbs
Turnips	Purple Top White Globe	DS	600'	2-Oct	2-Oct	1-Dec	30-Dec	250 lbs
Watermelon	Crimson Sweet	DS	1000'	1-May	30-May	30-Jun	1-Sep	1500 lbs
Watermelon	Babydoll F1	DS	600'	1-May	1-May	30-Jun	28-Aug	400 lbs
Watermelon	OrangeGlo	DS	600'	1-May	1-May	30-Jun	28-Aug	300 lbs

Hearty Fork Farm Income Statement, 2015

Expenses	
Rent	$10,800.00
Licenses, Fees, etc.	$630.00
Farm Insurance	$520.00
Farmers' market stall fees	$1,540.00
Farmers' market supplies	$200.00
Fertilizer	$525.00
Greenhouse & cooler use	$225.00
Irrigation/pump use fees	$325.00
Seeds	$3,200.00
Farm Supplies	$6,000.00
Business Taxes & Fees	$1,600.00
Worker's Comp Insurance	$2,720.00
Labor	$25,500.00
Irrigation system parts	$1,200.00
Total	$54,985.00

Income	
Farmers' Markets	$24,850.00
Direct sales to customers	$800.00
Restaurant Sales	$3,550.00
Blackberry Wholesale	$19,050.00
Other sales to value-added producers	$3,920.00
Farmstand Sales	$7,250.00
	$59,420.00

Net Income (profit/loss) $4,435.00

Invasive Species Fact Sheets:

False Codling Moth
Oriental Fruit Fly

Teaching Tools for Grades 1-9

EVALUATION

California Foundation for Agriculture in the Classroom

April 30, 2016

Table of Contents

Introduction

This study was designed and implemented by the California Foundation for Agriculture in the Classroom (CFAITC). With its mission to increase awareness and understanding of agriculture among California's educators and students, the CFAITC develops and disseminates accurate, teacher-tested and scientifically sound classroom materials to increase agricultural literacy, to support the pursuit of agricultural careers and continuing education, and to enhance the educational experience of K-12 students. To ensure the quality of the curricula and educational materials they develop, the CFAITC conducts program evaluations and uses the findings to improve program effectiveness.

The current evaluation examines impacts of the Invasive Species Fact Sheets teaching tools developed for the False codling moth and Oriental fruit fly. The tools, designed for grades 1 through 9, promotes the development of STEM abilities and critical thinking skills, while increasing teacher and student knowledge of the False codling moth and Oriental fruit fly invasive species. The objectives of the fact sheets include increasing knowledge and awareness of why these particular insect species are a problem, how people may prevent their spread, and how the species travel. The fact sheets also provide teachers with ideas for educational activities and further discussion.

The purpose of the evaluation is to measure the extent to which these educational objectives have been met and to inform program designers of needed modifications or improvements.

Methods

Instruments

CFAITC developed four self-administered instruments to collect evaluative data from teachers and students. Two instruments measured the effectiveness of the teaching tools using teachers' subject knowledge before and after they used the fact sheets. Two instruments measured students' subject knowledge before and after the fact sheet materials were presented. Teachers and students completed and entered all four surveys online from January to April 2016.

The teacher surveys, attached as Appendix A (pre) and Appendix B (post), include 9 items that test and retest teachers' subject knowledge and 3 items that identify participants by name, school, and grade level(s) taught. The teacher post-survey includes 6 additional items (4 close-ended and 2 open-ended) that measure other aspects of program effectiveness. Teachers were asked to submit comments and to elaborate on their experiences using the fact sheets.

Two student surveys, attached as Appendix C (pre) and Appendix D (post), use the same 9 close-ended items included on the teacher survey to test and retest students' knowledge of the False codling moth and Oriental fruit fly. Both surveys include 4 additional items that identify participants by name, school, grade level, and first language (English or non-English).

Procedures

In January 2016, prior to exposing students to the fact sheet materials, participating teachers completed pre-surveys and administered the pre-survey to their students. Students used classroom time to respond to the questions. Following the presentation of the fact sheet materials in February and March 2016, teachers completed post-surveys and administered the post-survey to students. Between January 28 and April 9, 2016, teachers and students entered their completed surveys into a web-based data collection software. Teachers entered 11 pre-surveys and 12 post-surveys, and students entered 296 pre-surveys and 231 post-surveys.

Participants

***Teachers* –** Teacher participants from 12 school locations throughout California contributed to the evaluation of the False codling moth and Oriental fruit fly Invasive Species Fact Sheets. A total of 11 teachers at 11 different schools completed the pre-survey and 12 teachers at 12 schools completed the post-survey following their participation in the project. At post-survey, 75% participants were teaching grades 1-4.

Q17 Please type the name of your school:

School	1 Pre-Survey		2 Post-Survey	
	Frequency	Percent	Frequency	Percent
Buttonwillow Union School District	1	9.1	1	8.3
Crane Country Day School	1	9.1	1	8.3
El Camino Real Charter High School	1	9.1	1	8.3
Ernest Righetti High School	1	9.1	1	8.3
Fitch Mountain Campus (Healdsburg)	1	9.1	1	8.3
Franklin High School	1	9.1	1	8.3
High Tech Elementary North County	--	--	1	8.3
Lillian Larsen Elementary School	1	9.1	1	8.3
Penngrove Elementary	1	9.1	1	8.3
Phoenix Ranch School	1	9.1	1	8.3
Sunset Ranch Elementary	1	9.1	1	8.3
Woodlake Elementary	1	9.1	1	8.3
Total	**11**	**100**	**12**	**100**

Q18 Please include the grade level/s you teach:

	1 Pre-Survey		2 Post-Survey	
	Frequency	Percent	Frequency	Percent
Grade 1	1	9.1	1	8.3
Grade 2	3	27.3	4	33.3
Grade 3	2	18.2	3	25.0
Grade 4	--	--	1	8.3
Grade 5	2	18.2	--	--
Grade 6	3	27.3	2	16.7
Grade 7 (and above)	--	--	1	8.3
Total	**11**	**100.0**	**12**	**100.0**

Students – A total of 296 students from 13 schools participated in the pre-survey. Students completed and entered their pre-surveys into the online data collection system between January 28 and April 8, 2016. A total of 231 students (78%) also participated in the post-survey, which was completed and entered between February 10 and April 8, 2016. Students in grade 1 through grade 9 were represented. Note that 1 pre-survey and 3 post-surveys were not identified by school, 2 pre-surveys were not identified by grade, and some students declined to enter their name. Additionally, inconsistencies in the way student names were entered, such as use of initials, first names only, duplicate entries, and refusals, prevent the use of this text field to reliably match individuals' pre- and post-survey responses.

Q11 Please type the name of your school:

School	1 Pre-Survey		2 Post-Survey	
	Frequency	Percent	Frequency	Percent
Buttonwillow School	20	6.8	12	5.2
Crane Country Day School	28	9.5	24	10.4
El Camino Real Charter High School	1	0.3	1	0.4
El Vista	3	1.0	0	0.0
Ernest Righetti High School	72	24.3	49	21.2
Fitch Mountain Campus (Healdsburg)	24	8.1	23	10.0
Franklin High School	27	9.1	27	11.7
High Tech Elementary	13	4.4	13	5.6
Lillian Larsen School	19	6.4	6	2.6
No Response	1	0.3	3	1.3
Penngrove Elementary	25	8.4	15	6.5
Phoenix Ranch School	6	2.0	7	3.0
Sunset Ranch Elementary	31	10.5	25	10.8
Woodlake Elementary	26	8.8	26	11.3
Total	296	100.0	231	100.0

Q12 Grade Level

Grade Level	**1 Pre-Survey**		**2 Post-Survey**	
	Frequency	Percent	Frequency	Percent
Grade 1	24	8.1	14	6.1
Grade 2	90	30.4	85	36.8
Grade 3	54	18.2	38	16.5
Grade 4	1	.3	1	.4
Grade 5	25	8.4	14	6.1
Grade 6	87	29.4	65	28.1
Grade 7	7	2.4	8	3.5
Grade 8	2	.7	3	1.3
Grade 9	4	1.4	3	1.3
No Response	2	.7	0	0.0
Total	296	100.0	231	100.0

Students from Ernest Righetti High School provided the most responses across all participating schools (72 at pre-survey and 49 post-survey), but the largest number of pre- and post-surveys came from 2nd graders (90 at pre-survey and 85 at post-survey). A majority of students at pre-survey (76%) and at post-survey (78%) indicate English is their first language. Three students at pre-survey (1%) and 7 students at post-survey (3%) declined to indicate their first language.

Q13 Is English your first language?

	1 Pre-Survey			2 Post-Survey		
	Frequency	Percent	Valid %	Frequency	Percent	Valid %
1 Yes	222	75.0	75.8	174	75.3	77.7
2 No	71	24.0	24.2	50	21.6	22.3
No Response	3	1.0		7	3.0	
Total	296	100.0	100.0	231	100.0	100.0

Analysis

On April 14, 2016 evaluators exported the completed teacher and student survey data from the online system in Excel format and reviewed the export. Once the integrity of the contents was confirmed, the data was transferred into SPSS statistical software for analysis. Note that many student pre- and post-surveys appeared to be duplicate entries and were removed from the analysis. For clarity, both variable and value labels that correspond to the instruments provided were entered into SPSS.

The following quantitative analysis utilizes primarily descriptive techniques, such as the number and/or percentage of students and teachers who selected each response (frequency data), the number and/or percentage of students who answered each knowledge-based item correctly, and observed differences in the percentage of correct responses before and after program exposure. No measure of program exposure is included in the data; thus, exposure is presumed to be the same for all participants. Teachers' open-ended responses have been only minimally cleaned. A comprehensive analysis of qualitative data is beyond the scope of this evaluation.

Results

Teacher Survey

Teacher responses to all subject knowledge items have been summarized in the table below. Correct responses are shaded. All teachers responded to all close-ended items, so percentages in this table are derived from valid, non-missing data. Note that some question text has been abbreviated for display purposes. Appendix A and Appendix B contain the full text of the teacher surveys.

Of 165 responses provided across all 11 teacher pre-surveys, 118 (72%) were correct at pre-survey. Of 180 responses provided across all 12 post-surveys, 151 (84%) were correct after using the fact sheets. This 12-point increase represents a moderate 17% overall improvement in subject knowledge among teachers after they used the fact sheets. Scores improved markedly on items Q2B, Q2D, Q3B, Q4, and Q6 with at least a 20 percentage point increase in correct responses at post-survey. Scores did not improve for items Q3D, Q7, and Q9. Notably, teachers' scores declined markedly on item Q9 with a 24 percentage point decrease in correct responses after using the facts sheets. Figure 1 presents the percentage of teachers who gave correct responses sorted by post-survey results.

Q1 What are invasive species?	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Organisms moved into ecosystem where not previously found	10	90.9	12	100.0
2 Organisms that enter the bodies of animals	1	9.1	0	0.0

Q2 Why is the False codling moth a problem?		1 Pre-Survey		2 Post-Survey	
		Count	Valid %	Count	Valid %
A It is not a local problem right now	0 Not Selected	8	72.7	7	58.3
	1 Selected	3	27.3	5	41.7
B Caterpillars eat and destroy fruits	0 Not Selected	5	45.5	2	16.7
	1 Selected	6	54.5	10	83.3
C There is no way to get rid of them	0 Not Selected	8	72.7	11	91.7
	1 Selected	3	27.3	1	8.3
D It will cost farmers to get rid of them	0 Not Selected	5	45.5	2	16.7
	1 Selected	6	54.5	10	83.3

Q3 The Oriental fruit fly is a problem because:		1 Pre-Survey		2 Post-Survey	
		Count	Valid %	Count	Valid %
A They infest areas quickly	0 Not Selected	4	36.4	2	16.7
	1 Selected	7	63.6	10	83.3
B Have short life cycles	0 Not Selected	9	81.8	6	50.0
	1 Selected	2	18.2	6	50.0
C Can destroy a farmer's entire crop	0 Not Selected	1	9.1	1	8.3
	1 Selected	10	90.9	11	91.7
D They are not a local problem right now	0 Not Selected	10	90.9	10	83.3
	1 Selected	1	9.1	2	16.7

Q4 The False codling moth travels mainly:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Inside fruits and vegetables	8	72.7	12	100.0
4 I don't know	3	27.3	0	0.0

Q5 The main way the Oriental fruit fly travels is:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Inside infested fruit	10	90.9	12	100.0
2 Flying from state to state	1	9.1	0	0.0

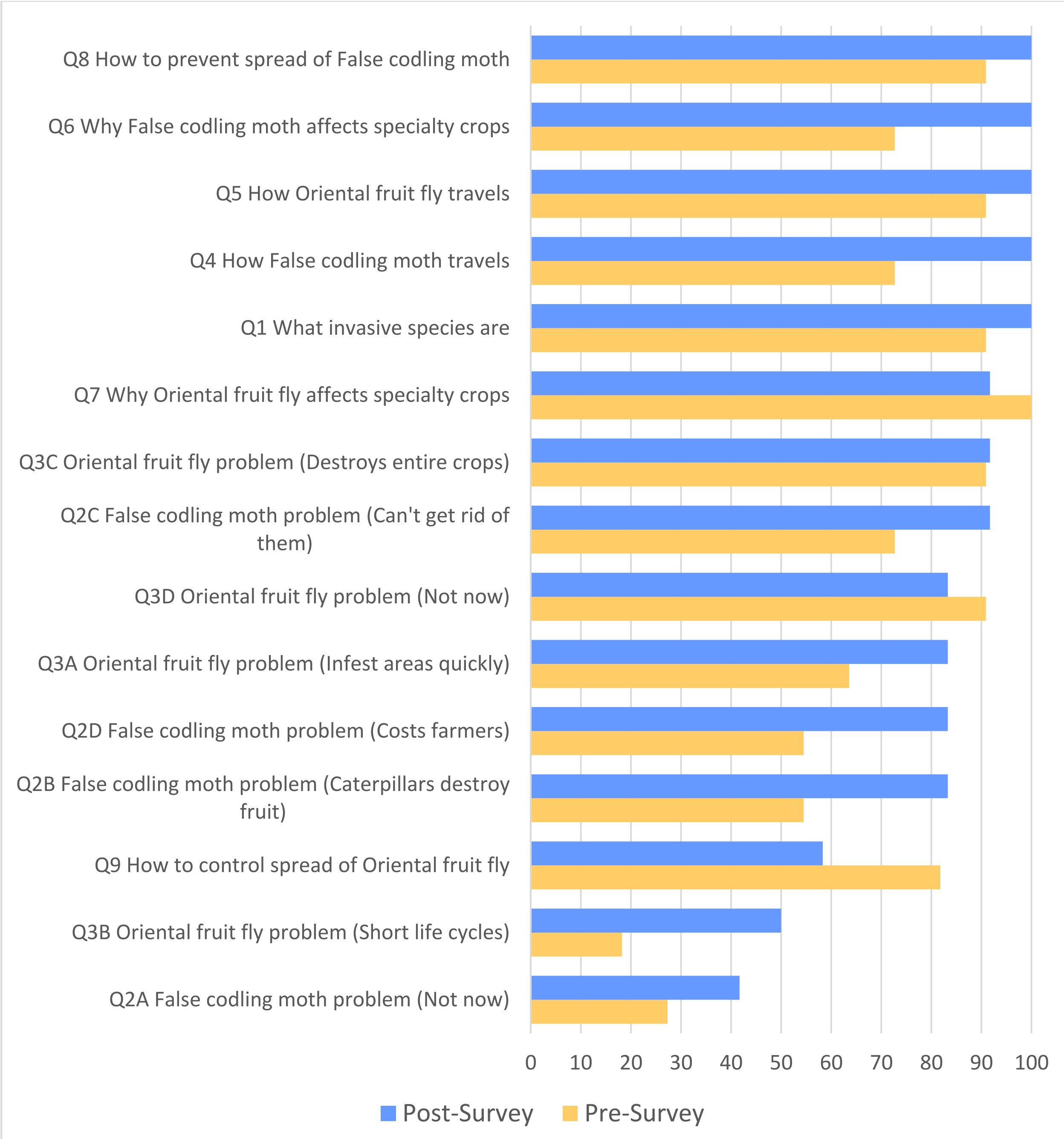
Q6 False codling moth affects specialty crops because:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
3 Specialty crops incl. fruit, nuts, vegetables that moth can destroy	8	72.7	12	100.0
4 I don't know	3	27.3	0	0.0

Q7 Oriental fruit fly affects specialty crops because:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 It attacks around 200 different kinds of California crops	11	100.0	11	91.7
3 Specialty crops include grains	0	0.0	1	8.3

Q8 Can help prevent spread of False codling moth by:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Not bringing in fruits, vegetables, and plants from out of state	10	90.9	12	100.0
4 I don't know	1	9.1	0	0.0

Q9 Can control Oriental fruit fly from spreading by:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
2 Limit movement of fruits and vegetables where flies are found	9	81.8	7	58.3
3 Using the "male attractant technique" with a bait station	2	18.2	5	41.7

Figure 1: Percentage of Correct Responses (Teachers)



Responses to the 4 close-ended items used to assess the teaching tools on other programmatic dimensions have been summarized in the table below. These items were asked at post-survey only. All teachers responded to all close-ended items, so percentages in the table are derived from valid, non-missing data. Note that some question text has been abbreviated for display purposes. Appendix B contain the full text of these items.

Teachers overwhelmingly felt equipped to teach the topics with the materials provided (100%). Teachers also agree they would like to teach the topics again (100%), and the majority strongly agreed they would like to teach them again (67%). Teachers unanimously found the fact sheets well written and easily understood (100%). Over half report the fact sheets worked well with their grade level (58%) and are in line with academic standards (58%). Nearly all participants used the Fantastic Facts materials to lead discussions with students (92%). Finally, over half of teachers report they did one or more of the lesson ideas on the back of the sheets (58%) and used the Invasive Species Fact Sheet California Standards (58%).

Q10 I felt equipped to teach this topic with the resources provided.	Count	Percent
1 Strongly agree	5	41.7
2 Agree	7	58.3
Q11 I would like to teach about invasive species again in the future.	Count	Percent
1 Strongly agree	8	66.7
2 Agree	4	33.3
Q12A Invasive Species Fact Sheets are well written and easily understood.	Count	Percent
1 Selected	12	100.0
Q12B Invasive Species Fact Sheets worked well with my grade level.	Count	Percent
0 Not Selected	5	41.7
1 Selected	7	58.3
Q12C Invasive Species Fact Sheets are in line with academic standards.	Count	Percent
0 Not Selected	5	41.7
1 Selected	7	58.3
Q12D Invasive Species Fact Sheets are none of the above.	Count	Percent
0 Not Selected	12	100.0
Q14A Had discussion with students about fantastic facts on back of sheets?	Count	Percent
0 Not Selected	1	8.3
1 Selected	11	91.7
Q14B Did one or more of lesson ideas on back of sheets?	Count	Percent
0 Not Selected	5	41.7
1 Selected	7	58.3
Q14C Used Invasive Species Fact Sheet California Standards?	Count	Percent
0 Not Selected	5	41.7
1 Selected	7	58.3

Two-thirds of all teachers (67%) provided open-ended responses to Q13, which asked teachers to elaborate on their experiences with the fact sheets. Seven of the eight responses include highly positive and enthusiastic remarks about the fact sheet materials and their effectiveness as a teaching tool. One comment suggests the materials may be more suited to children in grade 6 and higher.

Q13 Please elaborate or share any comments about the fact sheets:
I like to teach about healthy eating and vegetables. Gardening is a big part of my lessons and this helps students learn more about protecting our food.
I think it is very important to spread the word about the problem with invasive species.
I thought they were very clear and to-the-point.
I used this with 9th and 10th grade special education students to teach how to annotate informational text. The pre and post tests proved that class discussion and annotating text really do help people learn. I also included three of my AP Garden Club students in the surveys. They stated that they learned as well. (They read the sheets on their own.)
Loved the fact sheets
Students love this and teacher loves the 1 page format and the pics plus a variety of activities that can be done both short and long term. THANK YOU!
This is probably better for 6th -8th. Kind of dry for 4th grade. Bug Smugglers was a fun activity.
This year I used the fact sheets with my 9th grade general science classes. They usually HATE reading. It was interesting to watch but these kids really liked reading through the information, discussing both the oriental fruit fly and the false codling moth with their group members and looking up current pictures on the Internet to see what they look like. This led to a great discussion about invasive species' effect on the ag in our area. (We are a heavy agricultural area) It also led to a discussion and research on the Zika Virus we've been hearing about.

Half of all teachers (50%) provided open-ended responses to Q15, which asked teachers what other educational activities or uses they made of the fact sheets. Two of the six responses (33%) mentioned activities students particularly liked. Two other responses (33%) include ways to improve the surveys themselves.

Q15 Did you do anything else?
I love having these fact sheets! They're easy to use, interesting and informative. It would be awesome to have other sheets easily accessible such as the effects acid rain can have on crops, carbon cycle and nitrogen cycle.
I teach both 9th and 10th grade English, but your survey only lets me check one.
I teach grade levels 5th -8th but #18 will only allow one answer.
It's been a couple of weeks since I taught this, so I hope I remembered enough to get the right answers!
The students enjoyed doing the moth activity with graph paper.
The students like the idea of writing a play and especially liked the exterminator expo.

Student Survey

Student responses to all subject knowledge items have been summarized in the table below. Correct responses are shaded. Note that some question text has been abbreviated for display purposes. Appendix C and Appendix D contain the full text of the student surveys.

Of 2,920 responses provided across 296 student pre-surveys, 1,470 (50%) answers were correct at pre-survey. Of 2,346 responses provided across 231 post-surveys, 1,842 (79%) were correct at post-survey. This 29-point increase represents a sizeable 56% overall improvement in subject knowledge among students after exposure to the fact sheets. Scores improved markedly on items Q1, Q4, Q5, Q6, Q7, and Q8 with at least a 29 percentage point increase in correct responses at post-survey. Scores declined slightly on item Q3B. Figure 2 presents the percentage of students who gave correct responses sorted by results at post-survey.

Q1 What are invasive species?	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Organisms moved into an ecosystem where not previously found	113	38.3	148	64.3
2 Organisms that enter the bodies of animals	39	13.2	16	7.0
3 Organisms such as plants and animals from a different state	36	12.2	54	23.5
4 I don't know	107	36.3	12	5.2
Total Valid	295	100.0	230	100.0
No Response	1		1	
Total	296		231	

Q2 Why is the False codling moth a problem?		1 Pre-Survey		2 Post-Survey	
		Count	Valid %	Count	Valid %
A It is not a local problem right now	0 Not Selected	238	80.4	158	68.4
	1 Selected	58	19.6	73	31.6
B Caterpillars eat and destroy fruits	0 Not Selected	155	52.4	90	39.0
	1 Selected	141	47.6	141	61.0
C There is no way to get rid of them	0 Not Selected	198	66.9	206	89.2
	1 Selected	98	33.1	25	10.8
D It will cost farmers to get rid of them	0 Not Selected	156	52.7	110	47.6
	1 Selected	140	47.3	121	52.4

Q3 The Oriental fruit fly is a problem because:		1 Pre-Survey		2 Post-Survey	
		Count	Valid %	Count	Valid %
A They infest areas quickly	0 Not Selected	157	53.0	103	44.6
	1 Selected	139	47.0	128	55.4
B Have short life cycles	0 Not Selected	236	79.7	185	80.1
	1 Selected	60	20.3	46	19.9
C Can destroy a farmer's entire crop	0 Not Selected	102	34.5	49	21.2
	1 Selected	194	65.5	182	78.8
D They are not a local problem right now	0 Not Selected	250	84.5	204	88.3
	1 Selected	46	15.5	27	11.7

Q4 The False codling moth travels mainly:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Inside fruits and vegetables	107	36.6	211	91.7
2 By bird	32	11.0	6	2.6
3 By mammal	36	12.3	6	2.6
4 I don't know	117	40.1	7	3.0
Total Valid	292	100.0	230	100.0
No Response	4		1	
Total	296		231	

Q5 The main way the Oriental fruit fly travels is:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Inside infested fruit	109	37.1	181	79.0
2 Flying from state to state	60	20.4	32	14.0
3 By animal	39	13.3	11	4.8
4 I don't know	86	29.3	5	2.2
Total Valid	294	100.0	229	100.0
No Response	2		2	
Total	296		231	

Q6 False codling moth affects specialty crops because:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Specialty crops are not affected	19	6.6	13	5.7
2 Specialty crops incl. rice, wheat, other grains that moth destroys	64	22.1	30	13.2
3 Specialty crops include fruit, nuts, vegetables moth can destroy	99	34.1	175	76.8
4 I don't know	108	37.2	10	4.4
Total Valid	290	100.0	228	100.0
No Response	6		3	
Total	296		231	

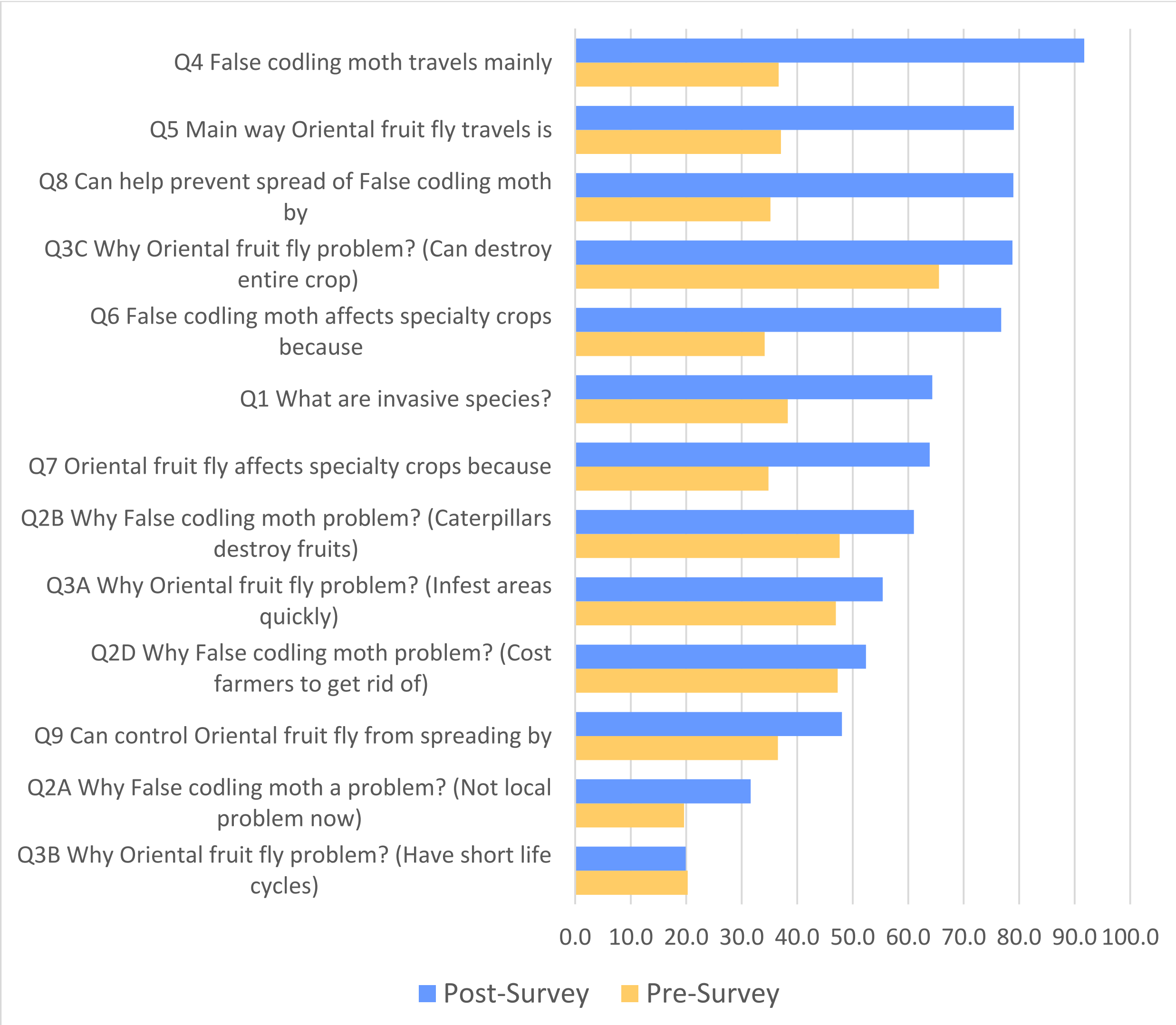
Q7 Oriental fruit fly affects specialty crops because:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 It attacks around 200 different kinds of California crops	101	34.8	145	63.9
2 Specialty crops are not affected	41	14.1	27	11.9
3 Specialty crops include grains	42	14.5	37	16.3
4 I don't know	106	36.6	18	7.9
Total Valid	290	100.0	227	100.0
No Response	6		4	
Total	296		231	

Q8 Can help prevent spread of False codling moth by:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 Not bringing in fruits, vegetables, and plants from out of state	102	35.2	180	78.9
2 If you find fruit with worms in it, discard the fruit	60	20.7	23	10.1
3 There isn't any way to prevent the spread	22	7.6	11	4.8
4 I don't know	106	36.6	14	6.1
Total Valid	290	100.0	228	100.0
No Response	6		3	
Total	296		231	

Q9 Can control Oriental fruit fly from spreading by:	1 Pre-Survey		2 Post-Survey	
	Count	Valid %	Count	Valid %
1 There isn't any way to prevent the spread	24	8.2	9	3.9
2 Limit movement of fruits and vegetables in areas where found	107	36.5	111	48.1
3 Using the 'male attractant technique' with a bait station	44	15.0	95	41.1
4 I don't know	118	40.3	16	6.9
Total Valid	293	100.0	231	100.0
No Response	3		0	
Total	296		231	100.0

The items on Figure 2, ordered by the percentage of students who gave correct responses at post-survey, show that especially high increases in subject knowledge was apparent on 4 of 13 items (31%), including Q4, Q5, Q6, and Q8. Students demonstrated moderate improvement on 6 items (46%). Little or no improvement in subject knowledge was evident on 3 of 13 items (23%), including Q2D, Q3A, and Q3B. Results suggest students performed somewhat better on standard single-response items, while some students, possibly younger children, may have been less familiar with the “select all that apply” question type. No analysis of improvement by grade level has been performed here.

Figure 2: Percentage of Correct Responses (Students)



Students' first language did not appear to impact their subject knowledge scores. For all but one item at pre-survey (Q2C), students with English as their first language scored the same as students whose first language is not English, based on a Pearson chi-square test. Students with English as a first language were significantly more likely to answer Q2C correctly at pre-survey than those whose first language is not English, χ^2 (1, N = 293) = 4.72, p < .05. For all questions at post-survey, however, chi-square analysis confirms students with English as their first language scored the same as those whose first language is not English.

Appendix A: Invasive Species Teacher Pre-Survey

Welcome. This is an online survey to understand how much you know about certain insects that are invasive. Please answer to the best of your knowledge. This is not a test. Thank you for participating.

Q1. What are invasive species?

1. Organisms that have been moved into an ecosystem where they have not been previously found
2. Organisms that enter the bodies of animals
3. Organisms such as plants and animals from a different state
4. I don't know

Q2. Why is the False codling moth a problem? (check all that apply)

- Q2A. It is not a local problem right now
- Q2B. Caterpillars eat and destroy fruits
- Q2C. There is no way to get rid of them
- Q2D. It will cost farmers to get rid of them

Q3. The Oriental fruit fly is a problem because . . . (check all that apply)

- Q3A. They infest areas quickly
- Q3B. Have short life cycles
- Q3C. Can destroy a farmer's entire crop
- Q3D. They are not a local problem right now

Q4. The False codling moth travels mainly . . .

1. Inside fruits and vegetables
2. By bird
3. By mammal
4. I don't know

Q5. The main way the Oriental fruit fly travels is . . .

1. Inside infested fruit
2. Flying from state to state
3. By animal
4. I don't know

Q6. The False codling moth affects specialty crops because . . .

1. Specialty crops are not affected
2. Specialty crops include rice, wheat, and other grains that the moth destroys
3. Specialty crops include fruit, nuts, and vegetables that the moth can destroy
4. I don't know

Q7. The Oriental fruit fly affects specialty crops because . . .

1. It attacks around 200 different kinds of California crops
2. Specialty crops are not affected
3. Specialty crops include grains
4. I don't know

Q8. You can help prevent the spread of False codling moth by . . .

1. Not bringing in fruits, vegetables, and plants from out of state
2. If you find fruit with worms in it, discard the fruit
3. There isn't any way to prevent the spread
4. I don't know

Q9. You can control Oriental fruit fly from spreading by . . .

1. There isn't any way to prevent the spread
2. Limiting movement of fresh fruits and vegetables in areas where they are found
3. Using the "male attractant technique" with a bait station
4. I don't know

Q16. Please type your name:

Q17. Please type the name of your school:

Q18. Please include the grade level/s you teach:

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Appendix B: Invasive Species Teacher Post-Survey

Welcome. This is an online survey to understand how much you know about certain insects that are invasive. Please answer to the best of your knowledge. This is not a test. Thank you for participating.

Q1. What are invasive species?

1. Organisms that have been moved into an ecosystem where they have not been previously found
2. Organisms that enter the bodies of animals
3. Organisms such as plants and animals from a different state
4. I don't know

Q2. Why is the False codling moth a problem? (check all that apply)

- Q2A. It is not a local problem right now
- Q2B. Caterpillars eat and destroy fruits
- Q2C. There is no way to get rid of them
- Q2D. It will cost farmers to get rid of them

Q3. The Oriental fruit fly is a problem because . . . (check all that apply)

- Q3A. They infest areas quickly
- Q3B. Have short life cycles
- Q3C. Can destroy a farmer's entire crop
- Q3D. They are not a local problem right now

Q4. The False codling moth travels mainly . . .

1. Inside fruits and vegetables
2. By bird
3. By mammal
4. I don't know

Q5. The main way the Oriental fruit fly travels is . . .

1. Inside infested fruit
2. Flying from state to state
3. By animal
4. I don't know

Q6. The False codling moth affects specialty crops because . . .

1. Specialty crops are not affected
2. Specialty crops include rice, wheat, and other grains that the moth destroys
3. Specialty crops include fruit, nuts, and vegetables that the moth can destroy
4. I don't know

Q7. The Oriental fruit fly affects specialty crops because . . .

1. It attacks around 200 different kinds of California crops
2. Specialty crops are not affected
3. Specialty crops include grains
4. I don't know

Q8. You can help prevent the spread of False codling moth by . . .

1. Not bringing in fruits, vegetables, and plants from out of state
2. If you find fruit with worms in it, discard the fruit
3. There isn't any way to prevent the spread
4. I don't know

Q9. You can control Oriental fruit fly from spreading by . . .

1. There isn't any way to prevent the spread
2. Limiting movement of fresh fruits and vegetables in areas where they are found
3. Using the "male attractant technique" with a bait station
4. I don't know

Q10. I felt equipped to teach this topic with the resources provided.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q11. I would like to teach about invasive species again in the future.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q12. The Invasive Species Fact Sheets are (please check all that apply)

Q12A. Well written and easily understood

Q12B. Worked well with my grade level

Q12C. In line with academic standards

Q12D. None of the above

Q13. Please elaborate or share any comments about the fact sheets here:

Q14. Did you also do any of the following? (check all that apply)

Q14A. Had a discussion with students about fantastic facts (on the back of the fact sheets)

Q14B. Did one or more of the lesson ideas (on the back of the sheets)

Q14C. Used the Invasive Species Fact Sheet California Standards

Q15. Other (please elaborate if you have anything else to share)

Q16. Please type your name:

Q17. Please type the name of your school:

Q18. Please include the grade level/s you teach:

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Appendix C: Invasive Species Student Pre-Survey

Welcome. This is an online survey to understand how much you know about certain insects that are invasive. Please answer to the best of your knowledge. This is not a test. Thank you for participating.

Q1. What are invasive species?

1. Organisms that have been moved into an ecosystem where they have not been previously found
2. Organisms that enter the bodies of animals
3. Organisms such as plants and animals from a different state
4. I don't know

Q2. Why is the False codling moth a problem? (check all that apply)

Q2A. It is not a local problem right now

Q2B. Caterpillars eat and destroy fruits

Q2C. There is no way to get rid of them

Q2D. It will cost farmers to get rid of them

Q3. The Oriental fruit fly is a problem because . . . (check all that apply)

Q3A. They infest areas quickly

Q3B. Have short life cycles

Q3C. Can destroy a farmer's entire crop

Q3D. They are not a local problem right now

Q4. The False codling moth travels mainly . . .

1. Inside fruits and vegetables
2. By bird
3. By mammal
4. I don't know

Q5. The main way the Oriental fruit fly travels is . . .

1. Inside infested fruit
2. Flying from state to state
3. By animal
4. I don't know

Q6. The False codling moth affects specialty crops because . . .

1. Specialty crops are not affected
2. Specialty crops include rice, wheat, and other grains that the moth destroys
3. Specialty crops include fruit, nuts, and vegetables that the moth can destroy
4. I don't know

Q7. The Oriental fruit fly affects specialty crops because . . .

1. It attacks around 200 different kinds of California crops
2. Specialty crops are not affected
3. Specialty crops include grains
4. I don't know

Q8. You can help prevent the spread of False codling moth by . . .

1. Not bringing in fruits, vegetables, and plants from out of state
2. If you find fruit with worms in it, discard the fruit
3. There isn't any way to prevent the spread
4. I don't know

Q9. You can control Oriental fruit fly from spreading by . . .

1. There isn't any way to prevent the spread
2. Limiting movement of fresh fruits and vegetables in areas where they are found
3. Using the "male attractant technique" with a bait station
4. I don't know

Q10. Please type your name:

Q11. Please type the name of your school:

Q12. Please select your grade from the following:

4
5
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11
12

Q13. Is English your first language?

1. Yes
2. No

Appendix D: Invasive Species Student Post-Survey

Welcome. This is an online survey to understand how much you know about certain insects that are invasive. Please answer to the best of your knowledge. This is not a test. Thank you for participating.

Q1. What are invasive species?

1. Organisms that have been moved into an ecosystem where they have not been previously found
2. Organisms that enter the bodies of animals
3. Organisms such as plants and animals from a different state
4. I don't know

Q2. Why is the False codling moth a problem? (check all that apply)

Q2A. It is not a local problem right now

Q2B. Caterpillars eat and destroy fruits

Q2C. There is no way to get rid of them

Q2D. It will cost farmers to get rid of them

Q3. The Oriental fruit fly is a problem because . . . (check all that apply)

Q3A. They infest areas quickly

Q3B. Have short life cycles

Q3C. Can destroy a farmer's entire crop

Q3D. They are not a local problem right now

Q4. The False codling moth travels mainly . . .

1. Inside fruits and vegetables
2. By bird
3. By mammal
4. I don't know

Q5. The main way the Oriental fruit fly travels is . . .

1. Inside infested fruit
2. Flying from state to state
3. By animal
4. I don't know

Q6. The False codling moth affects specialty crops because . . .

1. Specialty crops are not affected
2. Specialty crops include rice, wheat, and other grains that the moth destroys
3. Specialty crops include fruit, nuts, and vegetables that the moth can destroy
4. I don't know

Q7. The Oriental fruit fly affects specialty crops because . . .

1. It attacks around 200 different kinds of California crops
2. Specialty crops are not affected
3. Specialty crops include grains
4. I don't know

Q8. You can help prevent the spread of False codling moth by . . .

1. Not bringing in fruits, vegetables, and plants from out of state
2. If you find fruit with worms in it, discard the fruit
3. There isn't any way to prevent the spread
4. I don't know

Q9. You can control Oriental fruit fly from spreading by . . .

1. There isn't any way to prevent the spread
2. Limiting movement of fresh fruits and vegetables in areas where they are found
3. Using the "male attractant technique" with a bait station
4. I don't know

Q10. Please type your name:

Q11. Please type the name of your school:

Q12. Please select your grade from the following:

4
5
6
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9
10
11
12

Q13. Is English your first language?

1. Yes
2. No

Invasive Species Student Fact Sheets Report

Executive Summary

The invasive species fact sheets were developed as a teaching tool to provide teachers with resources needed to teach about different invasive species. This set of fact sheets included the following invasive species: Varroa Mite, Asian Citrus Psyllid, Meditteranean Fruit fly and European Grapevine Moth. The front of the fact sheet presented the information about the particular species as well as ways to prevent it spreading. The back of the fact sheets included 'fantastic facts', and ideas for activities and further discussion.

The invasive species fact sheet survey was administered to a total of 645 students (pretest). 501 students completed the post-test. Tables 1.1 - 1.3 in the student report show the number of students by grade who participated in pretest and posttest.

Total pretest and post-test scores were computed for the sample and then checked for significant difference with a t-test. Students scored significantly higher in the post-test than in the pretest ($p<.01$), indicating that there was an overall increase in knowledge (of more than 50%) about invasive species (see Table 2.1 and Graph 2.1).

Mean post-test scores were significantly higher than pretest scores for all grades (See Graph 2.2) except grade 8 (because of no participants who completed the post-test).

In the post-test, students were asked to rate their interest in invasive species and how important they thought learning about invasive species was. A majority of students, 73% agreed that learning about invasive species was important. 66% of the students agreed that learning about invasive species was interesting.

Student Report

1. Frequencies

The following tables show the frequencies of students by grade and English language speakers.

Table 1.1: Showing frequencies and demographics of students in pretest and posttest

	N	English first language (yes)
Pretest	645	496 (77%)
Posttest	501	387 (77%)

Table 1. 2: Showing number of students by grade for pretest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	193	29.9	30.1	30.1
	5	159	24.7	24.8	54.9
	6	95	14.7	14.8	69.7
	7	50	7.8	7.8	77.5
	8	15	2.3	2.3	79.9
	9	3	.5	.5	80.3
	10	3	.5	.5	80.8
	11	36	5.6	5.6	86.4
	12	87	13.5	13.6	100.0
	Total	641	99.4	100.0	
Missing	System	4	.6		
Total		645	100.0		

Table 1. 3: Showing number of students by grade for posttest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	156	31.1	31.4	31.4
	5	142	28.3	28.6	60.0
	6	82	16.4	16.5	76.5
	7	26	5.2	5.2	81.7
	9	1	.2	.2	81.9
	10	4	.8	.8	82.7
	11	24	4.8	4.8	87.5
	12	62	12.4	12.5	100.0
	Total	497	99.2	100.0	
Missing		4	.8		

Total	501	100.0		

2. Invasive Species Fact Sheets Pretest and Posttest analysis

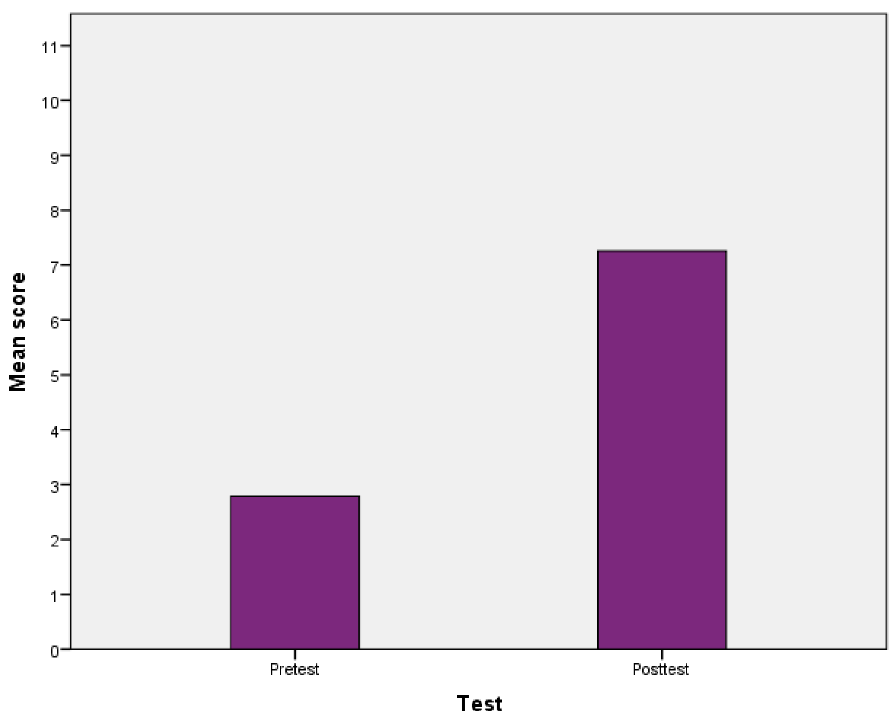
   i) Change in knowledge overall

   F-test (one way anova) showed that mean post-test score was significantly higher than pretest (p=.00). This indicates that students increased in their knowledge of invasive species.

Table 2.1: Showing mean pretest and post-test scores

Test	N	Mean	Std. Deviation	Std. Error Mean
Pre-test	645	2.8	2.3	.09
Post-test	501	7.3	2.7	.12

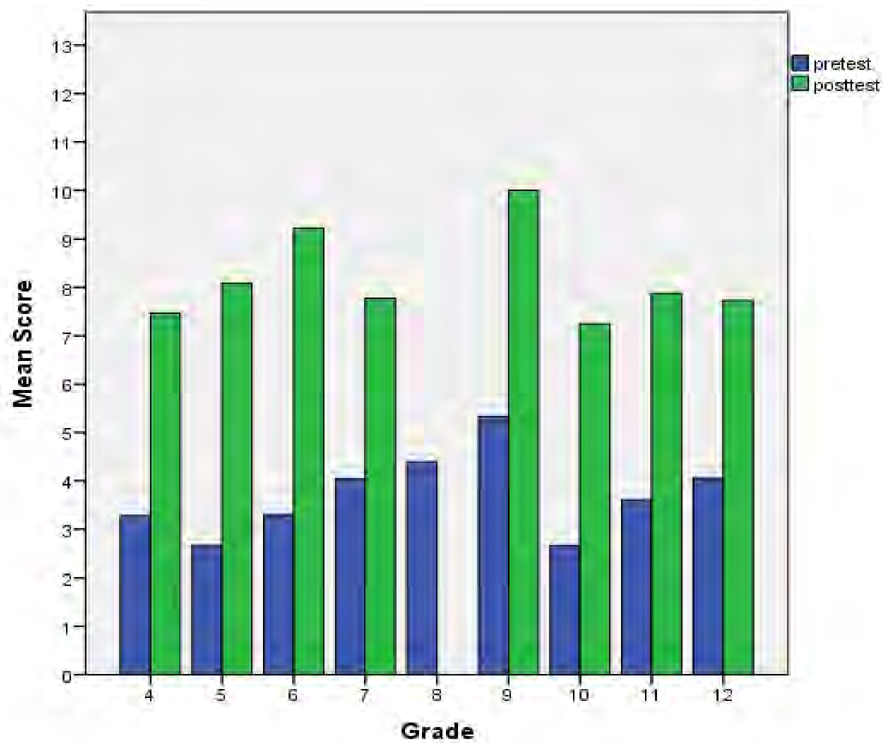
Graph 2.1: Showing mean pretest and posttest on knowledge of invasive species



ii) Pretest and posttest scores by grade

All pretest and posttest scores (except for grade 8) showed a significant increase in knowledge.

Graph 2.2: Showing mean pretest post-test scores by grade



3. Student rating of importance and engagement

i) Importance of learning about invasive species.

A majority of students (73%) stated that they agreed that learning about invasive species was important.

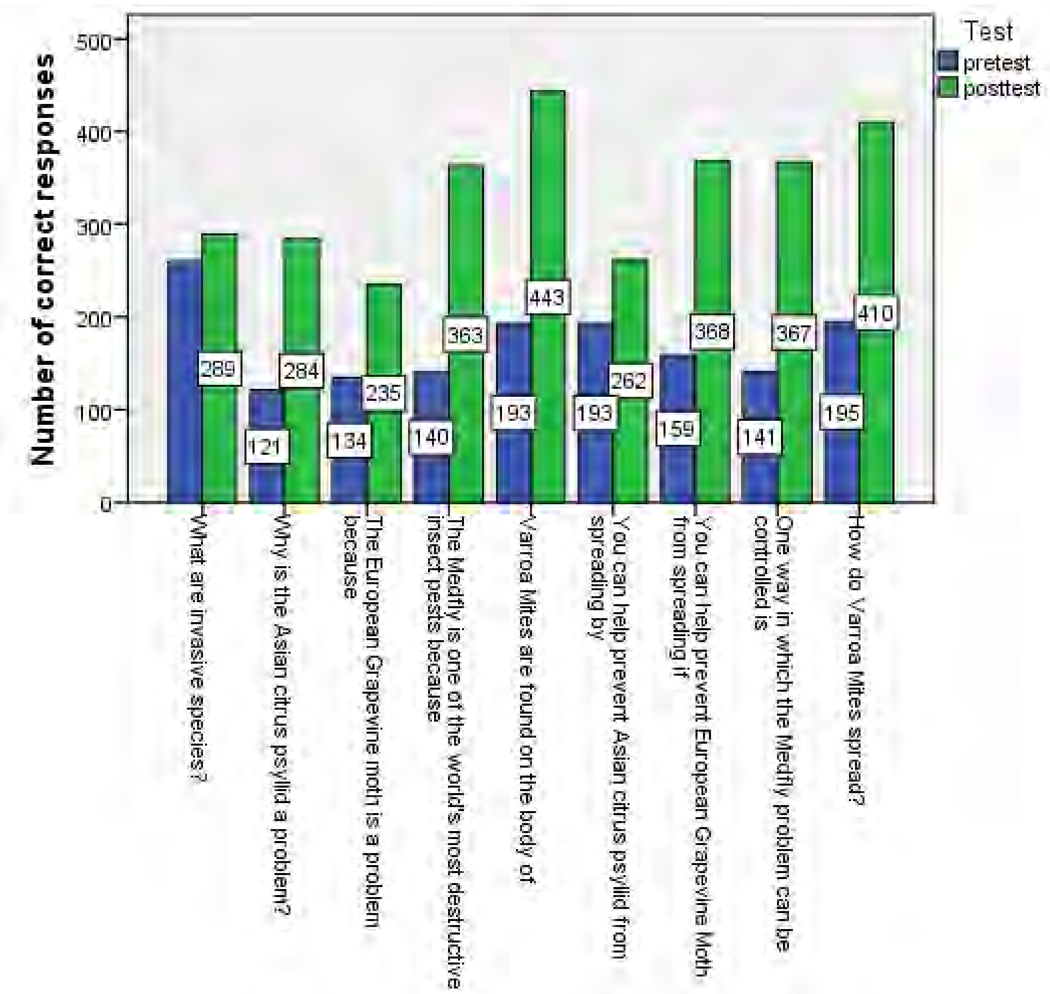
Learning about invasive species is important	Frequency	Percent
(missing)	148	22.9
Agree	258	40.0
Disagree	19	2.9
Strongly Agree	211	32.7
Strongly Disagree	9	1.4
Total	645	100.0

iii) Interest in learning about invasive species

A majority of students (66%) agreed that learning about invasive species was interesting.

Learning about invasive species is interesting to me.	Frequency	Percent
Valid	147	22.8
Agree	310	48.1
Disagree	43	6.7
Strongly Agree	115	17.8
Strongly Disagree	30	4.7
Total	645	100.0

4. Student responses by item (number of correct responses)



The Invasive Species teaching resources have been promoted throughout Ag in the Classroom's social media from October 2015 through July 2016. The posts have reached and engaged audiences on Twitter, Facebook and Instagram, boosting awareness of the resources and sparking conversations. Although all engagement has been positive, the posts have received limited success in driving traffic to the website. Ag in the Classroom has studied the two tweets that have been success in driving traffic to the website and is striving use similar strategies when crafting future social media posts.

Social Platform	Date Posted	Impressions	Engagements	Engagement Rate	Link clicks
Twitter	July 19	154	4	2.6%	0
	June 28	649	9	1.4%	2
	June 8	246	0	0.0%	0
	May 3	389	2	.5%	2
	April 13	432	8	1.9%	0
	February 11	1,258	6	.5%	0
	February 9	14	4	28.6	0
	October 30	213	1	.5%	0
Facebook					
	June 22	529	9	.02%	0
	April 30	638	5	.01%	0
	April 27	49	11	22%	0
	October 30	773	22	.03%	0
Instagram					
	June 9	NA	11	NA	0
	April 27	NA	8	NA	0
	April 14	NA	4	NA	0

AgAlert
THE WEEKLY NEWSPAPER FOR CALIFORNIA AGRICULTURE

Urban-edge farms give new life to Santa Clara

Issue Date: November 26, 2014
By Bob Johnson

In the shadow of Google and Apple, there may yet be room for a revival of agriculture in one part of Santa Clara County.

A diverse coalition is involved in an effort to bring fruit and vegetable production back to the Coyote Valley area between San Jose and Morgan Hill, including the Santa Clara County Farm Bureau and the county agricultural commissioner, the Community Alliance with Family Farmers, the local Resource Conservation Service, and numerous groups committed to preserving open space in Silicon Valley.

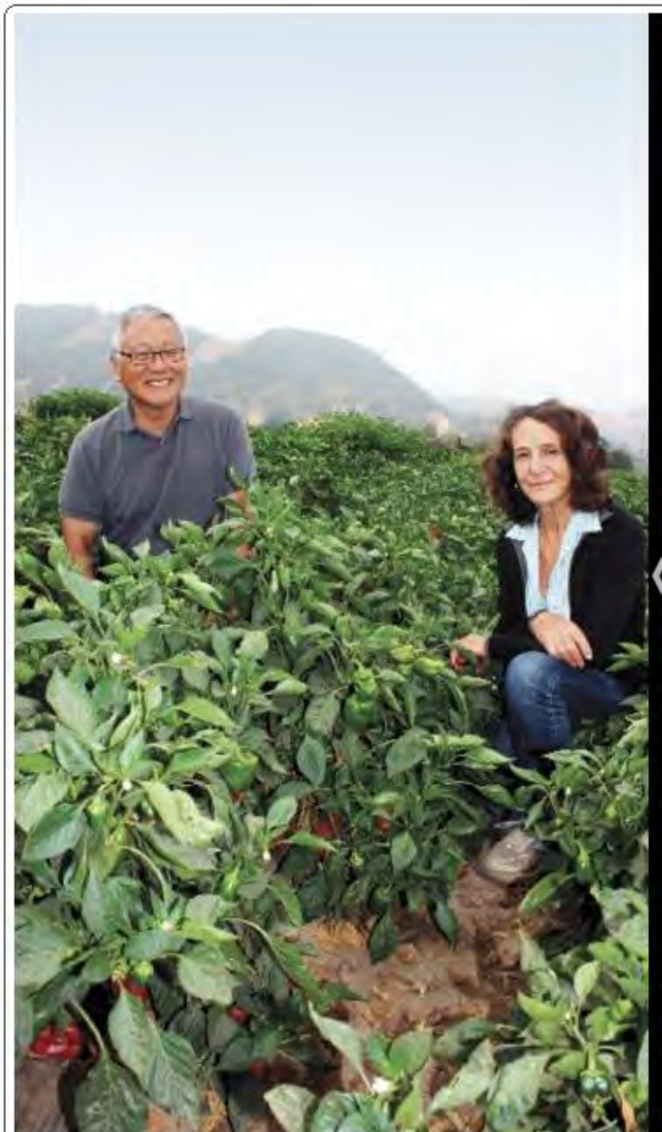
"The vision many people have for the Coyote Valley is that it would be revived as a food belt for San Jose and Morgan Hill," said Sibella Kraus, president of Sustainable Agriculture Education, or SAGE. "We see urbanedge agriculture as critical for the cities."

The project, called Sustaining Agriculture and Conservation in the Coyote Valley, is being managed by SAGE, a non-profit that specializes in bringing together agricultural, governmental and environmental groups to develop and sustain urban-edge agriculture.

The California Department of Food and Agriculture is helping finance this attempt to promote expanded specialty crop farming on the edges of urban development in Santa Clara County.

"We are trying to increase specialty crop acreage in the Coyote Valley, increase opportunities for existing specialty crop growers and increase sales to local markets," Kraus said.

She discussed the effort with the farmers and others who came to the UC Cooperative Extension pepper variety trial on a Uesugi Farms field just outside Morgan Hill in the Coyote Valley.



Sibella Kraus, president of Sustainable Agriculture Education and project director of Revitalizing Specialty Crop Agriculture in the Coyote Valley, and Bill Fujimoto, market consultant and treasurer of SAGE, visit a Coyote Valley pepper field.
Photo/Bob Johnson

The peach and apricot orchards that once supplied local canneries in Santa Clara County, called the "Valley of the Heart's Delight," are largely gone but the county still produces crops worth more than a quarter billion dollars annually.

Photo of peppers that are ready to be harvested.
Photo/Bob Johnson

"There are 75 varieties of peppers grown in Santa Clara County, and we are fourth in the nation in bell pepper production," said Santa Clara County Agricultural Commissioner Joseph Deviney. "People in San Jose don't know what's going on down here."

The apricot and cherry orchards that once flourished have been reduced to barely over a thousand acres, but there is still significant production of other specialty crops, including mushrooms.

"Santa Clara County is No. 2 in mushrooms in the state, and No. 3 in bell peppers," Deviney said. "I am trying to remind people how much agriculture is still going on in Santa Clara County. I worked in Contra Costa County for 24 years, and I jumped at the opportunity to come to a place with four times as much agriculture."

Even experienced farmers in the area can be taken aback by the size of the local harvest.

"It surprised me at first when Joe (Deviney) told me we were fourth in the nation in bell peppers, but it makes sense," said Pete Aiello, general manager of Uesugi Farms. "The climate here is perfect; it gets warm in the day, but cools at night."

The Aiello family has farmed in the Coyote Valley area for 35 years. Shortly after graduating from Cal Poly San Luis Obispo, his father began working with local pioneer pepper grower George Uesugi.

"We see a bright future in pepper production. Demand has done nothing but increase for 35 years," Aiello said.

The goals of Sustaining Agriculture and Conservation in the Coyote Valley include increasing agritourism and marketing specialty crops grown in the area to nearby city residents.

SAGE treasurer and board member Bill Fujimoto is a marketing consultant for farm products throughout the greater Bay Area.

"The people I talk to, mostly specialty restaurants and a few higher-end markets, are interested in fresh and grown well," Fujimoto said.

Sustaining Agriculture and Conservation in the Coyote Valley faces its most severe challenge in finding ground for specialty crops that isn't already taken.

"There is more demand for land than there is supply," Kraus put it succinctly.

Less than a decade ago, planners eyed the 7,400-acre stretch of land between San Jose and Morgan Hill for future development, but current plans call for open

Pepper fields like this one propel Santa Clara County into its position as one of the nation's top counties in pepper production.
Photo/Bob Johnson

space and agriculture. This shift in official thinking about Coyote Valley makes it feasible to pursue converting fallow and hay acreage to specialty crop production.

Uesugi Farms is able to lease the 37-acre field used for the most recent pepper trials at rates far lower than are common in the nearby Salinas and Pajaro valleys because strong planning restrictions make development impossible, at least for now.

But Uesugi general manager Aiello said he wonders what would happen to Coyote Valley agricultural rents if state and local governments decide they can no longer afford to continue Williamson Act contracts, which give landowners reduced property taxes in exchange for keeping their land in agriculture.

Water might be available for Coyote Valley specialty crops, because the Santa Clara Valley Water District is building a recycling facility in San Jose capable of treating 8 million gallons of water a day to the point that it is fit for reuse.

"The water district is producing more high quality reusable water than it has use for," Kraus said.

Wastewater plants in nearby Watsonville and Marina are already responding to shortages by releasing highly treated water for use in Pajaro and Salinas Valley fields, and a similar program seems feasible in the Coyote Valley, she said.

(Bob Johnson is a reporter in Santa Cruz. He may be contacted at **bjohn11135@aol.com**.)

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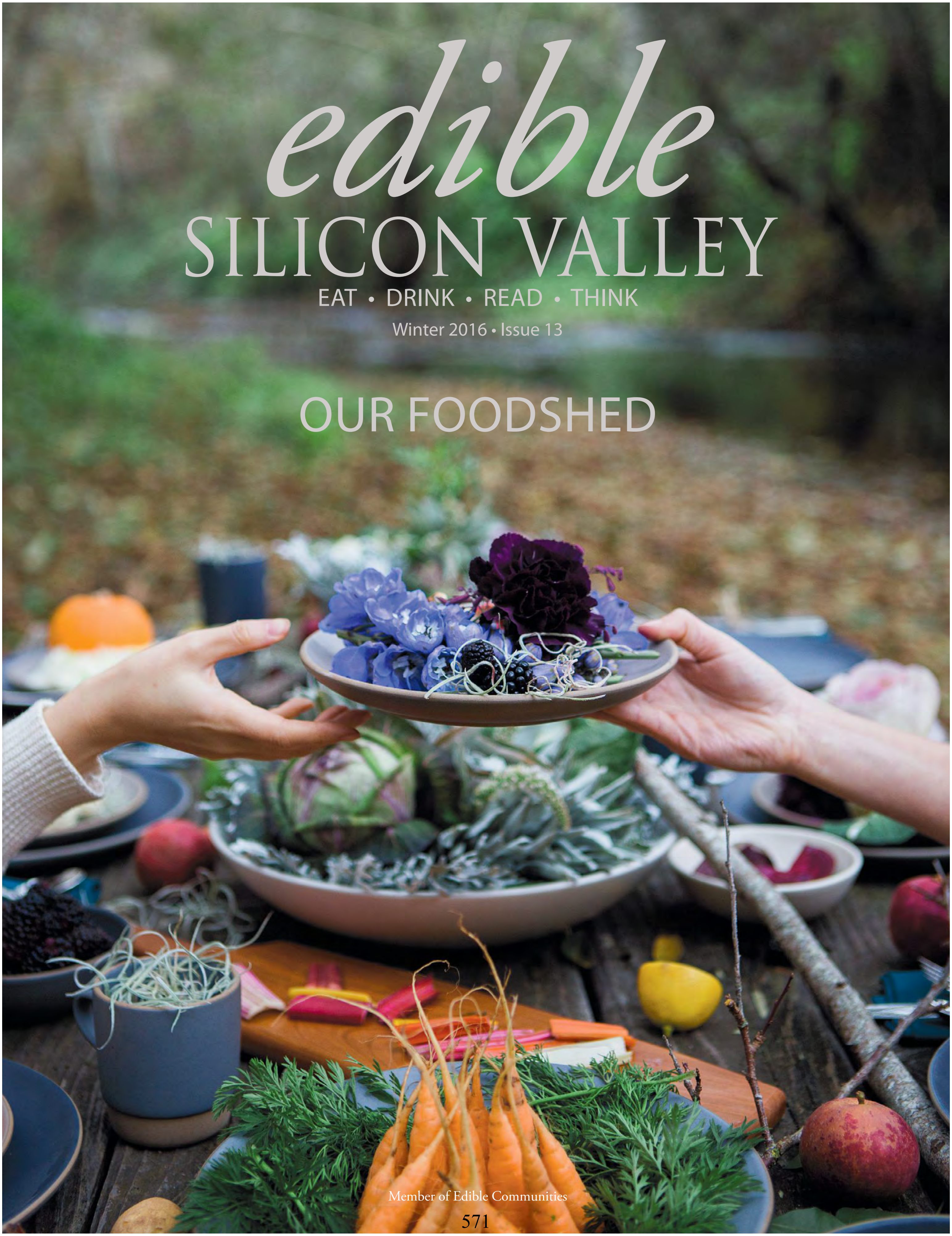

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CONTENTS WINTER 2016

A SLOW DANCE WITH NATURE

Agriculture and development in the future of Coyote Valley

BY CHERYL ANGELINA KOEHLER

The buzzing of bees around blossoming fruit trees was once a sign of spring unfurling in the Valley of Heart's Delight. And while the prevailing sound these days is a year-round hum coming from Silicon Valley's tech corridors, Santa Clara County has not entirely lost its rich agricultural heritage. Mushrooms, nursery products, peppers, tomatoes, lettuces, cherries and wine grapes are the leading crops.

One has only to follow Santa Terese Boulevard over a low rise on the southern edge of San Jose to arrive in a part of the county that looks a whole lot like farmland. A developer standing on that rise, gazing over the seven- by two-mile expanse of Coyote Valley a decade or more ago, probably would not have been admiring the pumpkin fields. More likely, he was plotting out the routes between soon-to-be tech campuses and warrens of classy retail and housing. If he felt a chilly wind nipping at his neck, it might have been a premonition of the Great Recession blowing in.

Since 2008, the developers' vision has become a bit cloudy. The IBM satellite campus at the northwest end of Coyote Valley sits alone as tech companies reconsider the value of expanding their footprint and adding transportation issues for workers not eager to relocate. The pause in growth has made room for a coalition of open-space and agriculture advocates to pose questions like these:

Could agriculture and conservation be sustained in Coyote Valley even as development continues or quickens? Does San Jose need new land for jobs and housing, or can it accommodate growth within its urban core? In an expanding economy, can South Bay communities still assign high values to locally grown food, places for outdoor recreation and habitat for wildlife? Time will have its answers. Meanwhile, here is a brief look in on activity in Coyote Valley at year's end.

Small Farmer on a Busy Corner

On the north end of Coyote Valley in early November, acres of tall sunflowers beam their last yellow rays over the Spina Farms Pumpkin Patch at the corner of Santa Teresa Boulevard and Bailey Avenue. A few stray pumpkins passed over for jack-o-lanterns lie unpicked in the fields as John Spina (father and son) work with a few farm hands to deconstruct the rides that carried ebullient children among the crops. Shelves and bins at the Spina family's farm stand still brim with late-harvest tomatoes, peppers, squash, apples and nuts.

"The people are right there," says the elder John Spina, indicating the close proximity of his farm to urban consumers. The original farm, started in 1944 by John's father, was an orchard in the middle of San Jose. They relocated to Coyote Valley in 1965, planted row crops and set up the farm stand for sales direct to consumers. The Spina's key to success in Coyote Valley has been diversification: tree and row crops through spring and summer, the Pumpkin Patch, firewood and Christmas trees in winter.

Big Grower on a Quiet Corner

The Spinas are among the few growers offering direct sales in Coyote Valley, so a stranger meandering the grid of farm roads in the off season can only guess who is growing what. Pete Aiello, general manager of Uesugi Farms, stops by the quiet and undistinguished northeast dead end of Richmond Road, location of his now-cleared cornfield. He's recalling the raucous feasting of the crows in late summer when a heat wave caused the maturing ears to burst out of their husks. Peppers, pumpkins or Napa cabbage might be planted here next summer, and by then Aiello hopes to have a new high-tech irrigation monitoring system running from his smartphone. Such technology is important to a big operation like Uesugi Farms. With 5,000 acres in production through the year across eight California counties and into Mexico (including 40-plus leased acres in Coyote Valley), Aiello is providing ever-growing urban markets with a wide range of crops through all four seasons. He's always in search of additional acreage to meet that demand.

"If we're looking for more ground, this is the spot," Aiello says, indicating that the Coyote Valley soil, the climate and especially the location are ideal. Having a place to grow in this unincorporated part of Santa Clara County so near Bay Area consumers is a great asset. "City limits have not yet encroached, but it's 'when' not 'if,'" he says, believing the development pressures will not let up even as demand for food in San Jose, the fastest growing community in the Bay Area, increases. Like most experienced farmers, he sees endless opportunity for producers—as long as there are fields to farm.

John Spina is proud to be selling his family farm's produce right at the corner of Santa Teresa Boulevard and Bailey Avenue in Coyote Valley. (Photo by Cheryl Angelina Koehler) Opposite page: Santa Clara County is a significant producer of peppers, both in the state and nationally, as illustrated by this photo of Pete Aiello's Coyote Valley pepper field (courtesy of Uesugi Farms).

"There's room for everybody in the food field," he says.

Among those who want Coyote Valley to be a welcoming place for beginning farmers is Andrea MacKenzie, general manager of the Santa Clara Open Space Authority, who describes Coyote Valley as "arguably the most important agricultural and natural landscape remaining in the South Bay." Her public land conservation agency is able to protect natural and agricultural lands through land purchase and conservation easements. When they purchase properties from farmers who do not want to continue farming, they are able to sell the land back to new farmers at rates that could be 40–60 percent below full market value in exchange for an easement, which is an agreement that the land will remain in agricultural use.

"This is how the cheese makers in Sonoma County got started; how they got their properties," she says, as the conversation turns to the possibilities for reclaiming an agritourism identity for the "Valley of Heart's Delight." "There's a sense of place in Coyote Valley."

Room to Grow

Many Coyote Valley growers do their work in spacious indoor facilities. The multi-story Monterey Mushrooms plant on Santa Teresa Boulevard is one of many such fungi farms this international company maintains across the continent. Mushrooms are a high-value "specialty" product, so this is a popular industry in many California growing regions, where the companies benefit from the ready availability of low-grade agricultural waste they can use as growing substrate.

But far more numerous in the inventory of Coyote Valley covered growing spaces are the long, low, interconnected greenhouses of the Bay Area Chrysanthemum Growers Association (BACGA). Since NAFTA shifted flower trade to South America in the 1990s, it's mainly food, not flowers, growing under these plastic-covered wood structures. This cooperative, established by Chinese-American farmers in 1956, now supports growers of specialty Asian greens like bok choy, gai lan and Napa cabbage. Second and third generations of those founding farmers—joined by more recent Asian immigrants—continue to benefit from BACGA membership. But just as in 1956, language barriers and limited resources to improve their operations create disadvantages for this farming group. On top of that is uncertainty about agriculture continuing here in the face of continued development.

"That uncertainty is having a chilling effect on investment in agriculture," says MacKenzie, whose organization is part of a coalition envisioning a brighter future for agriculture in Coyote Valley.

Also at the heart of that coalition is SAGE (Sustainable Agriculture Education), a nonprofit founded in 2001 to protect and revitalize agriculture on the urban fringe. In 2012, with funding from the California Coastal Conservancy, the nonprofit produced a Feasibility Study and Recommendations for Sustaining Agriculture and Conservation in Coyote Valley. SAGE was then awarded a California Department of Food and Agriculture (CDFA) Specialty Crop Block Grant for increasing specialty crop production in Coyote Valley. Specialty crops (defined by the CDFA as fruits, vegetables, nuts and nursery crops) generally bring higher value at the market, but producing these crops can also take more investment, says SAGE director Sibella Kraus, who has identified BACGA as the group of specialty-crop growers in the valley most in need of technical assistance.

During a stop at one of the greenhouse farms, a young Chinese-American woman translates for an elderly farmer, who makes it quite clear that he is not to be identified in any reporting. The meeting was arranged so that Kraus and Drew Mather, a soil conservationist for the Natural Resource Conservation Service, could hear feedback regarding this farmer's participation in the CDFA grant-funded weed management demonstration trials. The farmer has been testing the efficacy of a new type of seeder intended to make his crop of greens easier to weed.

With upkeep of the greenhouse structures as his highest annual expense, this farmer watches all expenditures. He understands that

Hikers following trails through the Coyote Valley Open Space Preserve are treated to splendid views of Coyote Valley farmlands. (Photo by Stephen Joseph courtesy of Santa Clara Open Space Authority) Below: Students in Ann Sobrato High School's ag program plant a hedgerow, which will provide a windbreak and pollinator habitat to benefit their garden. (Photo by Sibella Kraus, courtesy of SAGE)

the cost of the seeder, were he to purchase one, could be offset by savings in labor, but he's not keen on new approaches, including Mather's other suggestions for flame weeding or crop rotation. Mather comments in an aside that "efficiency" for a long-time grower is often to do things the same old way, but he adds that this farmer is more open-minded than many in this group. When asked if there are any other innovations the CDFA grant could facilitate, the farmer suggests he might like to have some of those [GMO] pesticide-resistant seeds.

"While some BACGA farmers are doing well, quite a few are not operating economically or ecologically sustainable businesses, and their children are not interested in taking over," says Kraus. "However, there is huge demand for Coyote Valley farmland from a whole range of farmers—diversified organic growers and conventional growers like Pete Aiello who need more land to meet market demand, immigrant farmers wanting to produce specialty ethnic crops for their local communities and alfalfa growers."

Heard Through the Hedgerow

On the Morgan Hill end of Coyote Valley, a group of college-bound students engage with leading-edge practices in sustainable agriculture as they maintain their recently planted hedgerow of fruit trees, edible herbs and native shrubbery along the western edge of their school's "farm" classroom. These participants in Ann Sobrato High School's acclaimed agriculture program have had the benefit of instruction and direction from an outside advisor, Sam Earnshaw of Hedgerows Unlimited, who was retained by SAGE to help enhance habitat on Coyote Valley farmland. Earnshaw teaches that use of hedgerows dates to the dawn of agriculture. Largely abandoned (and even deconstructed) in 20th century practice, they are now understood to play a key role in a healthy balance between natural and agricultural ecosystems, most notably as habitat for pollinators.

With the hedgerow project well under way, SAGE is turning attention toward a new CDFA grant to help develop a business plan for a 10-acre organic demonstration farm on the high school campus. This will create more and wider opportunities for the Ann Sobrato students.

Directing her charges in their afternoon farm/classroom activities, Tanya Callabretta steps away for a moment to talk about the importance of community partnerships, such as those facilitated by SAGE and the National FFA Organization, in a modern educational environment. Until the 1980s, FFA stood for "Future Farmers of America," but as Callabretta explains, that "future" no longer means production farming. The stunning array of studies and careers her students will pursue include all the new technologies and engineering around food and farming, plus the increasingly vital environmental sciences that address depletion of natural resources. They might work in regulation and biosecurity; veterinary science; horticulture; culinary, floral, and landscape arts; product development; marketing; education; leadership; cultural studies, and much more.

Tanya Diamond of Pathways for Wildlife caught this bobcat in the viewer of one of her field cameras in Coyote Valley. "Our goal is to try and determine what are important pathways that animals are traveling along that connect across the valley floor," she says. Below: Solar panels provide energy for Uesugi Farms operations. (Photo courtesy of Uesugi Farms)

A Slow Dance with Nature

This long day of exploring agriculture in Coyote Valley ends at the Coyote Valley Open Space Preserve, which the Santa Clara County Open Space Authority opened on the west side of the valley in June 2015. Late afternoon hikers cast long autumn shadows as they head up into the wild lands, where they might encounter grazing cattle from Tilton Ranch to the south or innumerable species of wildlife. If they know what to look for, they might also perceive signs of tule elk, coyote, grey fox, American badgers or mountain lion. These magnificent creatures cross from the Santa Cruz Mountains to Mt. Hamilton and the Diablo Range on the eastern side of the valley via a "critical wildlife corridor" made up of Coyote Valley farmland and two US 101 underpasses. Wildlife technicians from the De Anza College Environmental Studies Department and independent researchers like wildlife ecologist Tanya Diamond of Pathways for Wildlife have mapped these corridors and captured images of these nearly vanished wild populations using remotely operated cameras. This ecosystem is still wild enough to be revered by naturalists, but can it stay that way?

As the visit winds down, conversation about the future of Coyote Valley turns back to the students at Ann Sobrato High School and how their studies in Coyote Valley might inspire exciting paths ahead.

"That young person might follow Tanya Diamond into wildlife ecology," Kraus says, "or she might help Pete Aiello with cutting-edge farming technology."

Cheryl Angelina Koehler is the editor/publisher of *Edible East Bay* and the author of *Touring the Sierra Nevada*, published by University of Nevada Press.

Pepper Management Seminar & Chili Pepper Field Day

Thursday August 28, 2014 — 8:30 a.m. - 12:00 noon
Coyote Valley: San Bruno & Hale Ave (follow signs to field location)

Program and Presenters:

Introduction —
8:30 Registration and Refreshments
8:45 Welcome & Introduction—*Aziz Baameur, UC Small Farms Advisor*
8:50 Peppers & Other Specialty Crops in Coyote Valley—*Sibella Kraus, President, Sustainable Agriculture Education (SAGE) and Project Director, 'Revitalizing Specialty Crop Agriculture in the Coyote Valley'*
9:00 Pepper place in the County Agriculture—Joseph Deviney, Santa Clara Ag Commissioner

Production Topics in Peppers —
9:10 Why we Grow Peppers?—Pete Aiello, General Manager, Uesugi Farms
9:30 Insects Vectoring Viruses—*Shimat Joseph, IPM Farm Advisor.*
9:50 Viruses, Phytophthora, & Powdery mildew issues in pepper—*Steve Koike-Plant Pathology Advisor & Aziz Baameur.*
10:10 Weed Management in Pepper production—*Richard Smith, Weed Science Advisor*
10:30 Break

Chili Peppers —
10:45 Does water stress affect "heat" in chili peppers?—*Aziz Baameur*
10:55 Chili Pepper Types: An Overview—*Aziz Baameur*
11:10 Chili Pepper Marketing—*Bill Fujimoto, Marketing Consultant*
11:30 Chili Pepper Variety & Fruit Display—*Aziz Baameur*
12:00 Final Words & Adjourn

To Register: **Registration is free!** Please follow this link: *http://tinyurl.com/PepperFieldDayReg*
Contact: UCCE Santa Clara office: 408-282-3111**or**
SAGE office: 510-526-1793 x 5 or email charlotte@sagcenter.org

Sponsors: UC Cooperative Extension-Santa Clara, San Benito, Monterey Counties. UCCE Small Farm Program, SAGE (Sustainable Agriculture Education), Santa Clara County Ag Commissioner, Uesugi Farms, CDFA Specialty Crop Block Grant Program, Project # 25029

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Chili Pepper Specialty Crops Production Trial

October 24, 2014 update

Background

As part of increasing specialty crop production in the Coyote Valley, SAGE partnered with UC Cooperative Extension in a chili pepper specialty crop production plot trial. The chili pepper plot was grown on Uesugi Farms land, which has 80 acres of farmland in the Coyote Valley. The trial featured 68 different types of chili pepper production, data of which was systematically recorded to be used for agricultural research purposes, especially for viability of pepper production in Coyote Valley. Hundreds of pounds of chiles were harvested over the growing season, most of them distributed for culinary uses to local restaurants and chefs in the Bay Area. The chili pepper trial has also been used as a learning tool for field days and seminars, and as a point of public interest and engagement in Coyote Valley through being featured at the Coyote Valley Family Harvest Feast.

Chili Pepper Field Days

SAGE and UC Cooperative Extension hosted two field days focusing on chili pepper cultivation. The first field day was on Tuesday, August 19 and hosted two groups, the Santa Clara County Master Gardeners and International Culinary Students Farm to Table students. Sixty Master Gardeners attended the educational field day with Aziz Baameur and received academic credit through UC Cooperative Extension. The International Culinary Students went on a field trip to the Coyote Valley as part of their Farm to Table curriculum focus, with most of their visit focusing on the chili pepper trial and locally sourced specialty crops.

The second field day on Thursday, August 28th was a pepper field day and seminar open to the general public with a targeted audience of beginning farmers, farmers in Santa Clara County, agricultural academics, and other food systems professionals. Twenty five people attended this workshop which focused on a variety of chili pepper production topics. Presenters and topics included:

- Peppers & Other Specialty Crops in Coyote Valley—Sibella Kraus, President, Sustainable Agriculture Education (SAGE) and Project Director, 'Revitalizing Specialty Crop Agriculture in the Coyote Valley'
- Pepper place in the County Agriculture—Joseph Deviney, Santa Clara Ag Commissioner
- Why we Grow Peppers?—Pete Aiello, General Manager, Uesugi Farms
- Insects Vectoring Viruses—Shimat Joseph, IPM Farm Advisor.
- Viruses, Phytophthora, & Powdery mildew issues in pepper—Steve Koike-Plant Pathology Advisor & Aziz Baameur.
- Weed Management in Pepper production—Richard Smith, Weed Science Advisor
- Does water stress affect "heat" in chili peppers?—Aziz Baameur
- Chili Pepper Types: An Overview—Aziz Baameur
- Chili Pepper Marketing—Bill Fujimoto, Marketing Consultant
- Chili Pepper Variety & Fruit Display—Aziz Baameur

Culinary Engagement with Local Chefs

In September, SAGE began collaborations with local chefs of the Bay Area to sample and experiment with different chili pepper varieties for relevant culinary uses. SAGE coordinated the delivery of chili peppers to local chefs throughout the Bay Area. Chefs were given an extensive sampling of chili pepper varieties based on what was recently harvested and relevant to culinary uses. Chefs were encouraged to use the pepper varieties in whatever ways interested them, ideally featuring the pepper as a main part of the recipe. They have been reporting back on their pepper use, recipes, and general assessment of the viability of the pepper variety for culinary purposes and potential consumer interest. Chefs were also reached out to regarding creating a chili sample for the Coyote Valley Family Harvest Feast. Café Pomegrante head chef Affie created a Persian Pepper Puree using sweet peppers and spicy habaneros, and collaborator Peter Ruddock created a tomatillo verde salsa using Serrano chiles. All samples were met with great enthusiasm at the Family Harvest Feast, with many attendees inquiring to where and how chiles could be purchased.

Restaurants and chefs that received chili peppers include:

- Café Pomegranate and Affie Mahini in San Jose; created a Persian Pepper Puree for sampling at the Coyote Valley Family Harvest Feast
- Peter Ruddock; prepared a tomatillo verde salsa for the Coyote Valley Harvest Feast; he has also been picking up and distributing peppers to a variety of other interested chefs, farmers, and food advocates in the Bay Area (deliveries and feedback are still in process)
- Parcel 104 and Chef Brad Ogden in San Jose
- Ramen Shop in Oakland, creating a spicy chili sauce for use in their dishes
- Penrose
- Boot and Shoe
- Camino, Chef Michael Tsai
- Bull Valley Road House
- Flower-Power Bakery Café, Chef Mimi Brown

Assessment

SAGE will continue to assess the culinary uses, local demand, and ways to meet demand and engage markets with different chili pepper varieties. Already the peppers have received astounding reviews from chefs, the public, and other people who have received specialty chili pepper varieties.

"I gotta say that those are the BEST red peppers ever - As declared by me and my kids - and my kids are not usually that effusive about red peppers - they asked for one with their dessert last night over fruit :) Our bag is labeled 44 Pritavid Hybrid. Appearance: beautiful deep red, shorter rounder then regular red peppers. Less waste inside with core and white sections. We have eaten three of the five we were gifted. We tried them raw, sliced into strips - goodness were these heavenly. The texture was crisp and juicy and the flavor was just right - not overly sweet but definitely full bodied. I'm afraid to cook the remaining two and detract from the wonderment of consuming raw. I can't imagine that cooking will improve what's already a form of nature's candy :) I hope these make the cut and we can start getting them at our markets - they are that good and I am not usually that excited about red peppers. Thanks so much for sharing them with us to test."

-- *Lisa Herndon of Lisa's Counter Culture, Palo Alto*

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
01		**Aji dulce**-- *C. baccatum* species—Peruvian origin Look just like a Red Habanero, but has little or no heat. 2 in. long red peppers offer the same strong aromatic essence and flavor that is found in Habanero, with only a hint of heat.
02		**Pasilla Bajio**-- *Capsicum annuum.* When fresh, this pepper is called 'chilaca (fresh form);' it is also known as 'chile negro.' 8 to 10 inch long cylindrical peppers are thin walled, and dark green ripening to dark brown. They have less than 250 Scoville units. Pasillas are used especially in sauces. They are sold whole or powdered in Mexico, the United States,
03		Pimieto: **Guajillo**—*C. annuum* species. 4 to 6 inches long and deep orange-red with brown tones. The guajillo chili's thin, deep-red flesh has a green tea flavor with berry overtones. Its fruits are large and mild in flavor, with only a small amount of heat (rating 2,500 to 5,000 on the Scoville scale). They are sometimes used to make the salsa for tamales. Guajillo may be used in pastes, butters, or rubs to flavor all kinds of meats, especially chicken.
04		**Anaheim** TMR-- *C. annuum* species Also know as the 'New Mexican Chile,-- moderately pungent fruit 7-1/2 inches long and 2 inches wide. They originated from New Mexico, they are also sometimes known as New Mexico peppers.
05		**Biggie Chile Hybrid**-- *C. annuum* species Anaheim-type chile 8 to 10-inch long, 4 ounce This classic 'California green chile' used for roasting, peeling, and including into cooked dishes. Very mild pungency.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
06		**Ancho San Martin Hybrid**-- *C. annuum* species Thick-fleshed peppers mature to 5-1/2 inches long and 3-1/2 inches wide. Dried, it is called ancho or ancho chile, from the Mexican Spanish name ancho ("wide") or chile ancho ("wide chile"). it is also usually used in the widely found dish chile relleno.
07		**Ancho San Luis**-- *C. annuum* species heart -shaped peppers are dark green, maturing to red, then mahogany. Mildly pungent peppers, 1,500 to 4,500 Scoville units, are 6 inches long and 3 inches wide.
08		**Poblano L**-- *C. annuum* species Dark green peppers mature to almost brown and are 5 inches long and 2-1/2 inches wide with a slight taper and blunt end. Scoville units from 600 to 1,800. These peppers are called Poblano when fresh and Ancho when dried
09		**Ancho 101**-- *C. annuum* species. mildly hot, heart-shaped peppers (are stuffed and made into chiles rellenos). When mature they are dark, rust red, richly flavored, and often dried and ground into chili powder. Peppers become 4 inches long, tapering to a blunt point. Wrinkled skin takes on even more character when dried. May be strung into long ropes or made into wreaths. 76 to 80 days.
10		**Sweet Banana**-- *C. annuum* species 5-1/2 to 6 inch long, tapered peppers that are wonderful fried or cut up into salads. Light green at first, they turn yellow and orange, and finally ripen to red. Compact plants. 72 days.

Code	Illustration	Description
11		**Bounty Hybrid**-- *C. annuum* species - 10 X 2 Sweet Banana type lives up to its name in that it puts out an incredible harvest of huge banana peppers that measure nearly a foot long. Peppers are typically 9 to 10 inches long and 2 inches across, and turn from light yellow to orange and finally red. Sweet flavor for eating fresh or cooked. Banana pepper flavor is not very hot (0–500 Scoville units)-heat decareses as fruit ripens.
12		**Long Red Slim Cayenne**-- C. annuum species. Bountiful harvest of pencil-shaped fruits that are 5 inches long and 1/2 inch thick, but often curled and twisted. Flavor is red hot and best used in very hot dishes. Easily dried. It is generally rated at 30,000 to 50,000 Scoville units.
13		**Large Red Thick Cayenne (Guinea spice)**-- *C. annuum* species Concentrated set of wrinkled, very pungent fruit, 6 inches long and 1-1/4 inches in diameter. Very pungent, even when small. Useful for sauce and drying.
14		**Sweet Cayenne**-- *C. annuum* species Long, sweet, cayenne shaped peppers grow to 1 foot long and turn crimson red when ripe. Productive plants bear loads of these crinkly, thin walled fruit that are perfect for use in stir fries or whenever a frying pepper
15		**Golden Cayenne**-- *C. annuum* species Beautiful clear lemon-yellow cayenne peppers really load up on compact wide. This is an unusual color in a hot pepper . 72 days.
16		**Cascabella**—*C. annuum* species Cone shaped, 1-1/4 inch long peppers range from 1,500 to 4,000 Scoville units. It is thick flesged pepper that is favored for pickling. (Not to be confused with 'Cascabel,' a thin-skinned variety that is round and usually dried).

Code	Illustration	Description
17		**Cherry bomb hybrid** (a pimiento)-- *C. annuum* species Hot cherry pepper that yields up to 50% more than the older, open-pollinated type. Thick-walled fruit is round to oval and matures from green to red. Pungency is medium-hot with about 20% less heat than a Jalapeno.
18		**Large Red Cherry Hot**-- *C. annuum* species Hot cherry pepper is round and matures from green to bright red. Popular for pickling and preserving. May also be stuffed with cheese and used as a popper.
19		**Red Cherry Sweet**-- *C. annuum* species 1 1/2 inch round fruit with a slight taper; turn from deep green to red and have medium-thick walls. Cherry pepper flesh is sweet, succulent, and more aromatic than that of the red bell pepper. It is recommended for use in salads and for pickling. 78 days.
20		**Cherry Pick Hybrid**-- *C. annuum* species This is the first hybrid sweet cherry pepper, offering earlier maturity and more uniform size and shape than open-pollinated cherry peppers. Very productive plants yield loads of 1 1/4-inch round fruit that mature from dark green to bright red. These are best loved for pickling, and the peppers can be used green, red, or halfway in between. 68 days to green.
21		**Habanero Mustard**—*C. chinense* species ("the Chinese pepper") This very different habanero is the result of an accidental cross between a chocolate-colored habanero with an orange habanero, resulting in striking coloration and extreme heat. Peppers start out as light green with a bit of purple streaking, progress to a mustard-hued peach before finally ripening to pure orange. Fruit is large and quite ruffled, making for a very beautiful habanero which is also very hot. 90 days.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
22		**Habanero**—*C. chinense* species A very hot pepper 40 times hotter than Jalapeno! Among the most potent ones we sell. Wrinkled fruit is 1 inch long and 1-1/2 inches wide, with a tapered end. Peppers begin as light green then turn to golden-orange and are loaded onto 36 inch tall plants. Thrives best in warm southern climates. 90 to 100 days.
23		**Habanero (red)** —*C. chinense* species Bright red version of Habanero is one hot pepper - 285,000 Scoville units! The fruit shape and size are much like the regular Habanero, wrinkled 1 inch to 1-1/2 inch long peppers with a tapered end. These peppers turn a bright red upon maturity. 85 days.
24		**White habanero**—*C. chinense* species These creamy white peppers are smaller than the typical habanero, only about 1 1/2 inches long and 1/2 inch across, but with the same habanero heat and distinctive fruity flavor. Expect abundant harvests of these very hot peppers. 90 days.
25		**Chichen itza hybrid**-- *C. chinense* species Fiery orange habanero type with 15,000 to 18,000 Scoville units and fruity taste matures 2 to 3 weeks earlier than open-pollinated habaneros. The peppers are also huge at 3-inches 85 days.
26		**Caribbean Red** -- *C. chinense* species Seed for this habanero variety was found in the Caribbean, and then improved, resulting in a uniform, fiercely hot pepper that is way hotter than the regular orange habanero. Dried samples of Caribbean Red measured 445,000 Scoville units whereas regular habanero tested at about 260,000 Scovilles. This pepper must be used carefully, but is wonderful for salsas, marinades, and making your own hot sauce. Bright red, wrinkled fruits are about 1-1/2 inches deep and 1 inch wide and have flavor with fruity overtones. 110 days to red.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
27		**Congo Trinidad**-- *C. chinense* species In Trinidad, habanero pepper relatives are called 'Congo peppers,' and this one is an extra-large red habanero type. At 2 inches long and wide, its peppers are significantly bigger and more ribbed than the typical red habanero. 80 days.
28		Red mushroom-- *C. chinense* species Thin-skinned, mushroom shaped red peppers are related to habanero and are extremely hot. Wrinkled peppers have a broad cap and are about 2 inches wide and deep, resembling a patty-pan squash, but colored brilliantly red. Large harvests of these peppers. 75 days.
29		Numex suave orange-- *C. chinense* species Developed by the Chile Pepper Institute, this pepper has all the wonderful flavor of a habanero but with very little heat, only about 800 Scoville Units. Has citrus-like aroma and flavor without the high heat level of a regular habanero. The word "suave" means smooth or mild in Spanish, and that is descriptive of the mellow flavor this variety delivers.. 95 days.
30		Purple Jalapeno-- *C. annuum*. species Jalapeno turns dark purple finally ripens to red. Peppers are somewhat larger than regular jalapeno. It has same thick walls and heat as other jalapenos. It's used in salsas and would be very attractive pickled with a mixture of other jalapeno colors. 75 days.
31		**Jalapeno M**—*C. annuum* species Peppers grow 3 in. long and 1-1/2 inches wide, with rounded tips. Dark green at first, then turning red. Good for fresh use or pickling. Good for fresh use or pickling; famous for nachos and other Tex-Mex dishes. 75 days.

Code	Illustration	Description
32		**Jalafuego Hybrid**—*C. annuum* species One of the hottest jalapeno varieties on the market. It has 4-inch long peppers. These jalapenos turn out smooth and very dark green. Large, plants that resistant to Potato Y virus. 70 days.
33		**Fooled You Hybrid**—*C. annuum* species Truly a jalapeno pepper for gringos, this one has **no heat**, but still retains the essential flavor of a jalapeno. Peppers look like normal jalapenos. The fruit is thick-walled and heavy and is perfect for making mild salsas or using in Mexican dishes for those who do not tolerate spicy food. 65 days.
34		**Chichimeca Hybrid**—*C. annuum* species A large-fruited jalapeno pepper that becomes 4 in. long and 2 in. wide. Fruit is a little milder than regular Jalapeno, measuring about 3500 Scoville units rather than the 5000 units registered by the standard Jalapeno. 65 days.
35		**Mucho nacho hybrid**—*C. annuum* species Jumbo jalapeno that is not only longer than most jalapeno fruit. fruit ripen to red upon full maturity. 75 days.
36		**Jaloro**—*C. annuum* species (2-2.5 in?) First yellow jalapeno pepper developed, from the Texas Agricultural Extension Service. Golden yellow before turning orange then red. Peppers are just as hot as regular jalapenos.

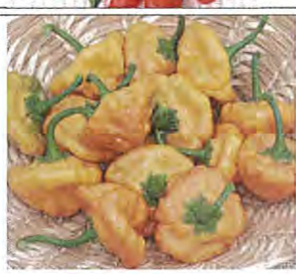
Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
37		**Mini Belle Pepper Red**—*C. annuum* species These cute little miniature bell peppers are just an inch or two long and feature very sweet flavor. When harvested as fully red,, can be used as sweet additions to salads. 55 days.
38		**Mini Bell Yellow Pepper**—*C. annuum* species very sweet flavor. Best when harvested as fully yellow orange. Similar to red min bells. 55 days.
39		**Mirasol**—*C. annuum* species -- The Spanish name of this pepper means 'looking at the sun,' for the way the pods are held erect on the plant. Fruit is 3 to 5-inch, thin-skinned red, and conical in shape. Medium heat, about 5,000 Scoville units. flavor has a hint of fruitiness. Dried, also known as Guajilli. 100 days
40		**Giant Marconi Hybrid**—*C. annuum* species. All america selections winner (earliness, yield, size, and flavor). It's the biggest of the Italian-type, sweet peppers. Peppers turn from green to red, and at 8 inches long with a lobed tip, they resemble a cross between a Marconi and a Lamuyo-type pepper. They are sweetest when red and are good for salads, but really are outstanding when grilled and roasted, methods that bring out the best of their great flavor. They are are resistant to potato virus and tobacco mosaic virus. 63 days.
41		**Purple Marconi**—*C. annuum* species. Sweet Italian peppers turn a rich shade of purple when they are fully ripe. Fruit is about 6-in. long with a tapered shape ending in a blunt tip. Traditionally used for frying, Marconis are also wonderful when eaten fresh. 90 days.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
42		**Pimiento Elite Hybrid**—*C. annuum* species. Sweet somewhat heart-shaped bright red fruit. 3-1/2 inch oval fruit that is less heart-shaped than Pimento L. Plants are resistant to tobacco mosaic virus. 85 days.
43		**Pimiento De Pardon**—*C. annuum* species. This pepper from Spain is traditionally used in its immature green stage, when it is picked quite small and fried in olive oil and served as an appetizer called a 'tapa.' When harvested small and green, peppers are mild, but get hotter as they grow. At full maturity, they are about 2 1/2 in. long and 1 1/4 in. wide, deep red and fiery hot. 65 days.
44		**Pritavit Hybrid**—*C. annuum* species. Deeply-ribbed, bell-shaped fruit is about 2 1/2 in. tall and 4 in. wide with a slightly flattened shape. This kind of pepper is known as a topepo type in Italy, where it is enjoyed for its rich sweet flavor and juicy red flesh. 75 to 80 days until red.
45		**Santa Fe Grande** (Yellow hot chili peppe)—*C. annuum* species. (3 X 1-1/2) Small, light yellow peppers are about 3 inches long and 1 1/2 inches wide, tapering to a point and resembling a miniature banana pepper. They are not sweet, however, but about as hot as a Jalapeno, measuring 5,000 to 8,000 Scoville units. 75 days.
46		**Mariachi Hybrid**—*C. annuum* species (4 X 2) Fleshy peppers, 4 in. long and 2 in. wide, ripen from yellow to red and have 500 to 600 Scoville units, much milder than average jalapeno heat levels. However, they can surprise you at times.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
47		**Scotch Bonnet** (Caribbean red peppers)—*C. chinense* species A Capsicum chinense very similar to Habanero, but later in maturity with fruit that is not quite as long. Found mainly in the Caribbean islands, it is also in Guyana and W Africa. Peppers that begin as green, but mature to red. Fruity aroma and same high heat as the Habanero (100,000-350,000 Scoville units). 120 days
48		**Serrano Del Sol Hybrid**—*C. annuum* species Fruit is larger in size and two to three weeks earlier than the original. Peppers are fleshy and which makes them favorite in Mexican cuisine. Measuring about 5,000 Scoville units, they are about the same pungency as a jalapeno, and are quite versatile for sauces, salsas, or flavoring. Fruit is about 3-inches long and 1/2 inches wide and green, maturing to a bright red. 64 to 67 days.
49		**Purple Serrano**—*C. annuum* species Purple-fruited version of Serrano--deep purple and a little longer than those of regular Serrano, but with the same candle-flame shape. Plants are tall and branching with the fuzzy foliage typical of Serranos. Very hot, good for salsas. 85 days..
50		**Serrano Chili**—*C. annuum* species. Very hot chile called for in many recipes. Candle-flame shaped fruit are 2-1/4 inches long, green, then red at full maturity. Suitable for salsas and sauce recipes as well as eating fresh. 75 to 80 days.
51		**Yellow Mushroom (squash pepper)** —*C. chinense* species. So named because of its shape resembling a mushroom, it is also sometimes known as a squash pepper for its resemblance to a patty-pan squash. Maturing to light yellow, then finally to golden. They are 2 inch, thin-skinned peppers. Yellow Mushroom chile has the heat level of a Scotch Bonnet but grow larger. Used in salsa, sauces and can be stuffed. And are also good when pickled. 80 days.
52		**Jamaican Hot Yellow**—*C. chinense* species Fruit is bright yellow or red, thin-skinned hot peppers that are shaped like a tam o' shanter. Actually a type of squash pepper. Fruit is spicy with a fruity flavor that makes it good to eat fresh, pickle, or use for hot sauce, or as a garnish. 95 days.

Code	Illustration	Description
53		**Jamaican Hot Red** –*C. Chinense* species. Densely foliaged plants bear an abundance of bright yellow or red, thin-skinned hot peppers that are shaped like a tam o' shanter. Actually a type of squash pepper. Interesting shape and spicy taste make this pepper good to eat fresh, pickle, or use as a garnish. 95 days.
54		**Tabasco**-- *C. annuum* var. glabriusculum Fiery hot, this is the one that has made Tabasco sauce famous. Green leaf strain that grows best in the South and East. Light yellow-green peppers turn to red and grow on tall plants. 80 days.
55		Sport (Tabasco-like)—*C. annuum* species. var. glabriusculum This pepper is popular for its use as a pickled pepper to go on hot dogs and other sandwiches. It is especially well known as an essential condiment in a Chicago-style hot dog. Peppers resemble Tabasco peppers, but the Sport pepper is larger, about 1-1/2 inches long and 1/2 inch wide. They are medium-hot and produced in great abundance on sturdy plants. 75 days.
56		**Thai Hot**—*C. annuum* species var. glabriusculum Extremely hot variety is originally from Thailand, and bears thin-fleshed peppers that are used especially in Oriental dishes. Peppers are used in soups, salads, and stir-fried dishes. They are also put in fish sauce as a condiment or eaten raw Clusters of bright red peppers. Heat level is 50,000–100,000 Scoville units. Fruit is up to 3 inches long. 90 days.
57		**Thai Hot Ornamental**-- *C annuum* species These compact, mound-shaped plants have tiny leaves and grow no more than 1 foot tall. They become covered with very hot, 1/2 to 1 inch long red fruit that is held upright on the plant, creating quite a showy display. Used mainly as an ornamental, but fruit is edible.. 90 days.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
58		**Aji limon (Lemon Drop, Hot lemon)** --*C. baccatum* species—Peruvian origin Hot, citrus-like, lemon-flavored pepper which is a popular seasoning pepper in Peru, where it is known as kellu uchu. fruits are about 2.5 in long and 0.5 in wide, and mature from green to yellow. Practically unknown in the West until the early 1990s, but are now gaining wide popularity. 30,000 - 50,000 Scoville Heat Units.
59		**Bhut Jolokia**-- *C. chinense species (*with some *C. frutescens* genes.*)* One of the hottest chile peppers in the world!! over 1 million Scoville Heat Units. The Bhut Jolokia is extremely hard to start from seed and requires patience when growing. The Bhut Jolokia can take up to 36 days before it starts to germinate and seeds have been observed germinating 80 days after planting. It also has a hard time self-pollinating and takes up to 160 days to start producing pods.
60		**Christmas Bell**-- *C. baccatum* species Originally from Brazil, this variety produces one of the most unusual pod shapes of any chile pepper. 2" long by 2" wide bell shaped hot peppers. Peppers have a mild spicy flavor and turn from light green to red when mature. Fruit is used fresh or dried for flavoring a variety of dishes. Preserve by canning, drying, or freezing. The petite size is perfect for pickling.
61		**Datil**. *C. chinense* species. 'Datil' is unique in that it is very hot (100,000 to 300,000 scovilles). The pepper is almost identical to a west African pepper called the "fatalii" or "fatal" in size, shape, color, heat and flavor,
62		**Rocoto**—*C. pubescens* species pepper grows in the Andes from Chile to Columbia, as well as in the highlands of Central America and Mexico. Very distinguished pubescent plant with purple flowers. Peppers tend to get consumed while fresh because of the thickness of the pods making them hard to dry properly. Good in salsas.

Chili (chile) Pepper Type Primer—Coyote Valley, 2014

Code	Illustration	Description
63		**Trinidad Scorpion**-- *C. chinense* species. Super Hot Variety, a landrace out of Trinidad, the original seed came directly from CARDI in Trinidad. It was formerly ranked as the hottest pepper (1.4 million Scoville units!!). Plants derived from the Trinidad moruga scorpion, which is indigenous to Trinidad and Tobago. The "scorpion" peppers are referred to as such because the pointed end of the pepper is said to resemble a scorpion's stinger.
64		**NuMex Veteran's Day** NMSU developed ornamental chile pepper plants, pod color changes from violet to burnt orange. While the pungent fruit is edible, it is usually just used as an ornamental. 120 days.
65		**Hybrid Golden Ghost**-- *C. chinense* species. Ghost chilli is an interspecific hybrid chili pepper. Ghost pepper was the world's hottest chili pepper, 401.5 times hotter than Tabasco sauce; the ghost chili is rated at more than 1 million Scoville heat units (SHUs).
66-68		**66-BOS 6600200,** 67- **BOS 6600336,** 68- **BOS 6600428**

0 - 500 Scoville Heat Units (SHU

11- Bounty Hybrid

10. Sweet Banana

42- Pimiento Elite Hyb.

44- Pritavit Hybrid

19- Red Cherry Sweet

37- Mini Belle Pepper Red

Mini Bell Yellow Pepper

14- Sweet Cayenne

41- Purple Marconi

01- Aji dulce

100 – 500 Scoville Heat Units (SHU

17- Cherry bomb hyb.

18- Large Red Cherry Hot

20- Cherry Pick Hybrid

850 Scoville Heat Units (SHU)

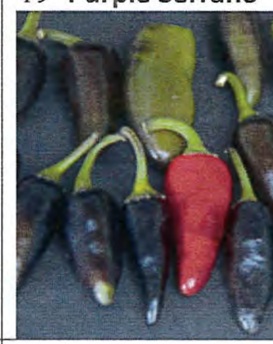
29- Numex Suave Orange

2,000 Scoville Heat Units (SHU				
06- Ancho S. Martin Hybrid 	07- Ancho San Luis 	08- Poblano L 	09- Ancho 101 	02- Pasilla Bajio 
2,500 Scoville Heat Units (SHU				
05- Biggie Chile Hyb. 	40- Giant Marconi Hyb. 	04- Anaheim TMR 	43- Pimiento De Pardon 	

2,000 to 5,000 Scoville Heat Units (SHU				
31- Jalapeno M 	32- Jalafuego Hybrid 	33- Fooled You Hybrid 	34- Chichimeca Hybrid 	35- Mucho nacho hyb. 
36- Jaloro 	16- Cascabella 	48- Serrano Del Sol Hyb 	50- Serrano Chili 	

2,500 - 5,000 Scoville Heat Units (SHU)				
39- Mirasol 	55- Sport 	28- Red mushroom 	60- Christmas Bell 	

5,000 – 8,000 Scoville Heat Units (SHU)				
45- **Santa Fe Grande** 	46- **Santa Fe Grande** 		64- **NuMex Veteran's Day** ? 	

25,000 Scoville Heat Units (SHU				
68- **BOS 6600428** 	66- **BOS 6600200** 	67- **BOS 6600336** 	49- **Purple Serrano** 	62- **Rocoto** 

30,000 - 60,000 Scoville Heat Units

58- Aji limon 	54- Tabasco 	15- Golden Cayenne 	12- Long Red Slim Cayenne 	13- Large Red Thick Cayenne 
15- Golden Cayenne 	12- Long Red Slim Cayenne 	13- Large Red Thick Cayenne 	51- Yellow Mushroom 	

80,000 to 150,000 Scoville Heat Units (SHU)

56- Thai Hot 	57- Thai Hot Ornamental 		

100,000 ~ 200,000 Scoville Heat Units				
52- Jamaican Hot Yellow 	53- Jamaican Hot Red 			
100,000–350,000 Scoville Heat Units (SHU)				
47- Scotch Bonnet 	24- White habanero 	23- Habanero (red) 	22- Habanero 	25- Chichen itza hybrid 
21- Habanero Mustard 	61- Datil 	27- Congo Trinidad 		

325,000 to 570,000 Scoville Heat Units (SHU)				
	26- Caribbean Red 			
1 to 1.4 million Scoville Heat Units (SHU				
65- Hyb Golden Ghost 	63- Trinidad Scorpion 	59- Bhut Jolokia 		

Free Grower Workshop

Irrigation Management:
Design, Maintenance and Efficiency

Thursday, April 23, 2015, 1 - 3 pm
At Amega Farms: 635 Pratt Lane, Morgan Hill, CA 95037

This workshop will provide concepts, tools, and on-farm examples for optimizing irrigation efficiency in greenhouse and row crops. Aspects of design, installation, and management of efficient drip and sprinkler irrigation systems will be discussed. Practical advice to help growers use water and fertilizer resources more efficiently will include proper pipe and pump sizing, flow meters, pressure regulation, sprinkler head spacing, drip design, and strategies to prevent and reduce emitter clogging from algae and debris. A guided tour of recently installed drip and sprinkler systems will demonstrate the basic equipment necessary to build and maintain your own efficient irrigation system.

Instructor: Michael Johnson has led over 200 irrigation system evaluations privately for growers and as part of region-wide efforts sponsored by water districts and public agencies throughout the Central Coast area. He also manages the Santa Clara Valley Water District Ag Mobile Irrigation Lab program and is the instructor for the Irrigation Systems Design and Management course at Cabrillo College.
To contact Michael about his services, please call (831) 325-3376 or email delsol@calcentral.com.

Light refreshments will be provided.
Translation (Cantonese) services will be provided.

To register for the field day and workshop:
Email info@discovercoyotevalley.org
Or call Charlotte at 510-526-1793 #5.

Please register by April 20 *so we will have enough materials and can send out logistical information.*

DISCOVER COYOTE VALLEY

S·AG·E SUSTAINABLE AGRICULTURE ·EDUCATION·

Workshop is funded by CDFA Specialty Crop Bloc Grant #SCB13024.

一个灌溉均匀性高的灌溉系统的重要性
The importance of a high distribution uniformity

一个灌溉均匀性高的系统是指整个灌溉的地区每一个地方得到的水份是一样的。一个灌溉均匀性低的系统，浪费更多的水去灌溉原本不需要这么多水的地方。
A high distribution uniformity means that the same amount of water is applied across the entire field. When a distribution uniformity is low (poor), some parts of the field get more water and others get less and therefore poor distribution uniformity means poor irrigation.

图1. 各类灌溉系统灌溉劣与优核对表
Table 1. Categories for poor to excellent distribution uniformities

DUlq 不同灌溉系统对比 (for different irrigation systems)

Irrigation System	DUlq		
	差 Poor	好 Good	非常好 Excellent
滴 泷 Drip	≤ 80	81 – 89	≥ 90
微喷头 Microsprinkler	≤ 75	76 – 84	≥ 85
喷头 Sprinkler	≤ 70	71 – 79	≥ 80
水耕 Furrow/Flood	≤ 40	41 59	≥ 60

灌溉系统难以处理的情况
Irrigation System Challenges

1. 水压过高 Operating pressure is too high
2. 水压过低 Operating pressure is too low
3. 相对管道直径水流量过大引致一定的水压流失 Flow rates are too high for pipe diameters leading to significant pressure losses
4. 发射器或喷头被阻塞 Emitters/sprinklers are clogged
5. 喷头间隔太远以致不能覆盖所有地方 The sprinklers are too far apart and there is not enough overlap of the wetted area
6. 水压足够，但系统的水压不稳定 Pressure is adequate, but pressure varies along the system

灌溉系统的建议
Irrigation System Recommendations

1. 利用喷水率小的喷头或喷嘴，**或者**换直径更大的水管 Either use sprinkler heads or nozzles with lower discharge rates, or increase pipe diameter sizes.

2. 为了预防铁罐内部生锈或因生锈而减小管道的直径引致影响水压，可用塑料PVC管代替旧的主泷或横泷 Replace older existing steel main line and submain pipe with PVC pipe to avoid rust build-up inside the pipes which can reduce inner diameter of pipe and negatively affect pressure.
3. 根据厂商所建议的压力值连接整个系统。**更改水**压方法有以下几种 Follow manufacturer's

pressure recommendations throughout the system. Pressure adjustments could be made by:

a) 在每条副主沈或横沈与主沈接驳口加上减压阀 Installing pressure reducing valves at each submain or at each lateral line lead after the gate valve.
b) **安装有**调速装置的抽水泵以适用于不同灌溉系统所需水压 Installing a variable speed drive pump that could be set to deliver the correct amount of pressure for the irrigation set.
c) 根据灌溉系统所建议的压力值安装相对应型号的泵 Installing a pump that is sized to deliver the recommended pressure.

4. 安装过滤器，以防止杂物进入到副主沈或横沈或导致喷水器堵塞。使用制造商所建议的过滤器型. Install a filter to prevent debris from entering the submain and lateral lines and clogging emitters.
5. 用相同制造商和型号的喷头和喷嘴安装整个系统。Use the same sprinkler type (manufacturer) and nozzle type (size) throughout the system.

6. 及时替换磨损的喷头及阻塞的喷嘴Replace worn sprinklers and clogged emitters.

7. 在每个横向沈的末端安装冲洗阀，可以在每次运行前自动清洗管道/沈，以及在每次关闭系统后自动排水。Install flush valves at the end of each lateral line to automatically flush lines at start-up and to automatically drain lines after the system shuts down.

8. 在副主沈每一端安装压力测试器（施雷德阀）和规划性地安装在某些横沈的头尾。这可以对每一套初始不平行的系统作出调整，以及确认每一个系统在正常水压下运作。根据喷头制造商的指引可调校到最佳运作水压。Install pressure test fittings (Shrader valves) at each end of the submain and strategically at the head and tail of several lateral lines.This would allow for initial correction of existing pressure imbalances, as well as, confirmation of operating pressures during each set. Follow sprinkler manufacturer's recommendations for optimal operating pressures.

9. 实施日常维护，包括目视检查整个灌溉系统的启动。立即维修有裂痕/漏水或损坏的地方。当检查漏水管道时，应同时注意整个系统水压。Implement a maintenance routine that includes visual inspection of entire irrigation system upon system start up. Repair leaks and breaks immediately. Check system pressure when inspecting system for leaks.

Figure 1. Typical components of a **drip irrigation system**

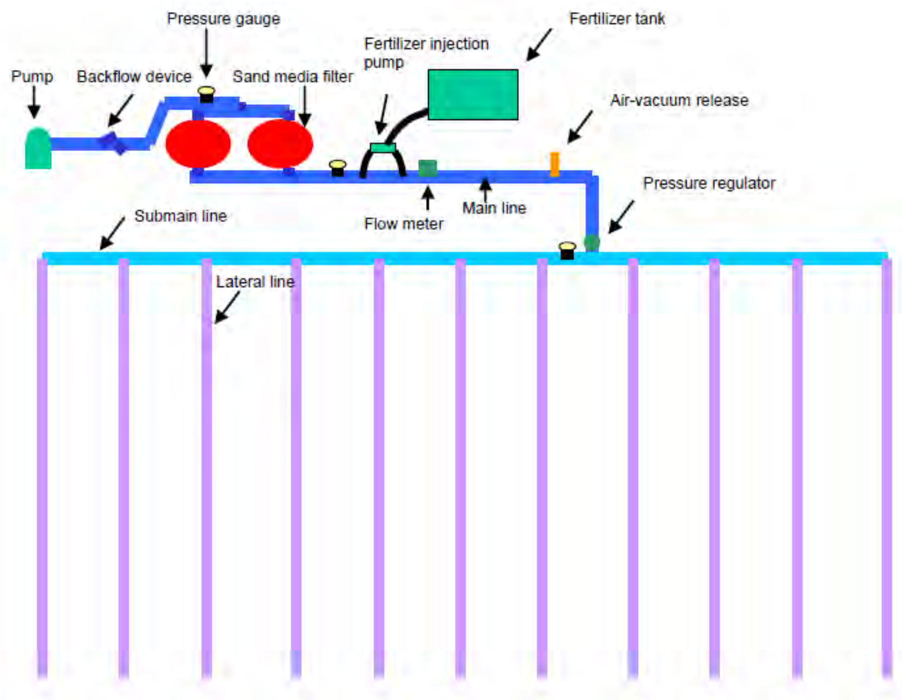
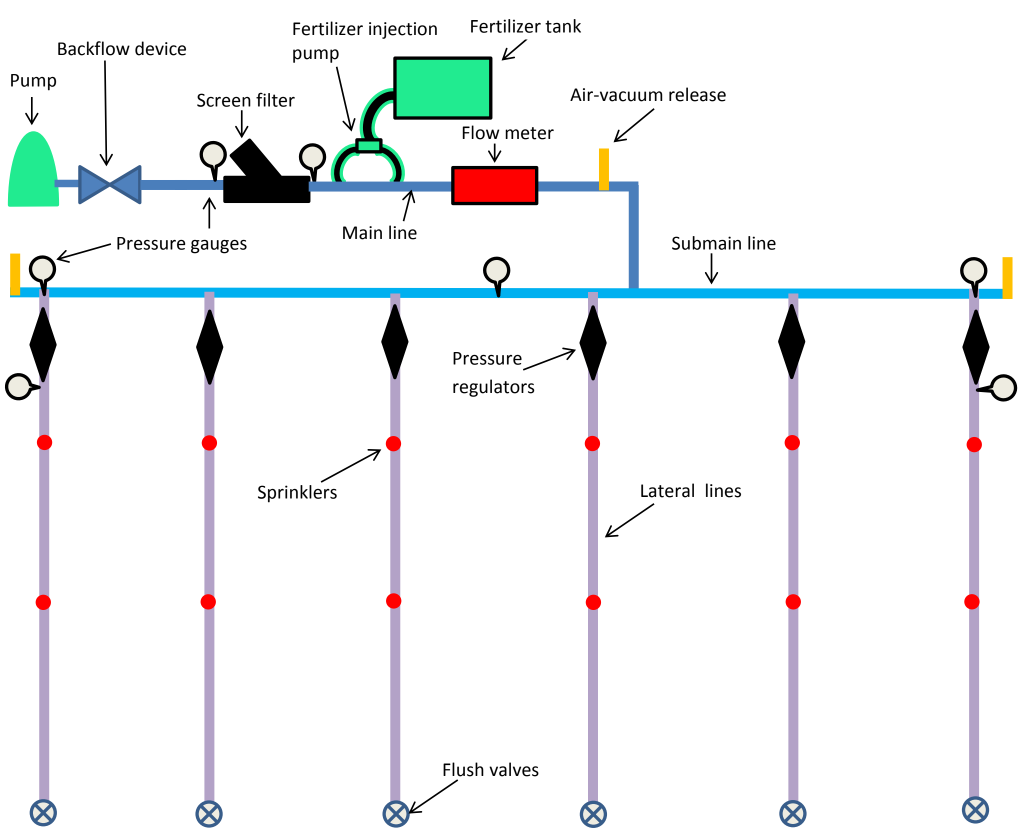


Figure 2. Typical components of a **micro-sprinkler irrigation system**



Coyote Valley Irrigation System Evaluation Report April 2015

Field Assessment and Report Completed by:

Michael Johnson
California H_2orticulture Services
2345 17th Avenue
Santa Cruz, CA 95062
831.325.3376
delsol@calcentral.com

Summary Information

Sustainable Agriculture Education (SAGE) partnered with California H_2orticulture Services (CHS) to provide professional services for projects that assist specialty crop growers in the Coyote Valley (CV) with adopting sustainable ag practices, including water conservation. CHS recently designed and installed a drip irrigation system for a greenhouse grower in the Coyote Valley. This included installation of a 2″ Schedule 80 PVC mainline, filter, flow meter, two adjustable pressure regulating valves, air vents, and other necessary components (Figure 1). Project costs were compared to estimated costs of typical CV area sprinkler systems to demonstrate the potential savings realized utilizing drip components (Appendix I).

Figure 1. New 2″ irrigation mainline with flow meter and adjustable pressure regulator

Two irrigation system evaluations were performed for the project to compare efficiency aspects of the previously existing system with the newly installed system. Funding for the irrigation system evaluations was provided by the Santa Clara Valley Ag Mobile Irrigation Lab program. The newly installed drip system significantly outperformed the previously existing system with much higher distribution uniformity and more consistent pressure measurements.

Description of the irrigation system evaluations

The irrigation systems were evaluated for design and components that assure high distribution uniformity. The systems were also evaluated for evidence of good operational and maintenance practices. Application uniformity of the drip system was evaluated at 3-4 locations in adjacent bays: 2 locations near the submain and two locations near the tail of each block. At each location the emission rate of 10 individual drip emitters was evaluated. Pressure was evaluated along the submain and at the head and tail of each bed.

Distribution Uniformity of the PREVIOUSLY EXISTING irrigation system

The overall DU (lowest quarter) was **64.7%** (Table 1). This is considered a **'poor' uniformity** for drip. A high uniformity (DUlq >90%) was found at **all four locations** (Table 1). The average tape discharge rate was 0.46 gpm/100 ft (Table 1) and varied significantly based on pressure. The application rate of the drip system was inconsistent throughout the evaluated area (Table 1).

Table 1. Uniformity and flow characteristics of drip system evaluated in 4 areas

Location	DUlq	Emitter discharge rate	Tape discharge rate	System flow rate	Field application rate	Average pressure
	%	gal/hr	gpm/100 ft	gpm/acre	inches/hour	psi
Area A	95.1	0.13	0.32	27.6	0.06	5.6
Area B	92.0	0.12	0.30	26.3	0.06	5.7
Area C	93.6	0.24	0.60	52.5	0.12	17.9
Area D	96.6	0.23	0.57	50.1	0.11	17.9
Overall	**64.7**	0.18	**0.46**	39.8	**0.09**	11.8

DU_{lq} = distribution uniformity of the lowest quarter; $DU_{10\%}$ = distribution uniformity of lowest 10%

Table 2. Categories for poor to excellent distribution uniformities (DUlq) for different irrigation systems

Irrigation System	DUlq		
	Poor	Good	Excellent
Drip	$\leq$ 80	81 - 89	$\geq$ 90
Microsprinkler	$\leq$ 75	76 - 84	$\geq$ 85
Sprinkler	$\leq$ 70	71 - 79	$\geq$ 80
Furrow/Flood	$\leq$ 40	41 59	$\geq$ 60

Description of existing drip system

Pressure was regulated at each line with a gate valve. This is not an appropriate method of accurate pressure regulation and significant pressure variations were observed during the evaluation (Table 1). No filter was present in the system. The existing 2″ steel submain was over 40 years old and corroded with rust on the inside, which can lead to increased friction (pressure) loss, diminished flow rates, and clogged emitters.

Irrigation System Challenges

Pressure regulation had the greatest negative effect on the overall low DUlq (Table 1). Average pressure differed significantly between the two evaluated beds with pressure readings lower than recommended for optimal performance (Areas A, B) and significantly higher than recommended (Areas C, D).

Irrigation System Recommendations:

The overall DUlq would likely improve (DUlq >90%) by following manufacturer's pressure recommendations (8-10 psi) throughout the system. Pressure adjustments could be made by installing pressure reducing valves at each submain or at each lateral line lead after the gate valve. Consider installing a filter (150 mesh screen) to prevent debris from entering the submain and lateral lines and clogging emitters.

Figure 2. Existing drip system with overhead steel submain and mainline and gate valve

Distribution Uniformity of the NEW irrigation system

The overall DU (lowest quarter) was **97.2%** (Table 3). This is considered an **'excellent' uniformity** for drip. A high uniformity (DUlq >90%) was found at **all three locations** (Table 3). The average tape discharge rate was 0.38 gpm/100 ft and was consistent throughout the evaluated area (Table 3).

Table 3. Uniformity and flow characteristics of drip system evaluated in 3 areas

Location	DUlq	Emitter discharge rate	Tape discharge rate	System flow rate	Field application rate	Average Pressure
	%	(gal/hr)	gpm/100 ft	gpm/acre	inches/hour	psi
Area A	98.0	0.15	0.39	67.3	0.15	9.5
Area B	97.6	0.15	0.38	65.5	0.14	
Area C	96.8	0.15	0.38	66.8	0.15	9.5
Overall	**97.2**	0.15	**0.38**	66.6	**0.15**	9.5

Description of new drip system

A 2″ Bermad adjustable pressure regulating valve with solenoid was installed to maintain a consistent down-system pressure throughout the irrigation set. Pressure readings averaged 9.5 psi throughout the system (Table 3). The drip tape manufacturer (Jain) recommends 8 – 10 psi operational pressure. Shrader valves were present at the submain and the head and tail of two lateral lines so that pressure measurements can be easily obtained throughout irrigation sets. A screen filter was present in the system to intercept debris that could clog emitters. A Hunter NODE two-station automatic irrigation controller was used to ease system operation. Automatic flush valves were installed at the ends of each lateral line to help prevent emitter clogging by flushing debris from lines.

The following recommendations were provided to the grower to support improved irrigation management practices and to maintain a high level of system performance.

1. Implement a maintenance routine that includes visual inspection of entire irrigation system upon system start up.
2. Repair leaks and breaks immediately.
3. Check system pressure when inspecting system for leaks.
4. Consider using a combination of CIMIS ET and soil moisture monitoring to guide irrigation scheduling and for regulating water stress to the crop so that yield and quality are optimized.

Conclusion

The new drip irrigation system was a major improvement over the existing system. Appropriate pipe sizing, adequate filtration, and consistent pressure regulation greatly contributed to the excellent DU results. System automation with an irrigation controller helped the grower improve irrigation timing and set lengths while providing greater control over frequency of water applications.

Drip irrigation system costs were calculated to be less than half of the costs for the typical overhead sprinkler systems that greenhouse growers in the CV area are currently using (Appendix I). Horticultural practices would need to be modified to accommodate drip irrigation systems in this grower community. Growers would also need to be trained how to design, install, and maintain efficient drip irrigation systems.

APPENDIX I

Estimated materials costs for drip irrigation system per 10,000 sq ft (five typical 20' X 100') greenhouse bays, *including* flow meter and pressure regulator

Irrigation System Material Cost Estimate per 10,000 sq ft (five typical 20' X 100' greenhouse bays)					
Item	Unit	Amount	Unit Cost	Cost	Notes
Transmission Mainline and Distribution Mainline (Submain)					
2" Sch 80 PVC pipe	FT	160	$1.21	$193.60	Up to 50 gpm maximum flow. Approved for above ground use.
2" Netafim WMR flow meter	EA	1	$372.76	$372.76	Lateral line connections
2" Hose Clamps	EA	10	$0.88	$8.80	
2" PVC Ball Valve Slip	EA	2	$4.06	$8.12	
2" Polyethylene Oval 450 ft (21 psi)	ROLL	0.22	$106.82	$23.50	Submain pipe (100 ft); 100'/450' = 0.22
2" Pressure adjustable regulating valve	EA	1	$202.62	$202.62	Reduce pressure for drip lines
2"PVC ball valve	EA	2	$4.06	$8.12	Install at end of line to be used as flush valve
2" brass ball valve	EA	2	$37.80	$75.60	
Lateral lines					
5/8" Toro medium flow drip tape 6 mil (7,500ft)	ROLL	.067	$270.00	$18.09	Lateral lines (500 ft); 500' /7500' = 0.067
1" Air Vent with Shrader Valve	EA	4	$8.74	$34.96	Install at ends of submain and after pressure regulator
5/8" Barb X Valve X Tape Lock	EA	20	$1.10	$22.00	To connect drip tape to submain
5/8" automatic tape lock flush valve	EA	20	$1.10	$22.00	To connect at ends of lateral lines for automatic flushing
Miscellaneous fittings	EA	1	$50.00	$50.00	To secure flexible pipe to connections
TOTAL (taxes not included)				**$1,040.17**	

Estimated materials costs for typical overhead sprinkler irrigation system per 10,000 sq ft (five typical 20′ X 100′) greenhouse bays, including flow meter

OVERHEAD MAINLINE *with UV Resistant submain pipe* Irrigation System Material Cost Estimate					
Item	Unit	Amount	Unit Cost	Cost	Notes
Transmission Mainline and Distribution Mainline (Submain) 3” Sch 40 UV Resistant PVC pipe	FT	260	$2.57	$668.20	Up to 110 gpm maximum flow. Approved for above ground use.
3" Netafim WST Flow Meter	EA	1	$903.00	$903.00	
3” Schedule 40 PVC Tee	EA		$9.58		Lateral line connections
3” Schedule 40 PVC Cross	EA	5	$12.54	$62.70	
3” Schedule 40 PVC 90° El	EA	1	$6.02	$6.02	
3” X 1-1/2” PVC Reducer Bushing Slip	EA	5	$2.92	$14.60	To connect 3” tees to 1-1/2” lateral lines
1-1/2” Class 200 PVC pipe	FT	500	$0.40	$200.00	Lateral lines
1-1/2” PVC Ball Valve Slip	EA	5	$24.46	$122.30	
1” Netafim Combination Air Vent	EA	1	$112.89	$112.89	Install at end of submain line
1-1/2” X ¾” Slip x FIPT Tee	EA	50	$3.02	$151.00	
Senninger Super Spray w/nozzle	FT	50	$4.64	$232.00	
3” PVC Coupler Slip X FIPT	EA	2	$3.69	$7.38	To connect flexible pipe to rigid pipe
3” PVC Adapter MIPT X Barb	EA	2	$6.01	$12.02	To connect flexible pipe to rigid pipe
3” Hose Clamps	EA	10	$1.02	$10.20	To secure flexible pipe to connections
2” X 4” lumber 10 ft	EA	4	$3.82	$15.28	Base plate for pipe support
¾” Galvanized steel hanger straps (roll 10 ft)	BOX	2	$2.97	$5.94	To secure pipe to base plate. Install every 2 ft
3-1/4” Nails D16	BOX	1	$30.97	$30.97	For base plate boards
TOTAL (taxes not included)				**$2554.50**	

Hummingbird Workshop

Wednesday, April 22, 2015

6 pm – 7:30 pm

Ann Sobrato High School, Room B114
401 Burnett Ave, Morgan Hill, CA 95037



Join the Natural Resources Conservation Service (NRCS), Sustainable Agriculture Education (SAGE) , and Wildlife Education and Rehabilitation Center (WERC) for an educational workshop on habitat enhancement in the Coyote Valley!

Key Speakers:

~**Amy Yee,** WERC

Overview of hummingbirds, migration, habitat, and food

~**Ann Sobrato High School Environmental Club**

Students will present plants liked by hummingbirds

~**Athena Pratt,** NRCS

Resources for creating hummingbird habitats

Light refreshments will be provided following the program.

For more information: Email Camille at *camille@rcdsanbenito.org* or call *(831) 637-4360 ext. 101*

~ Please share with your networks!~

USDA WERC SAN BENITO RESOURCE CONSERVATION DISTRICT S·AG·E SUSTAINABLE AGRICULTURE EDUCATION DISCOVER COYOTE VALLEY

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WWW.DISCOVERCOYOTEVALLEY.ORG

FOR IMMEDIATE RELEASE:
May 11, 2015

CONTACT:
Sibella Kraus, 510-526-1793 #3
sibella@discovercoyotevalley.org

Sobrato High School Students Plant Hedgerows around the School Farm

Coyote Valley, California -- On Wednesday, May 13, 2015, from 8 a.m. to 2 p.m. Sobrato High School Horticulture program students will be planting a windbreak hedgerow of native trees and shrubs along the northern edge of the school's 2-acre farm. Earlier this spring on April 11, the students planted a pollinator/ harvestable hedgerow of fruit trees, herb shrubs and native plants along the western edge of school farm. These two hedgerows – over 10,000 square feet combined - will have habitat and windbreak functions and will also be an important teaching tool. The hedgerow design and planting is being overseen by Sam Earnshaw of Hedgerows Unlimited, who has established over 400 miles of hedgerows in California.

"We're delighted that the students have this opportunity to learn about planting and about the many ways that hedgerows can benefit farms," says Vera Gomes, Assistant Principal and long-time agriculture program teacher. The high school has a long term goal to develop a 10-acre organic row crop and orchard demonstration farm next to the current 2-acre farm, which mainly focuses on animal husbandry. Recent soil bore tests have shown that the location has excellent soil, but fulfilling the school's dream of developing a diversified demo farm will require planning and resources. The project already has a key asset – dedicated community engagement.

The hedgerow planting is a partnership between the high school's acclaimed agriculture program, in which about a third of the school's 1,500 students are involved, and Sustainable Agriculture Education (SAGE), a nonprofit dedicated to supporting agriculture near cities. SAGE is working with the high school on the hedgerow and the demonstration farm planning, as part of the project, Revitalizing Specialty Crop Agriculture in the Coyote Valley, funded by a California Department of Food and Agriculture (CDFA) Specialty Crop Block grant. This project is guided by the Coyote Valley Agricultural Enterprise and Conservation program (COVAEC) Advisory Committee.

The website *Discover Coyote Valley* provides more information about Coyote Valley agriculture, local farmers, educational activities and the project in general. Discover Coyote Valley recently hosted other activities in the region, including a Hummingbird Habitat workshop at the high school and an irrigation workshop for Coyote Valley greenhouse growers. A recap of these past activities, as well as the April High School hedgerow planting, can be found on the Discover Coyote Valley blog.

For more information about the hedgerow planting, the workshops and the Coyote Valley Specialty Crop project, please contact Sibella Kraus by email at sibella@discovercoyotevalley.org.

###

  

Introduction to Hedgerows & Pollinators Workshop and Field Day in the Coyote Valley

Tuesday, May 3, 2016 — 5:30 p.m. - 8:30 p.m.

Ann Sobrato High School, 401 Burnett Ave., Morgan Hill
(park in front parking lot and follow signs to room location)

Program and Presenters:

Registration and Light Dinner — 5:30 p.m. – 6 p.m.
Welcome and introduction. Dina Iden, Executive Director, Loma-Prieta Resource Conservation District. Sibella Kraus, President, Sustainable Agriculture Education.

Workshop Program and Presenters —
6:00 Overview about Hedgerows – Sam Earnshaw, Hedgerows Unlimited
6:25 Overview about Pollinators and Pollinator Habitat – Hillary Sardinas, Pollinator Specialist, Xerces Society
6:45 Overview about funding to establish hedgerows and other natural resource enhancement projects – Drew Mather, Hollister Office, Natural Resources Conservation Service

Hedgerow Walking Tour
7:15 Walking tour of the windbreak and pollinator/harvestable hedgerows at Ann Sobrato High School – Sam Earnshaw and student docents. These two hedgerows – over 10,000 square feet combined – planted by students in 2015, with Sam overseeing design and planting. Students are continuing to manage and curate the hedgerows.

Cost, Registration and Further Information
Cost is $15 per person. Please pre-register by sending your name, address and farm acreage (if relevant) to **Loma Prieta RCD, 8010 Wayland Lane, Suite 1 D, Gilroy, CA 95020 by May 1, 2016**. For further information, please contact Mark Fishler by email (mark@lomaprietarcd.org) or phone (408-847-4171).

Sponsored by: Loma Prieta Resource Conservation District and SAGE (Sustainable Agriculture Education).
Support from: Ann Sobrato High School; Santa Clara Valley Water District; Xerces Society; Hedgerows Unlimited.
Funding from: CDFA Specialty Crop Block Grant Program, Project # 25029

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Attachment: Summary Tables

Table 1: Teacher responses to year 3 teacher survey about participation in activities. 108 total participants

Responses to participation in Harvest of the Month activities this last year.		Every Month	8 Times	7 Times	6 Times	5 Times	4 Times	3 Times	2 Times	1 Time	None
HOTM fruit/vegetable tastings	N = 106	99.1%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HOTM Educator Newsletter	N = 103	81.5%	0.0%	.9%	0.0%	1.9%	.9%	0.0%	1.9%	1%	7.8%
FOTM Newsletter	N = 96	83.3%	0.0%	0.0%	0.0%	2.1%	3.1%	1%	0.0%	1%	9.4%
FOTM Video	N = 88	29.5%	0.0%	2.3%	2.3%	6.8%	5.7%	13.6%	10.2%	8%	21.6%
FOTM Kids Take Home, half sheet	N = 104	95.2%	1%	0.0%	1%	0.0%	1%	1.9%	0.0%	0.0%	0.0%

**FOTM videos were only provided 4 months of the 9 months*

Table 2: Teacher responses to year 3 survey about student behaviors. 108 total participants

How often do you students…		Always	Frequently	Sometimes	Never
Ask about participating in the Harvest of the Month tasting activity	N= 108	10.2%	31.5%	52.8%	5.6%
Talk about the Farmer of the Month in class	N= 107	8.4%	23.4%	57%	11.2%
Talk about the Harvest of the Month in class	N= 107	14%	32.7%	48.6%	4.7%

Table 3: Teacher responses to year 3 survey about student behavior changes. 108 total participants

Compared to the start of the school year, are your students…		Strongly Agree	Agree	Disagree	Strongly Disagree
More receptive to tasting/eating vegetables	N= 107	38.3%	58.9%	.9%	1.98%
More receptive to tasting/eating fruits	N= 108	42.6%	54.6%	.9%	1.9%
Showing more interest in food, farms and/or nutrition	N= 108	29.6%	61.1%	7.4%	1.9%
More knowledgeable about food, farms and/or nutrition	N= 107	27.1%	65.4%	5.6%	1.9%

Linking Produce Education and Specialty Crop Distributions at California Food Pantries

Evaluation Outcomes of a 3-Year Intervention

October 2013 – June 2016

PRODUCE EDUCATION PROGRAM

CALIFORNIA ASSOCIATION OF FOOD BANKS

Prepared by

Perales & Associates Evaluation Services

June 2016

This project was made possible with funding from the California Department of Food and Agriculture's Specialty Crop Block Grant Program

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EXECUTIVE SUMMARY

In 2013, with funding from the California Department of Food and Agriculture's Specialty Crop Block Grant, the California Association of Food Banks (CAFB) developed the Produce Education Project (PEP). PEP was designed to achieve the following outcomes among food pantry clients: 1) Increase nutritional awareness of California specialty crops, 2) Increase likelihood of clients preparing and consuming produce received from food banks and pantries, and 3) Encourage clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.

Objective: To evaluate the impact of brief nutrition education interventions on low-income California food pantry clients participating in produce distributions.

Intervention: PEP designed brief 3 to 5 minute interactive nutrition lessons across 24 specialty crops that were accompanied by 45 corresponding recipe cards (frequently distributed specialty crops had multiple recipes). Depending on a pantry's available space, the lessons were delivered in one of four settings: 1) to 1 to 3 clients outdoors in the food distribution line, 2) to 1 to 3 clients indoors in the food distribution line, 3) in groups of 4+ outdoors in a classroom style setting, and 4) in groups of 4+ indoors in a classroom style setting.

PEP staff trained pantry volunteers to conduct the PEP lessons. Each lesson contained the same three key messages: 1) MyPlate is made up of 5 food groups: fruits, vegetables, grains, protein, and dairy, 2) Make half of your plate fruits and vegetables at each meal, and 3) Try the fruit or vegetable and the recipe talked about in today's lesson. The educators delivered each lesson from a brief script that focused on the day's featured specialty crop and its health benefits. The educators also used an interactive display board containing a large MyPlate image and colorful Velcro-backed cutout food items to engage clients in a fun MyPlate game of placing healthy food into the correct MyPlate food group. In addition, when possible, recipes and tasting/samples of the featured specialty crop were included in the lesson, to reinforce the intervention's key nutrition messages.

Evaluation Question: The study's key evaluation question was: *Does exposure to multiple nutrition education interventions, combined with recipe distribution and food tasting, increase food pantry clients' consumption of specialty crops distributed by the food pantries?*

Evaluation Design: The PEP outcome evaluation utilized a quasi-experimental evaluation design in which intervention participants, those who received the PEP intervention, were compared to a comparable group of control participants, those who did not receive the PEP nutrition education, to measure the impact of the PEP intervention. The PEP outcome evaluation also used a post-test only design, where participants were only asked evaluation questions after receiving the intervention. Post-intervention interviews were conducted in English and Spanish with clients at 18 intervention food pantries in 2014 and 11 control sites. In 2015, data were collected at 13 intervention sites and 10 control locations. Each year interviews were conducted after clients received a minimum of four exposures to the nutrition education messaging over the course of a four month period.

In 2016, CAFB and PAES agreed that the 2014 and 2015 intervention studies yielded information that confirmed the utility of PEP to increase knowledge and change consumption and purchasing behaviors. Therefore, it was decided to focus the evaluation on gathering qualitative data, via key informant interviews with the participating staff and volunteers from PEP affiliated food banks and pantries, on their experience with PEP. Specifically, the interviews were designed to identify program challenges, successes, and lessons learned in order to provide information to food banks and pantries wishing to replicate and/or to continue the PEP model.

Sampling Methods: The intervention sites were self-selected food pantries enrolled in PEP. The control sites were chosen by the PEP partner food banks. All sites had similar low-income food pantry client populations. The total sample size for both the intervention and the control groups was set at 250 clients in Year 1; approximately 10 to 15 clients per site. In 2015, the total sample size was set at 200 clients for both the intervention and control groups. A census sample of 6 food banks and 21 food pantry personnel who were directly involved in the PEP program were chosen for the key informant interviews in 2016.

Setting: Eight food banks and 24 food pantries covering 10 California counties participated in the PEP intervention and outcome evaluation in 2014 and 2015. In Year 3, four new food banks joined the PEP intervention only, but their associated pantries were not evaluated for outcomes. By the end of Year 3, PEP reached a total of 12 food banks and 28 food pantries.

Participants: In Year 1, 50% of food pantry clients interviewed in the intervention and control groups were Latino with Spanish as their primary language. White/Caucasian and Black/African Americans represented about 11% each. In 2015, there were statistically significant differences between the intervention and control groups among three of the five racial/ethnic groups. Indeed, half of the interviews among the intervention group were conducted in Spanish compared to only one-quarter among the control group. However, the racial/ethnic differences between the two groups are not significant for the purposes of this study, as they share the common experience of being food pantry recipients. The mean age for both years was 50. In 2016, key informant interview participants were food bank and food pantry representatives.

Analysis: The intervention and control data were entered into Survey Monkey in Years 1 and 2 and imported into the Statistical Package for the Social Sciences (SPSS) Version 20.0 for further analysis and reporting. Descriptive and inferential statistics were used to determine if group differences between the control and intervention groups were statistically significant, using cross tabulations and McNemar's Chi-square (Binomial Test) test for paired categorical data. All variables were considered significant at $p < 0.05$ (two-tailed). A content analysis of the qualitative data was performed to identify common themes. In addition, a more detailed analysis was completed for some key survey questions.

Results: Overall, the 2014 and 2015 results show the value of nutrition education in food distribution lines that reinforce the findings reflected in the CAFB 2012 "Walk the Line" study. The results show that PEP participants had more knowledge about how to use MyPlate to feed their families than the control group and were actually applying MyPlate to feeding their families. In addition, many people in the intervention group were utilizing the featured recipes to prepare healthier MyPlate-based meals for their families. Furthermore, both groups seemed to appreciate and value the produce they received from their pantry, as they were eating nearly all of the produce they received, wasting very little, and were very willing to purchase the featured produce.

The qualitative data analysis supported the quantitative findings. The food bank and pantry key informants interviewed in 2016 felt that the PEP was very successful. Indeed, a majority of respondents stated that PEP operated very well at their food pantry. Moreover, PEP contributed to the food banks' and pantries' missions, increased clients' knowledge and use of MyPlate for feeding their families, and increased the consumption of specialty crops. Pantries overcame various challenges in program coordination including PEP staffing, space for the lessons, and enough produce or the produce to correspond with a recipe card.

Discussion: The three year PEP evaluation highlighted the effectiveness of the PEP intervention model. Food banks and pantries found the PEP materials colorful and appealing. They liked the visual interactive MyPlate board because it was tactile and clients of all ethnicities and literacy levels could participate in choosing the food components to make a healthy plate. They especially liked the easy and colorful PEP recipes that matched the day's specialty crop distribution. These results confirm the importance of using theory and health behavior models to guide the design of effective strategies/interventions.

It seems evident that the PEP emphasis on fruit and vegetable consumption and recipe preparation, plus the availability of featured fresh produce on the day of the PEP presentation had a synergistic effect the clients' consumption and purchasing behaviors. This finding is particularly significant because it implies that food banks can achieve their mission of addressing hunger by promoting and supporting the PEP-style nutrition education at their pantries.

The evaluation results showed that PEP achieved the program's intended outcomes and confirmed that a nutrition education intervention grounded in theory can be conducted in brief sessions at food pantries and result in increased knowledge and behavior change.

Replication:

Food banks interested in replicating the practice-based PEP intervention model can gain knowledge from the challenges, successes, and lessons learned during the three-year PEP intervention and evaluation. Comments from food bank and pantry representatives provide helpful tips for replication. They include having a vision and plan for PEP, dedicating a food bank liaison to facilitate the program between the food bank and pantry, understanding the importance of integrating the PEP lessons with produce availability, using multiple avenues to secure enthusiastic volunteers (including offering stipends) interested in delivering PEP at their pantry, providing on-going educator training and technical assistance, and incorporating evaluation into their planning. Lastly, food banks should consider seeking small grants or stipends to fund the evaluation and assist food pantries in recruiting and training volunteers to conduct PEP. CAFB may be able to provide technical support in the form of online educator training modules or training in program evaluation.

ACKNOWLEDGEMENTS

This report culminates a three-year study of the impact of the California Association of Food Banks' (CAFB) Produce Education Program (PEP) in promoting the consumption and purchase of California specialty crops.

The authors wish to acknowledge the contributions of 8 California food banks and 25 food pantries for their participation in the gathering of quantitative and qualitative data for this evaluation. Lastly, we want to recognize the contributions of the CAFB staff whose vision and perseverance made PEP successful. They acquired funding for PEP, developed the colorful PEP curriculum, the associated materials, and provided on-going educator training and technical assistance to the participating food banks and pantries.

The authors hope this report will provide useful information for food banks and pantries wishing to replicate the California PEP education model, including how it was implemented and the challenges and successes to conducting nutrition education in food distribution settings. We are particularly grateful to Stephanie Nishio and Lena King for their very helpful feedback during the development of this report.

Primary Authors:

Daniel Perales, DrPH, MPH
Denise Cintron Perales, MS

Contributing Author:

Mignon (Mimi) Johnson, MPH

California Association of Food Banks Staff

Stephanie Nishio MPH, RD, Director of Programs, California Association of Food Banks

Terry Garner MA, Member Services Director, California Association of Food Banks

Lena King, BS, PEP Nutrition Education Coordinator

Cody Dunitz, BS, former PEP Nutrition Education Coordinator

INTRODUCTION

Overview of Produce Education Program (PEP) Evaluation

PEP was evaluated annually. Years 1 and 2 were outcome evaluations that involved food banks and food pantries surveying their clients. Year 3's evaluation was qualitative and consisted of interviews with key staff implementing PEP. In addition, in Years 2 and 3 food banks and food pantries were asked to track and report which lessons they were implementing at their distributions. This report will describe PEP's background, including how the PEP intervention was conducted, the evaluation methods, and will summarize the findings of outcome evaluation, the lesson tracking data, and the key informant interviews. More detail on the findings can be found in the Appendices.

Organization History

Founded in 1995, the California Association of Food Banks (CAFB) is a membership organization for California's food banks. CAFB provides support and resources to 44 member food banks with the purpose of increasing the visibility of hunger and its solutions, sharing food resources, and influencing public policy.[1]

CAFB and its members operate programs and services that assist low-income families, the homeless, veterans, seniors, and the disabled with the goal of ending hunger in California. One of those programs is Farm to Family, an innovative program that connects growers and packers with CAFB's network to provide fresh fruits and vegetables to food bank clients.[2]

CAFB Nutrition Education Background

In 2004, CAFB began collaborating with the California Department of Public Health's *Network for a Healthy California*[3] *(Network)* to support nutrition education programs at eight of CAFB's member food banks. A case study of the educational campaign identified the characteristics of effective nutrition education materials and strategies used by CAFB member food banks.[4]

CAFB's program grew to include 28 partners and the *Network*, in collaboration with CAFB, subcontracted with Perales & Associates Evaluation Services (PAES) in 2011 to conduct a review of the nutrition education literature and develop a Nutrition Education and Produce Distribution Toolbox for food banks. The Toolbox could be used by CAFB members, and their distribution partners, at food distribution sites while conducting nutrition education with clients. After an extensive review of the research literature to identify best practices, the study found there were very limited materials for use in food bank distribution lines. The final Toolbox

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[1] Source: California Association of Food Banks website http://www.cafoodbanks.org/

[2] Source: California Association of Food Banks http://www.cafoodbanks.org/Farm_to_Family.html

[3] The Network for a Healthy California was the precursor to the Nutrition Education and Obesity Prevention Branch of the California Department of Public Health

[4] MkNelly, B., Bartholow, J., Garner, T., Nishio, S. (2009). Banking on Better Health: California Association of Food Banks' Nutrtion Education Program: A Case Study Report. *Network for a Heatlhy California,* California Department of Public Health. Sacramento, CA.

contained examples of nutrition education materials specific to low-income clients that could be administered in food bank settings. Materials within the Toolbox include the most promising nutrition education materials, interactive activities, and resources as they relate to emergency food distribution settings.

In January 2012, the *Network* and CAFB awarded PAES a contract to develop short five to ten minute lessons that could be administered in food distribution lines. A registered dietitian was contracted to develop five lessons based on the five topics that would be initially identified through an online survey of 18 member food banks. Subsequently, the lessons were refined, with input from stakeholders, into three MyPlate-based lessons that focused on broccoli and the more general category of fruits and vegetables. Additional lesson components were added that included a recipe, and supplemental educator resource materials. The draft lessons were reviewed by nutrition staff from the Second Harvest Food Bank (SHFB) of Santa Clara and San Mateo Counties and revised based on their feedback. For example, the lessons were modified to make them shorter for brief encounters with clients in the food distribution line. Furthermore, they branded each lesson with a common template and added a small group interactive educational activity. Thus, the final lesson for each topic incorporated a common template with four components: resources for educators, interactive activities, a recipe for taste testing, and a produce tip card developed by SHFB as a handout for clients. The lessons were translated into Spanish with the client produce tip card written at a fourth or fifth grade reading level.

A quasi-experimental design (no random assignment), with six control group sites and six intervention group sites was used for the 2012 study. Post-test only data were gathered through client interviews with over 500 intervention and control participants at 12 food distribution sites operated by SHFB of Santa Clara and San Mateo Counties. The results showed that food bank clients at sites that received brief nutrition education interventions in food distribution lines had significantly greater awareness of MyPlate, greater recall and use of specific MyPlate messages, and were more likely to have prepared recipes received from the food bank than clients at control sites without the education. Intervention participants were also significantly more likely to have purchased one of the featured items at a store[5].

This study laid the groundwork for CAFB's specialty crop education funded by the California Department of Food and Agriculture's Specialty Crop Block Grant.

Food Banks and Food Pantries

This report frequently refers to food banks and food pantries – these organizations are different and each plays a vital role in addressing hunger in their communities. California's food banks are nonprofit organizations that procure, store, and distribute food to smaller organizations in their communities. Much like California as a whole, they are diverse. They are primarily county-based and range from small food banks in rural communities with few agencies to large multi-county operations with hundreds of agencies, and all are working to alleviate hunger in California. Agencies, which may be known in their communities as food pantries, food closets, and soup kitchens, deliver food they receive from the food bank directly to people experiencing hunger.

[5] The 2012 study became known as the "Walk the Line" intervention, a term coined by Terry Garner of CAFB and Janet Leader of the Second Harvest Food Bank of Santa Clara and San Mateo Counties.

II. The Produce Education Program (PEP)

Introduction

The 2012 CAFB study showed that a well-designed nutrition education intervention could be successfully implemented, within the time constraints associated with food distribution lines, and still have an impact on nutrition awareness and consumption-related behaviors. The study results addressed a need expressed by some of CAFB's member food banks for nutrition education materials and strategies that could be used at food distributions in locations such as food pantries. This need was also echoed by food pantry coordinators.

In 2013, CAFB was awarded a three-year California Department of Food and Agriculture Specialty Crop Block Grant to leverage CAFB's statewide network and use the promising practices learned from the 2012 approaches to deliver specialty crop education in emergency food settings. The goal of the grant was to increase specialty crop consumption among low-income food bank clients and improve health, alleviate hunger, and expand the market for California specialty crops. Through this funding, CAFB developed the Produce Education Program (PEP) that was designed to achieve the following outcomes among food pantry clients:

1. Increase nutritional awareness of California specialty crops,
2. Increase likelihood of clients preparing and consuming produce received from food banks and pantries, and
3. Encourage clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.

The PEP funding was divided into three periods and included the following broad activities listed below.

Year	Time Period	Activities
1	October 1, 2013 - September 30, 2014	• Identify participating food banks and pantries • Develop educational materials • Train pantry nutrition educators • Support nutrition education activities • Train educators on evaluation data collection • Collect post-test only knowledge, behavior, and produce utilization evaluation data from intervention and control pantry sites

Year	Time Period	Activities
2	October 1, 2014 - September 30, 2015	• Identify continuing and new participating food banks and pantries • Develop new educational materials • Train pantry nutrition educators • Support nutrition education activities • Collect monthly online data from pantries documenting PEP lesson delivery • Train educators on evaluation data collection • Collect post-test only knowledge, behavior, and produce utilization data from intervention and control pantry sites
3	October 1, 2015 - June 30, 2016	• Identify continuing and new participating food banks and pantries • Train pantry nutrition educators • Support nutrition education activities • Collect monthly data from pantries documenting their PEP lesson delivery • Collect PEP-related key informant data from participating food bank and pantry staff. • Write and deliver final evaluation report to California Department of Food and Agriculture

PEP Development

The Produce Education Program (PEP) was developed by CAFB in 2013 using the promising practices identified in the 2011 Nutrition Education and Produce Distribution Toolbox study, and the educational materials used in the 2012 “Walk the Line” intervention and study. PEP improved the lesson format and delivery based on feedback gathered from food banks and food pantries. Keeping in mind that the education would be delivered by food pantry volunteers, the new and improved lesson format included shorter lessons with more user-friendly scripts. Food pantries were also queried on which produce-specific lessons and recipe cards their clients would find most helpful and therefore, more likely to use.

Over the course of the three-year program, PEP developed 24 specialty crop lessons and 45 corresponding recipe cards (frequently distributed specialty crop lessons had multiple recipes). Each lesson contained the same three key messages and provided a brief script for PEP-trained educators to reference on the featured specialty crop of the day and its health benefits.

The PEP KEY MESSAGES were:

1. MyPlate is made up of 5 food groups: fruits, vegetables, grains, protein, and dairy
2. Make half of your plate fruits and vegetables
3. Try the fruit or vegetable and the recipe talked about in today’s lesson

PEP Education Materials

The PEP nutrition education materials were designed to promote healthy eating behaviors among low income, food insecure populations. Specifically, the MyPlate-based materials and the 'walk the line' methods were designed to encourage recipients to recognize the five food groups, make half their plate fruits and vegetables, prepare more fruits and vegetables for their families, and to purchase specialty crops at their local grocery stores and farmers' markets.

The program materials consisted of the following:

- Specialty crop-specific nutrition education lessons
- A 28" x 36" interactive poster with a large MyPlate logo in English and Spanish surrounded by multiple colorful images of items in the five MyPlate food groups
- Client specialty crop tip card and recipe
- Distribution of matching specialty crops (when available)
- Recipe tasting or specialty crop sampling (when possible)

The PEP interactive poster was designed to be simple, a size that was manageable for educators to be able to carry with them when they walked the down the food distribution line, and of a material that could withstand wear and tear. Each poster contained colorful removable Velcro-backed food images.

The recipes and lessons were designed to be bright, festive, and to grab people's attention. The client produce tip cards were written at a fourth or fifth grade reading level. Based on what a pantry site was willing and able to do, a Food Sampling Guidelines card gave pantries options for providing their clients with food samples. Agencies with full kitchens could prepare a recipe from scratch (Gold Level), those with limited facilities could chop vegetables and fruit that can be eaten raw (Silver Level), and those without a kitchen facility could deliver the lesson to clients and give out the recipe card without food samples (Bronze Level).

The PEP materials were branded with the same PEP logo, colorful style, and layout developed in collaboration with a graphic designer. All the materials were translated into Spanish at the outset and later into Russian and Chinese based on partners' requests.

The PEP materials are available on the CAFB website at: http://www.cafoodbanks.org/produce-education. *Also, see the Photo Gallery on the next page for images of the PEP Poster, PEP Lesson, and Recipe Card*

PHOTO GALLERY PEP EDUCATION MATERIALS


CAULIFLOWER
LESSON

EDUCATOR
You will be getting cauliflower today.

Here's a recipe you can use at home, and you can hang the card on your refrigerator if you want to.

Cauliflower is part of a healthy diet. They can help support **heart health, immune system, and vision.**

One way you can create a healthy diet is by using MyPlate. **Have you heard about MyPlate?**

PARTICIPANTS
If the participants answer "yes," ask them what they know about MyPlate. If the participants answer "no," explain what MyPlate is.

EDUCATOR
MyPlate helps you figure out a healthy amount for each food group at every meal.

It is made up of 5 food groups: fruits, vegetables, protein, grains, and dairy. It is good to make half of your plate fruits and vegetables at every meal.

Using all the food groups on the poster, what is a complete meal you and your families like to make using cauliflower? Or if you don't already eat cauliflower, what is a complete meal you would like to try making with it? Put all the parts of the meal in their correct groups on the MyPlate poster. You can also say your ideas out loud, and you can work together.

PARTICIPANTS
Participants answer the questions using the MyPlate poster.

KEY MESSAGES
1. MyPlate is made up of 5 food groups: fruits, vegetables, grains, protein and dairy.
2. Make half of your plate fruits and vegetables
3. Try the fruit or vegetable and the recipe talked about in this lesson.

PRODUCE EDUCATION PROGRAM


CAULIFLOWER

HOW TO USE
Cut it into small pieces, bake the pieces in the oven, then sprinkle them with low fat cheese for a tasty snack or side dish; Chop it up and mix it into a green salad for some crunch; Add cooked cauliflower pieces to your favorite pizza.

HOW TO STORE
Keep it in an open plastic bag in the refrigerator for up to 5 days.

HELPS SUPPORT
Heart health, immune system, and vision.

SPANISH CAULIFLOWER
Servings: 6
Preparation Time: 1 hour

INGREDIENTS
- 1 large head pf cauliflower
- 1 medium onion
- 1 large tomato
- 2 tablespoons of oil
- 2-3 cloves of fresh garlic, chopped finely

Optional
- 1 cup grated low-fat cheese
- 1 tablespoon dried parsley

Photo: USDA SNAP-Ed Connection Recipe Finder; Pennsylvania Nutrition Education Network Website

INSTRUCTIONS
1. Preheat the oven to 375 degrees Fahrenheit.
2. Wash the fresh vegetables, and then chop the cauliflower into 2-inch pieces.
3. Peel the onion and dice it into ½-inch pieces.
4. In a large bowl, mix the cauliflower, onion, oil, and salt. Put the mixed ingredients on a baking sheet, and bake them in the oven for 40 minutes.
5. While the cauliflower and onions are in the oven, dice the tomatoes. Once the vegetables have been in the oven for 30 minutes, add the diced tomatoes and cook them for the remaining 10 minutes.
6. Take the vegetables out of the oven and top with the cheese and parsley (optional).

Adapted from the USDA SNAP-Ed Connection Recipe Finder; Pennsylvania Nutrition Education Network Website Recipes

PRODUCE EDUCATION PROGRAM

PEP Food Bank Recruitment for Intervention and Evaluation

In late 2013, CAFB informed its membership through their newsletter about the opportunity to participate in PEP. Food banks that did not have nutrition educators, but had the capacity to do nutrition education with volunteers, and were willing to participate in the PEP evaluation, were the primary targets of CAFB's recruitment efforts. Interested food banks applied and were screened by a Nutrition Education Advisory Committee of five California food banks who assisted CAFB with the selection process.

The Year 1 intervention included five food banks, four in Southern California and one in the San Francisco Bay Area and 18 food pantries. However, the San Francisco Bay Area food bank discontinued their involvement in PEP after Year 1 because they did not have the internal capacity to coordinate the program with their pantry partners. In Year 2, there were 7 food banks, including 3 additional food banks from the Central Valley and the Central Coast and 13 pantries. In total, 8 separate food banks and 25 separate food pantries participated in the PEP intervention and outcome evaluation in Years 1 and 2. In Year 3, four new food banks joined the PEP intervention only, but their associated pantries were not evaluated for outcomes in Year 3. By the end of Year 3, PEP reached a total of 11 food banks and 29 separate food pantries. The table below lists the food banks by county that participated in the PEP educational intervention and the Year 1 and 2 outcome evaluation.

Table 1: Food banks participating in both PEP and the PEP outcome evaluation – 2014-2016

Food Bank and County	Year 1 PEP	Year 1 Eval	Year 2 PEP	Year 2 Eval	Year 3 PEP	Year 3 Eval
Feeding America San Diego –San Diego County	√	√	√	√	√	NA
Second Harvest Food Bank of Orange County	√	√	√	√	√	NA
Second Harvest Food Bank of Santa Clara and San Mateo Counties	√	√	No	No	No	NA
Los Angeles Regional Food Bank – Los Angeles County	√	√	√	√	√	NA
Westside Food Bank – Los Angeles County	√	√	√	√	√	NA
Community Action Partnership of Kern County	No	No	√	√	√	NA
Food Bank Coalition of San Luis Obispo County	No	No	√	√	√	NA
Second Harvest Food Bank of San Joaquin & Stanislaus Counties	No	No	√	√	√	NA
Redwood Empire Food Bank- Sonoma County	No	No	No	No	√	NA
The Resource Connection Food Bank – Calaveras County	No	No	No	No	√	NA
Community Action Agency of Butte County	No	No	No	No	√	NA
Sacramento Food and Family Services – Sacramento County	No	No	No	No	√	NA

NA: Outcome evaluation of PEP was not conducted in Year 3.

Training Food Pantry Staff and Volunteers

Year 1 and 2

At the start of each fiscal year, food pantry staff and volunteers were invited to attend regional trainings to learn about PEP, become acquainted with the PEP materials, and practice delivering PEP lessons. The PEP nutrition education coordinator conducted the 3.5-hour trainings. During the trainings, each participant received a packet with a Get Ready checklist, a food sampling handout, recipe cards, and additional nutrition education materials. Some pantries also had refresher trainings for new volunteers in the months or years after the sites' initial PEP trainings.

Year 3

In 2016, CAFB continued to provide training to both food bank and food pantry staff to implement PEP. PEP focused on learning from partners through the gathering of qualitative data and providing materials and protocols so that the regional food banks could support the pantries in their efforts to educate their clients about purchasing, preparing, and consuming healthy foods.

On-Going Support

Throughout the three-year project, PEP offered continuing education and support to food banks and food pantries. Periodic conference calls with PEP partners provided information and updates to the program, introduced new recipe cards and lessons, and afforded a venue for new and continuing pantry partners to ask questions and share what worked and did not work at their site. PEP Refresher Trainings were open to any food bank or pantry that requested them as an opportunity to train new staff or volunteers or serve as a refresher for individuals that attended previous PEP trainings.

PEP education and recipe tasting

Education in the Produce Distribution Line

Although designed to be implemented while clients waited for food distributions to start, PEP education took place in food distribution lines before and during food distributions. Food pantry volunteers generally walked the PEP poster down the line and conducted the education as clients waited for the distribution to begin. The poster's food images with Velcro backings made it easy to engage clients in playing the MyPlate game by using the images to arrange a meal that included the five food groups and the daily featured specialty crop. In addition to the lesson, participants were given the recipe of the day, and when possible either a taste of the recipe or a sample of the produce that matched the recipe.

III. PEP YEAR 1 (2014) AND YEAR 2 (2015) EVALUATION RESULTS

The evaluation question this study sought to answer was:

> Does exposure to multiple nutrition education interventions, combined with recipe distribution and food tasting, increase food pantry clients' consumption of specialty crops distributed by the food pantries?

EVALUATION METHODS

Evaluation Design

The PEP outcome evaluation utilized an evaluation design in which intervention participants, those who received the PEP intervention, were compared to a comparable group of control participants, those who did not receive the PEP nutrition education, to measure the impact of the PEP intervention. Using a post-test only design, where participants were only asked evaluation questions after receiving the intervention, the outcome evaluation assessed whether the CAFB's PEP intervention met its objective of increasing knowledge and consumption of specialty crops among intervention participants when compared to the control group.

Sampling Methods

The intervention sites were self-selected food pantries enrolled in PEP. The control sites were chosen by the PEP partner food banks. All sites had similar low-income food pantry client populations. The total sample size for both the intervention and the control groups was set at 250 clients in Year 1; approximately 10 to 15 clients per site. In Year 2, the total sample size was set at 200 clients for both the intervention and control groups.

Table 2, lists the criteria used for selecting the PEP intervention food distribution sites and the control sites.

Table 2: Site Selection Criteria

Criteria	Intervention Sites	Control Sites
Ability to recruit 10 to 15 clients per pantry	√	√
Similar demographic and racial/ethnic composition	√	√
Received the same produce	√	√
Education conducted during intervention period	√	No
Distributed produce recipes during intervention period	√	No
Recipe or featured produce tasting/sampling	√	No

Data Collection Methods

In Year 1, the sampling method consisted of a convenience sample of participants age 18 or older who were pre-screened for compliance using the sampling criteria, read an informed consent script, and agreed to be interviewed (See Table 3). The sampling criteria included proficiency in English and/or Spanish, and having been a recipient of food at the distribution center during the months of May, June, July, or August 2014 when specialty crop education lessons were delivered to clients in the food distribution line. The Year 1 sample included intervention clients who did not recall hearing either a healthy message or about MyPlate from the pantry nutrition educators during the intervention months. However, the Year 2 study gathered data from intervention clients who had received food from their pantry in any month from February through May 2015 and recalled hearing about MyPlate from the pantry nutrition educators. PEP education was not conducted during the months that data were gathered.

Table 3: Sample Selection Criteria

Criteria	Year 1 Intervention Group	Year 1 Control Group	Year 2 Intervention Group	Year 2 Control Group
Spoke English or Spanish	√	√	√	√
18 years of age or older	√	√	√	√
Received pantry food May through August 2014	√	√		
Received pantry food February through May 2015			√	√
Remembered hearing about MyPlate from pantry educators	Not a criterion	Not asked	√	Not asked
Client willing to complete the survey	√	√	√	√

Table 4, shows the data collection periods over the two-year PEP intervention period. In Years 1 and 2, data were collected by food bank and food pantry staff and volunteers with clients who met the sampling criteria.

Table 4: Intervention and evaluation data collection timeline

Year	Intervention Dates	Evaluation Data Collection Dates
1	May – August 2014	September 15 – October 15, 2014
2	February – May 2015	June 29 – July 24, 2015

Interviewer Data Collection Training

In Year 1, potential interviewers for intervention and control sites were invited to attend one of five regional trainings in locations convenient for food pantry representatives to attend. The 2-hour trainings were conducted by PAES and included information on the project background, a review of the survey instruments, a role-playing exercise that allowed participants to interview each other, and a question and answer period. Participants were given a packet that contained a copy of the training presentation, a sample PEP lesson and recipe cards, a copy of the intervention or control survey instrument, a photographic list of vegetables with their names in English and Spanish, colorful stickers to hand participants to identify those that completed interviews, and an Interviewer Checklist. The checklist provided details on conducting the interviews, as well as pre and post-interview activities. At the conclusion of the training, participants were asked to complete a Training Evaluation Survey.

The Year 2 Interviewer Training was conducted online via webinar and contained many of the same components as the previous training. However, since the webinar format did not afford participants the opportunity to role-play conducting a client interview, mock interview video prepared by the CAFB was posted on YouTube. The video was shown during the training and provided a good segue for online trainees to ask questions to assist them with conducting the surveys in their food pantry. The video was also available after the training so interviewers could use it as a refresher if they wished.

Client Interviews Evaluation Data Collection Methods

Post-intervention interviews were conducted with clients at 18 intervention food pantries in Year 1 and 11 control sites. In Year 2, data were collected at 14 intervention sites and 10 control locations. In-person interviews with clients in the control and intervention groups were conducted one-on-one before and during food distribution times. English-speaking and bilingual Spanish-speaking interviewers wore CAFB aprons and name badges to make them easily recognizable to the food pantry clients.

Client interview at food distribution

Only clients who met the screening criteria and consented to complete the survey were interviewed. No identifying information was gathered and survey responses were kept confidential. After a consent script was read, and the client agreed to be interviewed, interviews lasted an average duration of five to eight minutes. Clients who agreed to be interviewed were offered a nutrition education reinforcement item of their choice, either a Champions for Change cap or apron available in English or Spanish.

Evaluation Instruments

Two client survey instruments were developed for use in Years 1 and 2 of the PEP evaluation. The tools were grounded in a Behavior Change Logic Model developed by PAES to guide this evaluation. The Logic Model developed for CAFB's Phase II 2012 *Nutrition Education and Produce Distribution Toolbox Evaluation Project* served as a template for the new model. In addition, the Client Survey Instruments developed for CAFB's Phase II 2012 *Project,* were the foundation for the new instruments and modified to fit the 2013-16 Produce Education Program.

The client survey instruments (in English and Spanish) for both the intervention and control groups contained scaled response questions, specific to the intervention activities. The survey allowed for measurement of change factors such as knowledge, recipe use, and specialty crop consumption and purchasing behaviors, in addition to open-ended questions (Note: Evaluation Instruments are available upon request. Both instruments also screened participants using the interview criteria identified in the evaluation sampling plan and gathered demographic information from respondents.

The surveys were designed to be administered during the brief interview encounters (5-10 minutes) with clients in the food distribution line. The instruments were pilot tested and revised based on the testing before implementation at the control and intervention sites.

The online survey development website, SurveyMonkey, was used to create and post the *Intervention Client Interview Questionnaire* and *Control Client Interview Survey* for data entry. Each trained interviewer entered the data into SurveyMonkey from the completed client interview forms immediately after collection at the interview site.

Data Analysis

The intervention and control data were entered into SurveyMonkey in Years 1 and 2 and imported into the Statistical Package for the Social Sciences (SPSS) Version 20.0 for further analysis and reporting. Descriptive and inferential statistics were used to determine if group differences between the control and intervention groups were statistically significant, using cross tabulations and McNemar's Chi-square (Binomial Test) test for paired categorical data. All variables were considered significant at $p < 0.05$ (two-tailed). A content analysis of the qualitative data was performed to identify common themes. In addition, a more detailed analysis was completed for some key survey questions.

Below is a summary of the Year 1 and 2 evaluation results. For a complete report of the findings see Appendix A for the Year 1: 2014 Results and Appendix B for the Year 2: 2015 Results.

SUMMARY AND DISCUSSION OF EVALUATION FINDINGS

Year 1 (2013-2014) and Year 2 (2014-2015) PEP Interventions

Introduction

The goal of the Produce Education Program (PEP) was to increase produce consumption among low-income food bank clients and improve health, alleviate hunger, and expand the market for California specialty crops. Specifically, PEP was designed to achieve the following outcomes among food pantry clients:

1. Increase nutritional awareness of California specialty crops[6]
2. Increase likelihood of clients preparing and consuming produce received from food banks and pantries, and
3. Encourage clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.

This section of the final evaluation report summarizes and includes discussion of the findings from the Year 1 (2013-2014) and the Year 2 (2014-2015) PEP intervention studies. The report addresses each of the above three program outcomes[7].

Demographic Profile

The CAFB 2014 Year 1 evaluation collected 251 intervention surveys from 18 pantries and 160 surveys from 9 pantries. In Year 2, complete data was collected from 203 Intervention clients and 213 Control clients.

In Year 1, there were no statistically significant differences[8] in the racial/ethnic composition among the intervention and control groups. In Year 2, there were significantly more whites in the control group and significantly less Latinos. This is likely due to some of the control pantries (e.g., The Islamic Center in Los Angeles) serving mostly non-Latino populations. In addition, while in Year 1 Spanish was the primary language of about half of both intervention and control respondents, in Year 2 the intervention group (60%) was significantly more likely to indicate Spanish as their primary language compared to the control group (36%). In both years, and across both groups, approximately 80% of all respondents were female. There were no significant differences in the mean age of both groups (i.e., approximately 50 years old) in Year 1 or Year 2. In Year 1, in both groups, two thirds of respondents had children under age 18 in their household. In Year 2, the intervention group (71%) had significantly more children under age 18 in their household. compared to the control group. Again, this may be due to the location

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[6] Specialty crops are fruits, vegetables, tree nuts, dried fruits, and horticulture and nursery crops (including floriculture). California Department of Food and Agriculture. https://www.cdfa.ca.gov/Specialty_Crop_Competitiveness_Grants/

[7] Note: The results from both years are merged but the detailed individual Year 1 and Year 2 tables and results are located in the appendix.

[8] $p<.05$

of the control group populations. In Year 1 and 2, both groups had similar mean number of people over age 18 in their households (~2.40).

Outcome 1: Increase nutritional awareness of California specialty crops

MyPlate Awareness

In both Year 1 and 2, it was anticipated that the control group would not have heard about MyPlate. However, approximately 40% of control group respondents recalled hearing about MyPlate. This not too surprising given that the 2012 CAFB study found that participants had heard about MyPlate from sources such as medical offices, their child's school, work, television shows, and WIC among other settings. In effect, as shown in the previous CAFB studies[9], the MyPlate message is being heard from sources other than food pantry educators. However, it is very likely that in a great majority of those settings exposure to MyPlate does not include a well-designed educational intervention such as PEP. Indeed, food banks and pantries can utilize PEP to build on the limited exposure that participants may have had to MyPlate.

Knowledge about the PEP nutritional messages Year 1 and Year 2

The 2014 and 2015 PEP evaluation results found that, compared to the control group, the intervention group was significantly more likely to remember the key MyPlate nutrition messages delivered by the nutrition educators: 1) MyPlate is made up of 5 different food groups, 2) make half your plate fruits and vegetables, 3) make at least half your grains whole grains, 4) add lean protein, 5) eat low-fat dairy products, 6) eat from the 5 food groups throughout the day, and 7) eat balanced meals or portions. In effect, they recalled the PEP MyPlate messages and recognized the nutritional value and corresponding health benefits of utilizing the specialty crop fruits and vegetables as a significant portion of their meals.

Outcome 2: Increase likelihood of clients preparing and consuming produce received from food banks and pantries

The most commonly received produce, by intervention and control respondents at their respective pantry, varied somewhat from Year 1 to Year 2. In Year 1, both groups most commonly received cabbage, carrots, cantaloupe, celery, watermelon, pears, tomatoes, and bell peppers. In Year 2, they received cabbage, carrots, broccoli, sweet corn, sweet potatoes, pears, and honeydew melons. The differences in produce from Year 1 to Year 2 may be due to seasonal variations in the periods in which the PEP lessons were delivered.

The findings showed that, in both years, with the exception of eating low-fat dairy foods among the control group in Year 2, the intervention group was significantly more likely to have used MyPlate knowledge to prepare healthier foods for themselves and/or their families. For example, more than half are preparing more vegetables for their families to consume and are also giving their families more fruit to eat. Between one-quarter and one-third are preparing and consuming more low-fat dairy, lean meats, and whole grains compared to the control groups. The

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[9] Assessing the Impact of Nutrition Education at Produce Distributions. Perales & Associates Evaluation Services. October 2012. Available at: https://www.shfb.org/docs/advocacy/cafb_report.pdf

intervention group, compared to the control group, recalled the PEP MyPlate messages and recognized the nutritional value and corresponding health benefits of utilizing the specialty crops for their meals.

Another important aspect of PEP was the distribution of recipe cards that matched one of the produce that was being distributed the day of the lesson. Only the intervention group received recipe cards. Those that were interviewed were asked how they used the recipe. Overall, among those who received recipe cards for a featured produce, two-thirds in Year 1 said that they either made the exact recipe or modified it. In Year 2, three-quarters indicated that they either made the exact recipe, modified recipe, or did both. In effect, in both years, many of the PEP participants utilized their recipes with the respective featured produce.

The results showed that most food pantry clients consumed all of the produce they received and that little was wasted. However, the survey questions related to produce consumption changed from Year 1 to Year 2. In Year 1, clients were asked "How much" of the fruits and vegetables they received from the pantry they consumed: 1) All of it, 2) Most of it, 3) Some of it, or 4) None of it. In Year 1, approximately 95% of both intervention and control clients indicated they consumed all or most of the fruits and vegetables they received from their pantry. They were also asked what they did with the produce that their family does <u>not</u> like to eat. Both the intervention and control groups were as likely to take food back to the pantry (~5%), give food away to family friends, or neighbors (~41%), or throw it away (~10%). The control group was significantly more likely refuse food they did not like to eat (34%) but the intervention group was significantly more willing to eat all of it (42%) – even if their family did not like the produce.

In Year 2, clients were not asked "How much" of the fruits and vegetables, they received from the pantry they had consumed, since it was clear from the 2014 results that the great majority of clients were consuming all or most of the produce. Instead, clients were asked what they <u>did</u> with the produce they received from the pantry. In Year 2, the control group was significantly (86%) more likely to eat all of the produce compared to the intervention group (76%). In addition, there were no significant differences in giving food away, freezing the produce, or cooking and preserving the food, between the two groups. However, the control group was more likely to throw away produce (21%) that spoiled or expired than the intervention group (13%). This may mean that the PEP lesson and recipe cards motivated the participants to find creative ways to prepare and preserve the produce.

The above behaviors are likely due to the pantry nutrition educators' emphasis on fruit and vegetable consumption and recipe preparation, plus the availability of a featured fresh produce on the day of the PEP lesson. Combined, these factors may have had a stronger impact on participants' recipe preparation and produce consumption behaviors, than the MyPlate messages alone.

Outcome 3: Encourage clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.

In Year 1, both the intervention and control groups indicated that they got the produce their family eats at a pantry (~63%) and a grocery store (~30%). In Year 2, they got the produce from a pantry (~55%) and a grocery store (~35%). Approximately 4% in both years got produce from a farmers' market. This latter number may indicate that many pantries are not located near a farmers' market or that some food pantry participants do not have transportation to and from a farmers' market.

The MyPlate lessons also encouraged clients to purchase produce at supermarkets, local grocery stores, and farmers' markets. In both Years 1 and 2, approximately 80% of both the intervention and control respondents were very likely or somewhat likely to buy produce they obtain from the pantry. However, clients also provided reasons for not buying produce. In Year 1, approximately 13% of both groups said that they would not buy some produce because it is too expensive and 4% because they did not like it. In Year 2, the intervention group was significantly less likely to not buy produce because they did not like it. Furthermore, in Year 2 approximately 4% of both groups said that they would not buy produce because it was too expensive. However, the intervention group was significantly less likely to not buy produce because it was too expensive compared to the control group... In Year 2 only, participants were asked if availability of produce at the pantry affected their buying behavior and 9% of the Year 2 intervention group and 6% of the control group said they would not buy produce because they can get it from a pantry.

It appears that the primary reasons for not buying food are the expense and its availability at the pantry. This latter point may simply reflect the increasing efforts of food banks and pantries to provide more produce to their clients. In addition, not liking the produce was not a significant factor in the buying decision.

Conclusions: Year 1 and 2 Evaluation

Overall, the 2014 and 2015 results show the value of nutrition education in food distribution lines that reinforce the findings reflected in the 2012 "Walk the Line" study. The results show that PEP participants had more knowledge about how to use MyPlate to feed their families than the control group and were actually applying MyPlate to feeding their families. In addition, many people in the intervention group were utilizing the featured recipes to prepare healthier MyPlate-based meals for their families. Furthermore, both groups seemed to appreciate and value the produce they received from their pantry, as they were eating nearly all of the produce they received, wasting very little, and were very willing to purchase the featured produce.

It seems evident that the PEP emphasis on fruit and vegetable consumption and recipe preparation, plus the availability of featured fresh produce on the day of the PEP presentation had a synergistic effect on the clients' consumption and purchasing behaviors. This finding is particularly significant because it implies that food banks can achieve their mission of addressing hunger by promoting and supporting the PEP-style nutrition education at their pantries.

IV. YEAR 2 AND 3: LESSON TRACKING EVALUATION RESULTS

EVALUATION METHODS

Evaluation Design and Sampling

In early 2015, CAFB agreed with PAES that it would be very helpful to PEP development and the evaluation if data were gathered monthly from the participating pantries on how they were delivering PEP. This included data on the MyPlate messages covered, whether the lesson was delivered indoors or outdoors and in a line or in small groups, and recipe card distribution. A non-experimental design was used with a census sample of all participating pantries.

Data Collection Methods

An online SurveyMonkey Lesson Tracking form was used to document PEP lesson delivery activities. The food pantry educators were asked to submit monthly data indicating whether they had conducted PEP lessons the previous month. Data were collected during two periods across 13 months: first, between February 2015 and May 2015 and subsequently between September 2015 and March 2016. A total of 11 months of data were collected from 20 different pantries. Data were not collected in June, July, and August 2015 as no PEP lessons were offered due to evaluation activities.

Evaluation Instrument

The lesson tracking instrument was created in SurveyMonkey. Data were collected on PEP lesson components taught, whether the lessons were delivered indoors or outdoors and to the number people taught in each location, the types of produce and recipe cards distributed, and the number of days that PEP lessons were taught by type of produce distributed.

Data Analysis

The lesson tracking data were entered into SurveyMonkey, and then imported into the Statistical Package for the Social Sciences (SPSS) Version 20.0 that was used for descriptive statistics and cross tabulations. A content analysis of the qualitative data was performed to identify common themes. In addition, a more detailed analysis was completed for some key survey questions.

Below is a summary of the Lesson Tracking results. For a complete report of the findings from the online Lesson Tracking form see Appendix C.

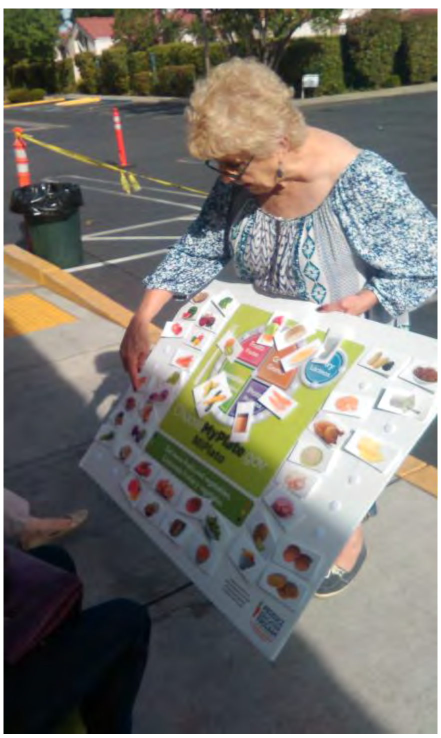
SUMMARY AND DISCUSSION OF EVALUATION FINDINGS

Year 2 (2014-2015) and 3 (2015-2016) Lesson Tracking

The online survey Lesson Tracking form was designed to be completed monthly in three to five minutes. It proved to be a very useful tool for gathering continuous feedback on pantry PEP activities and to identify situations where additional assistance was needed by the pantry coordinators and PEP educators.

The Lesson Tracking findings showed that among the pantries who taught the PEP lessons, most adhered well to the MyPlate key messages, used the interactive MyPlate poster, and provided recipe cards to the clients. Indeed, three-quarters of the lessons focused on the MyPlate 5 foods groups, making half the pate fruits and vegetables, and in the distribution of fruit or vegetable recipe cards with each lesson. Fifty percent of the pantries used the interactive MyPlate poster and slightly more than half encouraged clients to try the featured fruit or vegetable and the recipe card distributed during the PEP lesson. Only 14% of pantries had the kitchen facilities and/or staff resources to provide fruit or vegetable tasting/sampling.

Delivering the lessons either indoors or outdoors seemed to depend on the setting. Thirty-seven percent of the lesson delivery methods involved conducting the education indoors. Almost two-thirds of the education was conducted in the food distribution line and one-third in a classroom type setting. Among the pantries that conducted their PEP lessons outdoors, 90% of the lessons were in the food distribution line. Overall, whether indoors or outdoors, slightly more than three-quarters of all lessons were conducted in the food distribution line. The reason for this may be that clients do not want to leave their place in line for fear they will not get food.



Conducting Interative PEP education

Among the 20 pantries that reported conducting PEP lessons, all distributed specialty crops. In addition, all of the featured specialty crops were distributed at least four times (i.e., watermelon), with the two most commonly distributed items, cabbage (43 times) and carrots (32 times), accounting for 35% of 15 produce items distributed. Nine of the twenty pantries accounted for 83% of all produce distributed. Among the 199 times in which recipe cards were distributed, on 20 occasions cards were distributed without a matching fruit or vegetable. However, 82% of the distributed specialty crops at those sites were accompanied with a matching recipe card.

Most of the PEP lessons (82.5%) were conducted once a month. The remainder were conducted over two or more days per month. Several of the pantry partners cited the weather as the reason they did not teach PEP lessons, especially unusually high temperatures in September and October and the El Niño affected rains in the winter. Some of the written comments that were made include the following:

- *"The second Mobile Pantry in January was a rainy day. We do our PEP lessons outside, so we were unable to do PEP in the rain!"*
- *"The area we usually teach in was over 100 degrees. Too hot to make people stand in line for anything other than food. We will resume in October."*

Pantry partners also noted that sometimes they had no one to teach the lessons due to illness and/or lack of volunteer educators.

- *"The person that teaches was sick most of April."*
- *"Unfortunately, we were unable to offer My Plate lessons this month due to our volunteer scheduling conflicts. We are working to get the schedule filled for May."*
- *"Since we have had no one to teach about My Plate for a while, so we decided that we would at least pass out the beautiful recipe cards to all those who received a food box in February."*
- *"We were unable to do the lessons at either of our two Mobile Pantry deliveries because it was VERY hot, and many of our volunteers did not come, so we needed every person to help with the truck. We have since recruited some additional volunteers, so October should be better for us."*

PEP was also affected by the commonly busy food distribution holiday period that begins just before Thanksgiving and ends after the New Year. One person commented:

- *"Crazy December month! Nov. as well! Will start up lessons again in January."*

Recipe card distribution seemed to occur consistently with the featured produce. However, some sites indicated that they had difficulty receiving the recipe cards. This may have been due to printing delays and the challenge of tracking the number of cards received by each pantry. Some pantries were seeing more clients and would often run out of cards. Despite this challenge, the CAFB was able to supply most of recipe cards needed. One person stated:

- *"We are excited about the new recipe cards! Thanks!"*

There was very limited use of food tasting or sampling. This is likely due to not having on-site facilities or personnel to prepare food or sufficient volunteers to help with food distribution. One pantry noted,

- *"Our elementary school will have their final day of classes June 17th. So we will have more flexibility in the kitchen to prepare samples/recipes for upcoming PEP lessons."* Another person stated,
- *"We have more activities in our parish during Lent, specifically in the kitchen, so this month (March) we did not provide any samples during the lessons."*

The Lesson Tracking data provided a useful retrospective on PEP lesson delivery, and was also used by CAFB to track and respond to problems with lesson delivery. This responsiveness, and the effect it had on the pantries, was greatly appreciated by the pantry educators.

- *"Our Food Bank is becoming quite popular with average number of people is 25 but we have had as many as 50 individuals."*

Finally, one person made a comment that seemed to reflect the availability of both bilingual Spanish speaking educators and the recipe cards in Spanish.

- *"We think the program is valuable particularly for our Latino clients."*

V. YEAR 3: KEY INFORMANT INTERVIEWS EVALUATION RESULTS

Background

In Year 3, CAFB and PAES agreed that the Year 1 and Year 2 intervention studies yielded information that confirmed the utility of PEP to increase knowledge and change consumption and purchasing behaviors. Therefore, it was decided to focus the evaluation on gathering qualitative data, via key informant interviews with the participating staff and volunteers from PEP affiliated food banks and pantries, on their experience with the PEP program. Specifically, the interviews were designed to identify PEP program challenges, successes, and lessons learned in order to provide information to food banks and pantries wishing to replicate and/or to continue the PEP model.

EVALUATION METHODS

Evaluation Design and Sampling

A census sample of 6 food banks and 21 food pantry personnel who were directly involved in the PEP program were chosen for the interviews. Key informants from the food banks included staff members with direct PEP experience including food bank directors, assistant directors, and food bank staff, also known as food bank liaisons that coordinate regularly with food pantries.

Data Collection Methods

Telephone interviews with key informants were conducted in April and May of 2016. Data were collected from staff of all six food banks who were contacted for an interview. Twenty-three food pantries were contacted for interviews. Among the 23 food pantries, 21 staff/volunteers from 20 pantries agreed to be interviewed (one pantry had two persons). Six pantry staff identified themselves as pantry directors or coordinators, one was an assistant director, four volunteers, one food distribution coordinator, and one warehouse manager. The rest of respondents did not specify their positions. Eighteen had conducted PEP in the past 12 months. Three pantries did not implement PEP in the past year but were included in the interviews to learn about their challenges.

Evaluation Instrument

Two questionnaires were developed by PAES to query participants regarding challenges and successes in implementing the PEP program, including identifying any issues with program materials. The interview questions sought to determine if PEP was successful, the details of successful program implementation for each pantry, and specific information on how each pantry adapted PEP to their unique setting.

Data Analysis

Qualitative data obtained through key informant interviews were documented via pen to paper. Handwritten notes taken during each interview were transcribed after each interview and qualitative data analysis was performed to identify common themes, interpret the results, and summarize the findings.

Below is a summary of the results of the food bank and food pantry interviews (See Appendix D for a more detailed report of the Year 3: Key Informant Interview Results).

QUALITATIVE RESULTS: FOOD BANK INTERVIEW SUMMARY

The interviews completed with food bank representatives showed that PEP was successful in reaching food pantry clients. An overarching theme among food bank respondents was that implementing PEP has *contributed to the mission of participating organizations* through *building agency capacity and increasing the knowledge and skills* of the population they serve. Consistent with the food banks' missions, conducting PEP meant that pantries were asking for more produce and thereby increasing clients' access to and consumption of healthy food. Additionally, food bank representatives felt that they were introducing a healthy way of eating that would reach many people and help address factors that contribute to chronic illness. One food bank liaison noted that PEP sometimes involved pantries with no previous experience in delivering nutrition education. Lastly, some food bank volunteer peer educators stated that by participating in PEP they were becoming more knowledgeable about nutrition, leading to their own personal behavior change.

Respondents indicated that combining program elements including produce sampling, nutrition lessons, recipe cards, and the interactive MyPlate board contributes to the *success* and effectiveness of PEP. Sixty-seven percent of food banks were pleased with the utility of the recipe cards and stated they were accessible, colorful, appealing, compatible with low literacy populations, and available in Spanish. They noted that clients liked the cards and took them home. In addition, one food bank reported using the PEP recipe cards in other nutrition education settings with good success. Representatives found PEP to be more comprehensive and effective than other nutrition education programs. One liaison stated, "This [PEP] is such a good tool. I love and hope it is successful in other counties."

Food banks and their affiliated pantries also encountered challenges. Some of the challenges included identifying food pantries to implement PEP that would have the *volunteer capacit*y and space to effectively carryout the program. When food pantries did not have sufficient volunteers to conduct PEP, or the evaluation, the food banks stepped in to assist them. However, this sometimes caused a strain on food bank staffing.

Another challenge faced by food banks was *coordinating the produce distribution* to the food pantries. Factors that contributed to either short or no supply of a specific produce were often out of their control. This in turn, at times made it difficult for food pantries to plan a PEP lesson with matching produce and a recipe tasting or food sample.

Allowing food banks and pantries *flexibility* about where and how they conducted PEP proved to be important to both entities. Food bank staff indicated it was important to ask pantries what specifically they needed to make PEP successful. That meant that both the food bank and pantry had to be flexible about where and how PEP was conducted. In some cases the location of the food distribution needed to change in order to ensure that PEP was implemented. One pantry with help from CAFB reproduced the MyPlate Board as a laminated handout that they distributed during client registration, since the pantry had a registration table and no distribution line. Furthermore, as more food banks and pantries move to the Choice System of food distributions that involve clients choosing the food they get, and often in a small grocery store type setting, the PEP walk the line model may need to evolve with that transition.

Overall, interviewees held a positive view of their work with CAFB and appreciated the *technical assistance and support* they received. They also offered recommendations for future PEP programming including: making PEP a mandatory aspect of participating in Farm to Family, offering online training modules, continuing to offer training in program evaluation, providing small grants or stipends to food pantries to assist them in recruiting and training volunteers to conduct PEP, developing a smaller PEP interactive poster board for use in smaller, tighter settings and creating a website with a client portal to support the program.

Food banks and their liaisons played a key role in PEP's success by collaborating with CAFB and providing on-going support for their associated food pantries. Other food banks interested in replicating the PEP model need to factor in this aspect into their program. Other aspects integral to consider when replicating PEP include: *educating food bank and pantry staffs* on the benefits of PEP participation, knowing the PEP project requirements for both the food bank and the food pantry, and understanding the importance of integrating the PEP lessons with produce availability.

One food bank noted that Farm to Family works well with PEP, as they are mutually supportive. The respondent recommended making PEP a mandatory aspect of participating in Farm to Family and stated, *"If we hand out produce, it is critical to have the education to go along with it" - Kristin Salas, Second Harvest Food Bank of San Joaquin and Stanislaus Counties*

Based on the comments from the food bank representatives, it is clear that *PEP was successful* because:

- PEP contributed to the food banks' missions
- PEP increased the food pantry volunteers' awareness that produce consumption can play a part in preventing some chronic diseases
- PEP increased clients' knowledge of MyPlate and the health benefits of the featured fruit or vegetable of the day
- PEP increased consumption of specialty crops

Given the opportunity to make final comments about PEP, the food bank representatives said:

"PEP allows us to get produce out into communities that don't have access to it and have high rates of obesity and diabetes." - Food Bank Coordinator

"It has been a good experience helping pantries reach families, and to support these agencies in achieving their goals" - Kelcey Ellis, Feeding America San Diego

"I have been working at the food bank for a year. Of all the programs this one seems to have the biggest impact." - Maureen Andrews, Community Action Partnership for Kern County

QUALITATIVE RESULTS: FOOD PANTY INTERVIEW SUMMARY

A majority of respondents stated that PEP operated very well at their food pantry. They felt that clients remembered the educational messages and the engaging MyPlate board from visit to visit. Respondents noted a number of factors that contributed to PEP's *success.* The interactive material and the MyPlate board's Velcro tabs were visually helpful and entertaining. Indeed, the board engaged both parents and their children, as they waited for their food distribution. Respondents noted that PEP increases client knowledge about nutrition, preparation, and portions and that PEP starts a conversation with clients about different ways to prepare the produce. Respondents indicated that they believed after implementing PEP their clients were more aware of the importance of eating fruits and vegetables and also liked the PEP recipes. Additionally, pantry volunteers like that the recipes changed over time, as the clients were eager to receive new recipes. Moreover, after being exposed to PEP, pantries' respondents said their clients were willing to try new foods because they learned from the recipes that it is easy to cut and prepare raw produce for the family meal. In fact, pantry respondents felt that PEP seems to increase demand for produce. They also felt that participating in PEP improved their partnership with their food bank.

Some of the challenges experienced by food pantry representatives echoed the findings from the food bank interviews. Securing adequate *volunteer support* was one of the key challenges. Finding volunteers willing to commit over an extended period of time, as well as identifying bilingual translators to assist with lessons including Spanish, Korean, Vietnamese and Russian, was a challenge. *Produce coordination* was another challenge. Some pantries did not always receive enough produce or the produce to correspond with a recipe card. Produce coordination was important to ensure that a lesson's key messages were aligned with the produce being provided. An additional challenge included having only one food bank driver delivering produce to multiple pantries on the same day. This meant that the produce orders were sometimes confused across the pantries.

Cultural norms and perceptions about nutrition were a challenge at some pantries. In some cultures, it is not acceptable to learn nutrition from younger people. In addition, a few volunteers were not enthusiastic about conducting PEP, as they did not see its value.

Challenges and successes appear to be influenced in part by the distinct differences between urban and rural pantries. For example, space is a premium in urban pantries, making conducting a lesson in the distribution line more challenging. This is not necessarily the case in rural pantries. Rural pantries often had distributions and lessons outdoors, allowing for a classroom style presentation of PEP, but this also made the program vulnerable to extreme weather conditions in winter and summer. Urban pantries are closer in proximity to their food banks, allowing for potential additional volunteer support and ease of produce distribution.
Three food pantries encountered challenges with implementing PEP and did not conduct PEP between July 2015 and June 2016. Their challenges included lack of volunteers to conduct PEP, internal capacity within the pantry to coordinate PEP, and cultural norms among immigrant populations served by the pantry that made PEP not a good fit for their clients.

Pantries overcame various challenges in program coordination to ensure the success of PEP. Effective program planning and coordination included successfully identifying volunteers, supporting volunteer *training, managing volunteers in implementing PEP, and effective management of PEP material*s. Program success also involved effective *communication* within the pantry and between the pantry and its associated food bank.

Pantry respondents described *promising practices* in program implementation for their pantry. Promising practices fell under two different themes, including *commitment* from pantry staff and volunteers, and the importance of a *vision for success* among PEP volunteers. Several respondents stressed the importance of having a vision for how PEP would be implemented including timing, frequency, and the pantry location in which to conduct the lessons. No one vision worked for every food pantry. Representatives indicated that a team approach is best so the work can be shared. The pantries that identified a lead person for PEP that was enthusiastic about improving the health of their clients, committed to trying a new program, organized, and willing to communicate regularly with the food bank and CAFB staff, had the most success. *Program adaptability* was another best practice identified. Respondents indicated the need to adapt the PEP lesson to suit the individual pantry space and the available volunteer resources.

Food pantry representatives were asked what *advice they would give their peers* interested in implementing the PEP model. Ensuring the success of PEP involves many factors. Respondents highlighted the need to have direction, initiative, and drive about what you are getting into. Securing *volunteer support* and identifying the right location for the produce distribution and nutrition lessons are critical. If available, a *certified kitchen* where recipe tastings can be prepared in advance of the PEP education should also be considered when planning to follow the PEP model. Pantries should expect challenges in the first year of implementation. *Patience, flexibility and consistency* while the program is in its early phases are characteristics of a successful program. Another suggestion was to look for opportunities to conduct PEP in other community settings besides pantries, such as partnering with a local faith-based network to promote PEP at other pantries. Lastly, recognize that *it takes time to become successful* and that PEP volunteers may need to lower expectations initially until the program has time to mature.

Overall, food panty interview respondents spoke glowingly about PEP and the effect of the program on their pantry and the populations they serve. Below are some of their comments:

“We didn’t give out a lot of produce before we had the produce education program. Stores found out we are educating people to make better choices and have been donating produce to us.” - Bill Bennett, Grace Resource Center

“When PEP stops it won’t really stop, because so many participants have had the lessons and received the cards and practiced preparing the foods.” - Ruth Kennedy, Native American United Methodist Church

“I think the program is awesome. For a while celery was coming back because they did not know what to do with it. Now with PEP, no produce is being returned.” - Connie Totten, Community Action Partnership of Kern County

"People are actually showing up for the vegetables! They see it can be part of a meal. That they can do something with the produce!" - Richard Leavitt, Newport Church Food

"Some of the moms told me the kids try new foods!" - Ruth Kennedy, Native American United Methodist Church

"I love the materials. I feel so blessed." - Esau Canales, Church on Pearl.

"PEP exceeded our expectations." - Cynnde Lewis, World of Pentecost Food Pantry

Conclusions

The food bank and pantry key informants felt that the PEP was very successful. Indeed, PEP contributed to the food banks' and pantries' missions, increased clients' knowledge and use of MyPlate for feeding their families, and increased the consumption of specialty crops. Despite challenges in identifying food pantries to implement PEP due to space and staffing concerns, the food banks stepped in to ease the strain on staffing. Pantries began to recognize to expect challenges in the first year of implementation and that patience, flexibility and consistency were critical to early program success. The pantries that identified a lead point person for PEP that was enthusiastic about improving the health of their clients, committed to trying a new program, organized, and willing to communicate regularly with the food bank had the most success.

The availability of specialty crops became increasingly important to the pantries as the PEP was implemented. However, pantries came to recognize that either short or no supply of a specific produce item was often out of the food bank's control. This realization, in turn, improved communication and produce delivery planning between the food banks and the pantries.

Overall, interviewees held a positive view of their work with CAFB and appreciated the flexibility in how and where to conduct PEP and the continuous PEP technical assistance and support. Food banks interested in applying the PEP model should be prepared to support pantries by educating pantry staff on the benefits of PEP participation, knowing the PEP requirements for both the food bank and the food pantry, and understanding the importance of integrating the PEP lessons with produce availability. They may be able to get assistance from CAFB in the form of online educator training modules, training in program evaluation, small grants or stipends to food pantries to assist them in recruiting and training volunteers to conduct PEP, and developing new recipes and educational materials in more languages.

V. OVERALL DISCUSSION AND RECOMMENDATIONS

The three-year PEP evaluation highlighted the effectiveness of the PEP intervention model. Food banks and pantries found the PEP materials colorful and appealing. They liked the visual interactive MyPlate board because it was tactile and clients of all ethnicities and literacy levels could participate in choosing the food components to make a healthy plate. They especially liked the easy and colorful PEP recipes that matched the day's specialty crop distribution. These results confirm the importance of using theory and health behavior models to guide the design of effective strategies/interventions.

The evaluation results showed that PEP achieved the program's intended outcomes to:
(1) Increase nutritional awareness of California specialty crops, (2) Increase likelihood of clients preparing and consuming produce received from food banks and pantries, and (3) Encourage clients to purchase specialty crops at retail venues such as supermarkets and farmers markets. Furthermore, the evaluation showed that brief nutrition interventions could successfully impact participants' knowledge of healthy eating and increase consumption of fruits and vegetables among those receiving food in emergency distribution settings.

The PEP Year 1 and 2 evaluation findings demonstrated that PEP was successful in that, compared to the control group, the intervention group was significantly more likely,

- to be more knowledgeable about how to use MyPlate to feed their families,
- to remember the key MyPlate nutrition messages,
- to use my MyPlate to feed their families more fruits and vegetables.

Other results included the following:

- Many of the intervention group participants were utilizing the featured recipes to prepare healthier meals for their families.
- Two-thirds of the intervention group participants indicated that they either made the exact recipe or modified it.
- Approximately 80% of both groups were very likely or somewhat likely to purchase the featured produce.
- Approximately 95% of both groups were likely to consume all or most of the fruits and vegetables they receive from their pantry.
- Produce that their families did not want to eat was either not taken, or given to friends, family, or neighbors. Only about 10% threw produce away.
- Many pantries increased the amount of produce they distributed to their clients when PEP was implemented.
- PEP provided a nutrition education resource for food pantries that did not have nutrition programming in the past.
- Pantry volunteers were empowered with new skills and a new role in supporting their food pantry community.
- Farm to Family worked well with PEP, as they are mutually supportive.

In effect, PEP was successful in that most food pantry clients were not only eating, freezing, or preserving the produce they received from their pantry, but they were also purchasing produce at their local retail outlets after the PEP intervention.

PEP Education Intervention Challenges, Lessons Learned, and Recommendations

This section describes some of the challenges, successes, and recommendations to CAFB, food banks, and pantries on the continued implementation of PEP.

1. ***Challenge – PEP Staffing**:* Some pantries were not able to deliver the PEP consistently because they lacked volunteers or staff to deliver the PEP lessons.

   Recommendation: Most community colleges and universities require students to perform community service or internships, as part of their academic experience. Although these are often short-term commitments (e.g., three to four month semester, or a 3-month summer period), food banks and pantries should consider cultivating relationships with local academic institutions to recruit students to support the nutrition education. They could be trained as short-term PEP educators or they could provide support to a pantry PEP educator by assisting with the food sample preparation and distribution, oral bilingual translation, passing out flyers and recipe cards, and helping to recruit clients from the food distribution line to the day's lesson.

   Recommendation: Consider providing PEP educators with a small stipend.

2. ***Challenge – Untrained PEP Educators**:* The individuals who attended the PEP Educator Training sometimes were not the same persons that ended up conducting the education. This resulted in PEP being delivered by educators who were not familiar with the PEP lesson messages and the accompanying materials. The answer to this challenge was for PEP to offer on-going program support and refresher trainings to new educators.

   Recommendation: Food banks assign PEP to one of their nutrition educators, who in turn will provide continuous training and support for their local food pantry educators.

3. ***Challenge – Need for Educational Materials in Other Languages***: In Years 1 and 2, the PEP materials were developed in English and Spanish. However, some food pantries had clients who spoke and read Russian, Korean, Vietnamese, and Tagalog. PEP recognized the importance of expanding the material offerings to other languages and in Year 3 they translated the materials into Russian and Chinese. Both languages were chosen because multiple agencies that used PEP expressed a need for materials in those languages. At the time of this report, the new (Russian and Chinese) language materials were still under construction and in the graphic design process.

   Recommendation: California is home to the largest Asian population in the United States. The poverty level of Asian Americans is considerable higher than commonly believed. Rates are particularly high among Hmong (28%), Thai (18%), and Vietnamese (15%)[10], compared to 14.3% of the U.S. population as a whole. CAFB and the food banks should consider developing more PEP materials, particularly for the other Asian ethnic groups. In addition, clients can also be referred to websites, such as EatFresh.org (http://eatfresh.org/), that provide online recipes and other materials in Chinese and Spanish.

[10] Source: American Community Survey (1-year estimates) 2007–2014. U.S. Bureau of the Census.

4. ***Challenge – Produce Availability**:* Some food pantries had no advanced notice about which produce items they would receive from their local food bank. This challenge made it difficult for them to plan which lesson/recipe cards to distribute and to prepare the corresponding food sampling. PEP recognized this challenge and encouraged food pantries to keep their recipe cards stocked so that they would be able to pull out whichever recipe card they needed when the produce items came in.

   Recommendation: CAFB should continue to promote collaboration between the food bank liaisons and pantry partners in order to support communication related to produce availability.

5. ***Challenge – Food Sampling**:* When food pantries agreed to participate in PEP they were asked to choose the level of food sampling[11] their agency could provide based on their internal capabilities (i.e., if they had a commercial kitchen that allowed for food refrigeration and preparation). However, some food pantries were not interested in or did not have the kitchen capacity to participate in the food sampling element of this program. In addition, some pantries modified the recipe with ingredients that were not necessarily healthy.

   Recommendation: In Year 3, PEP recognized the food sampling concerns and offered suggestions to agencies that did not have the kitchen capacity to serve the recipe samples, such as cutting an unfamiliar vegetable in half to demystify the item and attract the clients' attention. PEP and the food banks should continue to provide the pantries with food bank flexibility. In addition, PEP should expand its present activity of developing more than one healthy recipe for a specific produce item. For example, many sites regularly receive get carrots and having several recipe cards for carrots could be keep clients interested in the program.

6. ***Challenge – Financial Incentive**:* PEP did not offer financial incentives or compensation to food banks and pantries for participating in the program. However, they did provide extensive program materials, including the PEP interactive board, recipe cards, cups and spoons for the recipe samples, and educator trainings.

   Recommendation: PEP should consider offering a financial incentive for participation. This has the potential to increase consistent participation in the program and may allow food banks and pantries to provide small stipends to volunteer PEP educators.

7. ***Challenge – Engaging Clients**:* Some clients were focused on receiving the food from the pantry and not in participating in the interactive education. Some were not interested in the lessons, especially once they heard the lesson more than once.

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[11] The PEP Food Sampling Protocol in brief:

Gold = Full kitchen, makes recipe and distributes samples

Silver = Limited kitchen. No recipe preparation, instead chop and serve small pieces of featured fruit or vegetable. No tasting for hard to eat produce, i.e., eggplant and winter squash

Bronze = No kitchen. No food samples distributed

Recommendation: PEP staff recognized that not all clients would be interested in the interactive program. Therefore, PEP staff told educators to not be discouraged but to instead find ways to engage clients in the education. For example, if a client previously heard the PEP lesson, the pantry educator could ask the client to give the group examples of how they had used the PEP nutrition information to feed their families.

Recommendation: For clients who previously heard the PEP lesson, pantries should consider expanding their educational offering to include quick lessons and/or handouts on food safety, kitchen safety, and shopping on a budget. There are numerous resources on those topics, such as $upermarket $aving$: 16 Tips that Total BIG Bucks! http://food.unl.edu/documents/supermarket-savings.pdf.

8. ***Challenge – Produce Spoilage:*** Some of the clients commented that the produce too often spoils.

   Recommendation: Food banks and pantries should consider adding recipes for converting produce into foods that can be frozen or safely stored for later consumption. For example, the Greater Pittsburg Community Food bank provides Produce Guides that show clients how to use and save their produce, such as overripe fruits and vegetables: https://www.pittsburghfoodbank.org/produce-guides/ . In addition, the Cooksmarts site has information for reducing food waste that can be reviewed by food bank and pantry educators and shared with the clients, as an addendum to PEP. http://www.cooksmarts.com/cooking-guides/cook-on-a-budget/reduce-food-waste/

9. ***Challenge – Participants' Understanding of the Program*****:** Some food pantry staff misunderstood or were not clear on what PEP was, or entailed, including some of the following details:
   a. what key messages to include in the lessons,
   b. when and with how many clients the lessons should be conducted,
   c. the need to focus on one fruit or vegetable that is being distributed that day and give out the matching recipe card, and
   d. that, whenever possible, all elements of the program should be done in conjunction with another, (i.e., conduct the lesson, give out the matching recipe card, and offer a matching produce sample or recipe tasting).

   Recommendation: In Year 2, the PEP coordinator addressed these issues by revising the pantry educator trainings to provide more time for the PEP lessons and role-playing the education delivery. They also conducted more site visits to food pantries to offer one-on-one technical assistance and support, and offered Refresher Group-Training to further reinforce the initial educator training. As responsibility for the PEP shifts to the food banks, they will need to be aware of and plan for continuous support of the pantry PEP educators.

10. ***Challenge - Program Ownership**:* During Years 1 and 2, some food bank and pantry staff said that they did not feel a sense of program ownership. Perhaps, this was because they did not fully understand the commitment necessary to successfully implement the program, including space for conducting the lessons and storing PEP materials, and the PEP staffing

needs. They also expressed concerns about the programs flexibility in that they were required to deliver the program without changes.

Recommendation: In Year 3, PEP worked to address the ownership challenges by collaborating with food banks and pantries to get more buy-in. They modified the program to allow more flexibility in the program's delivery. This, in turn, allowed food banks and pantries to take ownership over the program and tailor its delivery mode and timing to their organization's clientele, available physical space, and their staffing constraints. The PEP and food banks should continue promotion of pantry program ownership by tailoring materials to their local setting (e.g., recipes in Vietnamese for pantries with many Vietnamese clients) and providing continuous training.

11. ***Challenge – PEP Evaluation:*** The PEP evaluation of the PEP intervention showed that PEP works. PEP will not be able to support continued evaluation, so pantries who wish to continue evaluation will need to seek financial support.

    Recommendation: Food banks and pantries should consider conducting an evaluation of their PEP intervention for two important reasons. First, periodic evaluation will provide pantries what data on the effectiveness of their intervention. Second, positive evaluation results can be used by food banks and pantries in their efforts to seek external funding for continuing PEP, purchasing nutrition education materials, and to provide stipends for their educators. The evaluation questions in the existing intervention survey have been reduced from 16 questions in Year 1 to 5 questions in Year 2. There is now a short but accurate evaluation instrument that can be used by food banks and pantries interested in evaluating their PEP intervention. In addition, in Year 2 training of pantry interviewers became an online training that included a visual role-playing exercise to further enhance the interviewers' education and prepare them for conducting the interviews. The video was also available for viewing any time after the training and served as a refresher for the survey interviewers. The above changes increased the fidelity of the evaluation data in Year 2. Food banks should consider providing pantries with evaluation support in the form of data entry, data analysis, and short report writing.

Other Recommendations

a. Food banks and pantries should continue to provide PEP, but accept that there will always be challenges to continuous PEP delivery including weather, educator illness, busy holiday periods, and lack of bilingual educators among other factors.

b. Food banks and pantries should collaborate on developing a six-month timeline for PEP delivery that coincides with seasonal produce distribution and takes weather, and holidays into consideration.

c. Pantries should continue to recruit and train PEP educators from their regular pantry volunteers but should not overlook volunteers from the food recipient community that could be recruited to be peer educators. It is not uncommon to find pantry clients who have both the time and interest in serving as PEP nutrition educators (e.g., Latina promotoras).

d. Most of the food pantries provided PEP lessons to more than four persons at one time. However, three-quarters of those lessons were provided in the food distribution line and only one-quarter in a classroom style setting. The lower percentage of classroom style settings is likely a function of space limitations. However, clients may also be concerned about losing their place in line. One possible solution is for pantries to give clients numbers that guarantee their place in line. Another possibility is to have clients pre-register for the food distribution and assign appointment times. When clients arrive for their appointment they can also receive the PEP lesson while waiting and keeping their place in line. This approach proved very successful in the 2012 CAFB study in Santa Clara and San Mateo Counties.

Replication of the PEP Model

Food banks interested in replicating the practice-based PEP intervention model can gain knowledge from the challenges, successes, and lessons learned during the three-year PEP intervention and evaluation. Furthermore, as shown in the key informants interview section and appendix of this report, comments from food bank and pantry representatives provide helpful tips for replication. They include having a vision and plan for PEP, dedicating a food bank liaison to facilitate the program between the food bank and pantry, and ensuring that pantries receive produce to match the PEP lessons in time for the pantries to plan their PEP lesson and food sampling, using multiple avenues to secure enthusiastic volunteers (including offering stipends) interested in delivering PEP at their pantry, providing on-going educator training and technical assistance, and incorporating evaluation into their planning.

APPENDIX A

Year 1: 2014 Results

2014 RESULTS

Intervention and Control Locations

The CAFB FY14 evaluation plan called for the collection of 250 surveys from both the Intervention and the Control groups. Tables 1 and 2, below, show that the target numbers were achieved for the intervention group but not the control. Originally, 11 control sites were recruited in Year 1. However, two sites were not able to participate. In addition, one site gathered data from 28 clients that were excluded from the analysis because they had not received food in the previous four months and therefore did not meet the criteria for inclusion.

Table 1. CAFB PEP 2014 Intervention Client Interview Locations

Food Pantry	Associated Food Bank	Count
1. Bayview Charities	Feeding America San Diego	12
2. Church on Pearl	Westside Food Bank	15
3. Ecumenical Hunger Program, East Palo Alto	Second Harvest Food Bank of Santa Clara and San Mateo Counties	8
4. Fallbrook Food Pantry	Feeding America San Diego	10
5. First Church of the Nazarene	Los Angeles Regional Food Bank	12
6. First Unitarian Church	Los Angeles Regional Food Bank	14
7. Grace Resources	Los Angeles Regional Food Bank	15
8. Immanuel Presbyterian	Los Angeles Regional Food Bank	20
9. La Purisima	Second Harvest Food Bank of Orange County	16
10. Macedonia Food Pantry, San Mateo	Second Harvest Food Bank of Santa Clara and San Mateo Counties	15
11. Native American United Methodist	Second Harvest Food Bank of Orange County	12
12. Newport Church	Second Harvest Food Bank of Orange County	17
13. Pyramid Alternatives, Daly City	Second Harvest Food Bank of Santa Clara and San Mateo Counties	12
14. San Marcos	Feeding America San Diego	12
15. SOVA Community Food Program	Westside Food Bank	16
16. St Anne's Catholic Church and Shrine	Westside Food Bank	14
17. St. Joseph's Center	Westside Food Bank	15
18. Vista	Feeding America San Diego	16
Total		251

Table 2. CAFB PEP 2014 Control Client Interview Locations

Food Pantry	Associated Food Bank	Count
1. All People Christian Center	Los Angeles Regional Food Bank	37
2. Anaheim Vineyard	Second Harvest Food Bank of Orange County	11
3. Caminar Open Pantry	Second Harvest Food Bank of Orange County	26
4. Heaven's Window	Feeding America San Diego	12
5. La Maestra	Feeding America San Diego	15
6. Pacifica	Second Harvest Food Bank of Santa Clara and San Mateo Counties	12
7. Pauma	Feeding America San Diego	12
8. Perry Elementary	Feeding America San Diego	16
9. St. Joseph	Westside Food Bank	19
Total		160

Demographic Profile

Table 3 shows that the Intervention and Control groups had fairly similar race/ethnicity demographic profiles, with the exception of more whites in the control group. In both groups, most respondents were female. At least half of all respondents were Latinos. Indeed, about half of the interviews among the Intervention group were conducted in Spanish compared to only one-quarter among the Control group. However, in both groups Spanish was the primary language of about half of respondents. There were no significant differences in the mean age of both groups. Both groups were equally like to have children under age 18 in their household. Both groups had the same mean number of people over age 18 in their home.

Table 3. 2014 Respondents' Demographic Profile*

	Intervention N=251	Control N=160	*p* Value
Race/ethnicity			
White/Caucasian	11.2%	17.5%	.067
Hispanic/Latino	59.8%	55.0%	.340
Black/African American	11.6%	12.5%	.877
Native American/Indian	1.6%	2.5%	.517
Asian/Pacific Islander	8.8%	8.8%	1.00
Other Demographic variables			
Survey interviews conducted in Spanish	46.4%	36.3%	.006
Primary language Spanish	57.0%	45.6%	.223
Female participants	88.8%	81.6%	.634
Respondents' mean age	50.7	48.4	--
Households with children under age 18	65%	65%	1.00
Total number of children under age 18	380	281	--
Mean number of children per household	1.51	1.75	--
Total number of people age 18 or older	565	371	--
Mean number of people age 18 or older	2.38	2.38	--

Statistical significance $p<0.05$. *Calculations include adjustments for some missing cases.

MyPlate Awareness, Knowledge, and Use

As shown in Table 4, the Control group was significantly less likely to have heard about MyPlate for feeding their family than the intervention group.

Table 4. MyPlate awareness

	Intervention N=251	**Control N=160**	***P* Value**
Respondents remembered hearing an educational message about eating healthier from one of the pantry educators	72%	Not asked	--
Respondents that had heard about MyPlate for feeding their family	79%	41%	<.001

Statistical significance p<0.05. *Calculations include adjustments for some missing cases.

All respondents were asked what they remembered about how to use MyPlate. The respondents were not prompted with possible answers. As shown in Table 5, the Intervention group was significantly more likely to remember the PEP MyPlate nutrition messages than the Control group. Among both groups, making half your plate fruits and vegetables and eating balanced meals or portions were the two most remembered messages.

Table 5. MyPlate knowledge

Question: What nutrition information do you remember about how to use MyPlate for feeding yourself or your family?	**Intervention N=251**	**Control N=160**	***P* Value**
1. Did not remember or know how to use MyPlate	6.4%	2.5%	.075
2. MyPlate is made up of 5 different food groups	39.8%	14.4%	<.001
3. Make half your plate fruits and vegetables	55.0%	24.4%	<.001
4. Make at least half your grains whole grains	34.3%	10.0%	<.001
5. Add lean protein	38.6%	10.0%	<.001
6. Eat low-fat dairy products	35.1%	6.9%	<.001
7. Eat from the 5 food groups throughout the day	37.5%	10.0%	<.001
8. Eat balanced meals or portions	46.2%	13.8%	<.001

Statistical significance p<0.05.

As shown in Table 6, the Intervention group was significantly more likely to have used MyPlate to prepare food for their family than the Control group. Among both groups, preparing more vegetables and giving them more fruits were the two most common MyPlate practices.

Table 6. MyPlate Use

Question: How have you used MyPlate to prepare food for yourself or for your family?	**Intervention N=251**	**Control N=160**	***P* Value**
1. No, I have not used MyPlate	6.4%	4.4%	.692
2. Preparing more vegetables	53.8%	22.5%	<.001
3. Giving them more fruits	43.8%	19.4%	<.001
4. Giving them low fat dairy food	30.7%	7.5%	<.001
5. Giving them lean meats	35.5%	8.1%	<.001
6. Giving them more whole grains	36.7%	10.0%	<.001
7. Making sure they eat from the 5 food groups throughout the day	35.9%	8.8%	<.001
8. Serving them balanced meals/portions	34.7%	10.6%	<.001

Statistical significance p<0.05.

As shown in Table 7, the intervention group was significantly more likely than the control group to have heard about MyPlate at their pantry, their child's school, a medical setting, a nutrition class, and on a TV show. Although the percentages are small, both were equally likely to have heard about my plate in a WIC office or on the internet.

Table 7: Where respondents heard about MyPlate

Question: Where have you heard about MyPlate?	**Intervention N=251**	**Control N=160**	***P* Value**
1. Here (food distribution)	64.9%	6.3%	<.001
2. Child's school	19.9%	8.1%	<.001
3. Medical setting (Clinic, Doctor's Office)	19.5%	10.0%	<.001
4. Nutrition classes	15.1%	5.0%	.002
5. TV show	12.0%	5.0%	.018
6. WIC	11.2%	6.3%	.094
7. Work	1.6%	0.0%	.108
8. Internet	3.6%	2.5%	.540

Statistical significance p<0.05.

As shown in Table 8, an average of 27 cards was distributed monthly by each of the 18 pantries with an average of 110 across the 18 food pantries over the four-month period. Furthermore, the distribution of recipe cards increased from May to August by 20%. Overall, approximately two-thirds of the 251 respondents remembered receiving at least one recipe card between May and August. Table 8 shows that the most common recipe card clients remembered receiving was cabbage followed by watermelon, bell peppers, and carrots.

Recipe Card Usage

Table 8: Intervention Group - Number Recipe cards received May – August 2014

Q7. Which of these recipe cards do you remember getting since May at this food distribution site?[12]	May	June	July	August	Total	Average
	Count	Count	Count	Count	Cards	
1. Bell pepper (pimiento morron)	56	63	64	66	249	62
2. Cabbage (repollo)	63	72	78	83	296	74
3. Cantaloupe (melon)	50	53	60	60	223	56
4. Carrots (zanahorias)	49	57	65	66	237	59
5. Celery (apio)	38	40	42	42	162	41
6. Sweet corn (maiz)	51	54	55	56	216	54
7. Honeydew (melon verde)	36	38	43	42	159	40
8. Pears (peras)	39	46	50	52	187	47
9. Tomato (jitomate)	43	49	52	50	194	49
10. Watermelon (sandia)	60	65	68	68	261	65
11. Other recipe card:	12	11	10	11	44	11
Total	497	548	587	596	2228	
Average per pantry (N=18)	25	27	29	29	110	

As shown in Table 9, two-thirds (65.4%) of the intervention group respondents said they made the exact recipe or modified the recipe.

Table 9: Intervention Group: Prepared or changed recipe card in percent

	Percent of Total Respondents: N=251			
Q8. Of the recipe cards you received, did you **make or change** any of the recipes at home?[13]	Made Exact Recipe	Changed or modified	Did not make	Don't remember
Bell pepper (pimiento morron)	11.2%	5.6%	5.6%	2.0%
Cabbage (repollo)	13.5%	7.6%	5.2%	1.6%
Cantaloupe (melon)	9.2%	0.8%	2.8%	1.6%
Carrots (zanahorias)	8.8%	2.0%	6.4%	2.4%
Celery (apio)	5.6%	2.0%	5.6%	0.4%
Sweet corn (maiz)	4.4%	0.8%	6.4%	0.0%
Honeydew (melon verde)	3.6%	1.2%	2.4%	2.0%
Pears (peras)	10.0%	7.2%	3.6%	0.4%
Tomato (jitomate)	4.8%	1.6%	6.0%	1.6%
Watermelon (sandia)	10.8%	6.8%	5.2%	1.2%
Percent of total responses	45.6%	19.8%	27.3%	7.3%

[12] This question was only asked to the Intervention Group.
[13] This question was only asked to the Intervention Group.

Specialty Crop Tastings

As noted in Table 10, the overwhelming majority of interview participants said they did not taste one of the specialty crop recipes or a sample of the produce. Of those who did taste one of the recipes, the most common tasting was the cabbage recipe, followed by watermelon, carrots, and cantaloupe.

Table 10: Intervention Group- tasted a recipe or sampled food May - August?

Q9. Did you taste a recipe or sample any of these foods here since May?	Yes, tasted	Did not taste, did not remember, or did not respond*
Bell pepper	8.8%	91.2%
Cabbage	19.5%	80.5%
Cantaloupe	10.4%	89.6%
Carrots	10.8%	89.2%
Celery	4.0%	96.0%
Sweet corn	3.6%	96.4%
Honeydew	0.8%	99.2%
Pears	10.4%	89.6%
Tomato	5.6%	94.4%
Watermelon	13.5%	86.5%

* Percent of Total Respondents: N=251

Where Intervention and Control Participants Get Their Produce

Respondents were asked where they got the produce they ate the previous four months. Most participants indicated they got their food at a pantry. However, they were also getting produce at grocery stores and farmers markets. In both the intervention and control groups, cabbage and carrots were the most common foods received.

Table 11. Where Intervention group got the food they ate, by type of produce. N=187

Distributed Produce	Got it here	Grocery store	Farmers' market	Flea market	Street vendor	Friends /family	I grew it	No/Don't know	Count per produce
Cabbage	85%	39%	4%	0%	0%	2%	4%	7%	84
Cantaloupe	75%	45%	11%	0%	0%	1%	1%	6%	71
Carrots	87%	45%	4%	0%	0%	1%	0%	3%	69
Watermelon	84%	20%	4%	0%	2%	4%	4%	13%	56
Bell pepper	91%	31%	4%	0%	0%	0%	0%	2%	45
Pears	97%	28%	26%	0%	0%	3%	0%	0%	39
Tomato	84%	32%	6%	0%	0%	6%	3%	3%	31
Celery	83%	28%	0%	0%	0%	0%	0%	0%	18
Sweet corn	78%	28%	6%	0%	0%	22%	0%	6%	18
Honeydew	75%	25%	13%	0%	0%	25%	0%	13%	8

Note: Respondents could indicate more than type of produce and more than one location for each produce item.

Table 12. Where Control group got the food they ate, by type of produce. N=139

Distributed Produce	Got it here	Grocery store	Farmers' market	Flea market	Street vendor	Friends /family	I grew it	No/Don't know	count per produce
Celery	78%	41%	2%	1%	0%	3%	0%	5%	100
Cabbage	71%	44%	1%	0%	0%	3%	0%	3%	75
Carrots	86%	44%	2%	0%	0%	3%	0%	5%	59
Pears	73%	32%	5%	0%	0%	5%	0%	2%	44
Watermelon	67%	37%	2%	0%	0%	7%	0%	2%	43
Tomato	95%	29%	0%	0%	0%	3%	5%	3%	38
Sweet corn	23%	31%	23%	0%	0%	23%	0%	0%	13
Cantaloupe	25%	50%	25%	0%	0%	13%	0%	0%	8
Honeydew	0%	33%	67%	0%	0%	0%	0%	0%	6
Bell pepper	0%	100%	0%	0%	0%	0%	0%	0%	1

The following table summarizes where respondents got their food from a proportion of total responses to each of the featured fruits and vegetables located in this question (same distributed produce as shown in Table 12). Slightly more than 90% of both the Intervention and Control groups were equally likely to get their produce at a food pantry or a grocery store. The Control group was significantly more likely to get some produce from friends or family.

Table 13. Summary of where participants got their produce-2014

Q10. Did you or your family eat any of the following fruits or vegetables in the last 4 months? If yes, where do you get each fruit or vegetable?	Intervention Total responses n=573	Control Total responses n=472	P Value
1. Got it here (food distribution)	64.7%	60.2%	.128
2. Grocery store	26.9%	32.2%	.060
3. Farmer's market	5.6%	3.4%	.092
4. Flea market	0%	0.2%	.965
5. Friends/family	0.2%	3.6%	<.001
6. Street vendor	0%	0%	--
7. I grew it	2.6%	0.4%	.005

Likelihood of Buying Specialty Crops

As shown in Tables 14 and 15 among all respondents, they had very similar responses on the likelihood of buying specific produce distributed at the food pantries.

Table 14. Intervention group likelihood of buying produce obtained at pantry, by type of produce. (N=202)

How likely are you to buy any of the following produce in the future?	Very likely	Somewhat Likely	Not likely–too expensive	Not likely–Don't like	Don't know/not sure	Response Count
Cabbage	54%	22%	14%	6%	5%	106
Carrots	71%	18%	10%	1%	0%	68
Cantaloupe	74%	11%	7%	7%	2%	61
Bell pepper	63%	6%	20%	12%	0%	51
Watermelon	57%	10%	22%	2%	10%	51
Tomato	80%	7%	9%	2%	2%	44
Pears	41%	25%	31%	3%	0%	32
Sweet corn	57%	39%	0%	0%	4%	23
Celery	48%	48%	0%	0%	5%	21
Honeydew	22%	22%	44%	11%	0%	9
Overall Likelihood	61%	18%	14%	5%	3%	466

Table 15. Control group likelihood of buying produce obtained at pantry, by type of produce. Control (N=148)

How likely are you to buy any of the following produce in the future?	Very likely	Somewhat Likely	Not likely–too expensive	Not likely–Don't like	Don't know/not sure	Response Count
Celery	65%	16%	12%	6%	1%	99
Cabbage	68%	17%	11%	0%	4%	76
Carrots	65%	19%	10%	5%	2%	62
Pears	60%	19%	11%	6%	4%	53
Tomato	77%	13%	8%	2%	0%	52
Watermelon	61%	23%	16%	0%	0%	44
Sweet corn	50%	33%	0%	8%	8%	12
Cantaloupe	60%	20%	0%	20%	0%	5
Honeydew	60%	20%	20%	0%	0%	5
Bell pepper	100%	0%	0%	0%	0%	1
Overall Likelihood	66%	18%	11%	4%	2%	409

Overall, as shown in Table16, there were no significant differences between the two groups, regarding being very likely or somewhat likely to buy the featured produce.

Table 16. Overall very and somewhat likely of buying featured produce

Response	**Intervention Total response count n=466**	**Control Total response count n=409**	**P Value**
Very Likely	61%	66%	.161
Somewhat Likely	18%	18%	.848
Total	79%	84%	.056

Statistical significance p<0.05.

In addition, among all respondents, there were no significant differences between the two groups, regarding their reasons for not buying the featured produce Table 17).

Table 17. Reasons for Not Buying Featured Produce

	Intervention N=466*	**Control N=409***	**P Value**
Too Expensive	14%	11%	.154
Don't like it	5%	4%	.533
Don't Know/not sure	3%	2%	.323
All three reasons for not buying	22%	17%	.056

*N=total number of responses to question regarding likelihood of buying specific produce. Respondents could choose more than one answer.

Consumption of pantry fresh fruits and vegetables

When asked how much of the fruits and vegetables obtained from their pantry their family ends up eating each month, there were no statistically significant differences across the two groups. Both groups were approximately 95% as likely to consume all or most of the fruits and vegetables they receive from their pantry.

Table 18. Consumption of pantry fresh fruits and vegetables

How much of the fresh FRUITS that you receive from here does your family end up eating each month?	**Intervention**	**Control**	**P Value**
How much fresh fruits consumed?	N=233	N=157	
1=All of it	74.2%	73.6%	.883
2=Most of it	22.3%	20.8%	.712
3=Some of it	3.4%	5.7%	.288
4=None of it	0.0%	0.0%	-
How much fresh vegetables consumed?	N=227	N=157	
1=All of it	72.2%	79.6%	.100
2=Most of it	22.5%	15.9%	.114
3=Some of it	5.3%	4.5%	.606
4=None of it	0.0%	0.0%	-

As shown in Table 19, in terms of food their family did not like to eat, both groups were as likely to take food back to the pantry, give food away, or throw it away. The Control was significantly more likely to not take food they didn't like to eat but the intervention group was more willing to eat all of it – even if their family did not like the produce.

Table 19. What people do with the produce their family does not like to eat.

	Intervention N=215	Control N=153	P Value
1=Not take it	17.2%	31.4%	.001
2=Take but give back to pantry	3.7%	7.2%	.138
3=Give it away to family, friends, or neighbors	39.1%	42.5%	.511
4=Throw it away	7.9%	12.4%	.151
5=Eat all of it	42.3%	16.3%	<.001

Statistical significance p<0.05. . Note: Respondents could choose more than one answer.

APPENDIX B

Year 2: 2015 Results

2015 RESULTS

The CAFB FY15 evaluation plan called for the collection of 200 surveys from both the Intervention and the Control groups. Tables 1 and 2, below, show that the target numbers were achieved. Indeed, as noted in the tables, complete data was collected from 203 Intervention client interviews and 213 Control interviews during the 2015 survey period.

Table 1. CAFB PEP 2015 Intervention Client Interview Survey

Food Pantry	Food Bank	Count
1. Bakersfield New Life Center	Community Action Partnership of Kern County	20
2. Catholic Charities	Community Action Partnership of Kern County	16
3. El Sol Science/Arts Academy of Santa Ana	Second Harvest Food Bank of Orange County	12
4. Fallbrook Food Pantry	Feeding America San Diego	17
5. Immanuel Presbyterian Church	Los Angeles Regional Food Bank	11
6. La Purisima Church	Second Harvest Food Bank of Orange County	24
7. Native American United Methodist Church	Second Harvest Food Bank of Orange County	13
8. Newport Church	Second Harvest Food Bank of Orange County	20
9. Nineveh Outreach	Second Harvest Food Bank of San Joaquin and Stanislaus Counties	13
10. Pentecostal Church in Lamont	Community Action Partnership of Kern County	13
11. People's Self-Help Housing	Food Bank Coalition of San Luis Obispo County	20
12. St. Anne Catholic Church and Shrine	Westside Food Bank	12
13. St. Vincent de Paul Ministry (Modesto)	Second Harvest Food Bank of San Joaquin and Stanislaus Counties	12
Total		203

Table 2. CAFB PEP 2015 Control Client Interview Survey

Food Pantry	Food Bank	Count
1. Anaheim Vineyard Christian Church	Second Harvest Food Bank of Orange County	35
2. Calvary Community Church	Second Harvest Food Bank San Joaquin and Stanislaus Counties	16
3. Isaiah's Sober Living	Community Action Partnership of Kern County	16
4. Islamic Center	Los Angeles Regional Food Bank	24
5. Ramona Food and Clothes Closet	Feeding America San Diego	17
6. Second Baptist Church	Second Harvest Food Bank of San Joaquin and Stanislaus Counties	17
7. SOVA	Westside Food Bank	28
8. Stepping Higher	Feeding America San Diego	16
9. Loaves and Fishes	Food Bank Coalition of San Luis Obispo County	29
10. World of Pentecost	Community Action Partnership of Kern County	15
Total		213

Demographics

Table 3 shows that there were statistically significant differences between the Intervention and Control groups among three of the five racial/ethnic groups. Indeed, half of the interviews among the Intervention group were conducted in Spanish compared to only one-quarter among the Control group. However, the racial/ethnic differences between the two groups are not significant for the purposes of this study, as they share the common experience of being food pantry recipients. There were no significant differences in the mean age of both groups. However, nearly three-quarters of the intervention group households had children under age 18 compared to about half of the Control group. This is not too surprising, given that there were significantly more Latinos interviewed among the intervention group, and that California Latinos have the highest total fertility rate among women of childbearing age[14]. Both groups had virtually the same number of people over age 18 in their home.

Table 3. Demographic profile*

	Intervention N=203	Control N=213	*p* Value
Race/ethnicity			
White/Caucasian	19.1%	32.8%	.024
Hispanic/Latino	69.6%	56.9%	.009
Black/African American	5.7%	6.9%	.624
Native American/Indian	1.5%	4.2%	.091
Asian/Pacific Islander	6.7%	4.4%	.304
Other Demographic variables			
Survey interviews conducted in Spanish	51.1%	26.2%	<.001
Primary language Spanish	60.3%	35.9%	<.001
Female participants	80.0%	71.6%	0.046
Participants' mean age	49.0	50.8	--
Households with children under age 18	70.6%	54.4%	<.001
Total number of children under age 18	338	280	--
Mean number of children per household	1.72	1.33	--
Total number of people age 18 or older	494	496	--
Mean number of people age 18 or older	2.48	2.35	--

Statistical significance p<0.05. *Calculations include adjustments for no responses.

[14] State of California, Department of Public Health, Birth Records. TABLE 2-2. General Fertility Rates, Total Fertility Rates, and Birth Rates By Age And Race/Ethnic Group Of Mother, California, 2010 - 2014. (By Place of Residence). Available at http://www.cdph.ca.gov/data/statistics/Documents/VSC-2014-0202.pdf.

MyPlate Awareness, Knowledge, and Use

By design, participants in the Intervention group were only asked to participate in the survey if they remembered hearing about MyPlate from one of the food pantry educators in the last four months. Therefore, 100% of the Intervention group participants indicated they recalled hearing about MyPlate. By comparison, as shown in Table 4, the Control group was significantly less likely to hear about MyPlate for feeding their family from any source (e.g., WIC clinic, school, etc.).

Table 4. MyPlate awareness

	Intervention N=203	Control N=213	P Value
Remembered hearing about MyPlate from the educators at the food pantry	100%	Not asked	--
Respondents that heard about MyPlate for feeding their family	100%	38.5%	<.001

Statistical significance p<0.05.

MyPlate knowledge

The Intervention and Control respondents were asked what they remembered about how to use MyPlate. The respondents were not prompted with possible answers.

As shown in Table 5, Intervention group was significantly more likely to remember the seven key MyPlate messages compared to the Control group

Table 5. MyPlate knowledge

Question: What nutrition information do you remember about how to use MyPlate for feeding yourself or your family?	Intervention N=203	Control N=213	P Value
9. Did not remember or know how to use MyPlate	11%	6.6%	.111
10. MyPlate is made up of 5 different food groups	50.0%	12.2%	.012
11. Make half your plate fruits and vegetables	51.5%	13.6%	.032
12. Make at least half your grains whole grains	19.5%	8.0%	.001
13. Add lean protein	23%	8.9%	<.001
14. Eat low-fat dairy products	15.5%	6.1%	.002
15. Eat from the 5 food groups throughout the day	25.5%	10.3%	<.001
16. Eat balanced meals or portions	34.0%	12.7%	<.001

Statistical significance p<0.05.

MyPlate Use

With the exception of eating low-fat dairy food, the Intervention group was significantly more likely to have used MyPlate knowledge to prepare more fruits and vegetables for their families and for eating more fruits, low fat dairy, lean meats, whole grains, and balanced meals compared to the Control group.

Table 6. MyPlate use

Question: How have you used MyPlate to prepare food for yourself or for your family?	**Intervention N=203**	**Control N=213**	**P Value**
9. No, I have not used MyPlate	13.1%	68.3%	<.001
10. Prepare more vegetables	58.6%	20.5%	<.001
11. Eat more fruit	46.5%	18.0%	<.001
12. Eat more low fat dairy food	13.6%	8.3%	.085
13. Eat more lean meats	24.2%	7.3%	<.001
14. Eat more whole grains	19.7%	8.8%	0.002
15. Make sure they eat from the 5 food groups throughout the day	21.2%	9.8%	0.001
16. Eat balanced meals/portions	27.3%	1.0%	<.001

Statistical significance p<0.05.

Recipe Card Use

Frequency analysis of recipe card responses found that at least one recipe card was used by each person in the Intervention group. The most commonly used recipe cards were those for cabbage, carrots, sweet corn, sweet potatoes, and broccoli. Overall, among those who received recipe cards, 75% either made the exact recipe, modified or changed the recipe, or did both.

Table 7. Use of recipes by Intervention Group Response among those who got recipe cards

Featured Produce and recipe card	**Got this recipe card (N=199)**	**Made the exact recipe**	**Modified or changed the recipe**	**Made exact recipe and also modified the recipe**	**Did not make/modify recipe**
1. Cabbage	48%	21%	43%	14%	21%
2. Carrots	44%	18%	39%	15%	28%
3. Sweet corn	32%	25%	34%	12%	28%
4. Sweet potatoes	25%	30%	40%	6%	24%
5. Broccoli	22%	22%	50%	11%	17%
6. Summer squash	10%	30%	45%	25%	0%
7. Bell peppers	8%	31%	38%	6%	25%
8. Celery	8%	0%	38%	13%	50%
9. Honeydew melon	8%	25%	31%	19%	25%
10. Tomatoes	8%	33%	33%	0%	33%
11. Pears	6%	58%	17%	0%	25%
12. Watermelon	4%	25%	13%	0%	63%
Average	-	24%	39%	12%	25%

Where Intervention and Control Participants Get Their Produce

Respondents were asked where they got the produce they ate from May through August. In both groups, cabbage and carrots were the most common foods received. Most participants indicated they got their food at a pantry. However, they were also getting produce at grocery stores and some at farmers markets.

Table 8. Where Intervention group got the food they ate, by type of produce. N=203

Where do you get each fruit or vegetable?	Got it here	Grocery store	Farmers' market	Street vendor	Friends /family	Other	Response count per produce
Cabbage	77%	44%	5%	0%	3%	11%	133
Carrots	85%	41%	5%	1%	6%	11%	130
Sweet corn	72%	44%	6%	1%	9%	3%	90
Sweet potatoes	76%	29%	2%	0%	6%	3%	63
Broccoli	75%	47%	8%	0%	4%	2%	53
Honeydew melon	71%	35%	6%	12%	9%	3%	34
Pears	58%	42%	0%	0%	0%	3%	31
Celery	53%	53%	0%	0%	0%	10%	30
Tomatoes	64%	64%	16%	0%	0%	20%	25
Bell peppers	21%	67%	13%	0%	0%	8%	24
Summer squash	75%	29%	0%	0%	0%	13%	24
Watermelon	100%	23%	0%	8%	0%	0%	13
Average	55%	32%	4%	1%	3%	6%	650

Note: Participants could choose more than one response

Table 9. Where Control group got the food they ate, by type of produce. N=212

Where do you get each fruit or vegetable?	Got it here	Grocery store	Farmers' market	Street vendor	Friends /family	Other	Response count per produce
Carrots	79%	49%	3%	1%	3%	4%	190
Cabbage	65%	45%	2%	0%	1%	3%	137
Broccoli	62%	52%	2%	1%	3%	5%	99
Sweet corn	81%	33%	2%	0%	0%	3%	58
Celery	50%	58%	8%	0%	2%	6%	48
Tomatoes	85%	79%	8%	0%	2%	2%	48
Sweet potatoes	87%	43%	4%	0%	0%	2%	47
Bell peppers	42%	51%	2%	2%	4%	4%	45
Pears	44%	44%	6%	11%	0%	0%	18
Watermelon	100%	0%	0%	0%	0%	0%	5
Honeydew melon	0%	0%	100%	0%	0%	0%	1
Summer squash	0%	0%	0%	0%	0%	0%	0
Average	54%	38%	3%	1%	2%	3%	696

Note: Participants could choose more than one response

Summary of where Participants Get Their Produce

The Intervention and Control groups were equally likely to get their produce at a food pantry. The control group was significantly more likely to get produce at a grocery store and from friends and family than the intervention group.

Table 10. Summary of where participants got their produce

Did you or your family eat any of the following fruits or vegetables in the last 4 months? If yes, where do you get each fruit or vegetable?	Intervention total responses for all locations	Control total responses for all locations	P Value
1. Got it here (food distribution)	55%	54%	.843
2. Grocery store	32%	38%	.006
3. Farmer's market	4%	3%	.291
4. Street vendor	1%	1%	1.0
5. Friends/family	3%	2%	.016
6. Other	6%	3%	.003

Above measurements are based on a proportion of the total responses to each of the featured fruits and vegetables located in this question (same produce as those shown in Table 7).

As noted in Table 11, among both the Intervention and Control groups, carrots, cabbage, broccoli, sweet corn, and sweet potatoes were the produce items most commonly obtained from a pantry.

Table 11. Produce most commonly obtained from pantry

Fruits and vegetables received by all survey participants from their pantry ("Got it here" response)	**Intervention N=203**	**Control N=213**
1. Carrots	56%	74%
2. Cabbage	51%	45%
3. Broccoli	20%	30%
4. Sweet corn	33%	22%
5. Sweet potatoes	25%	10%
6. Celery	8%	12%
7. Tomatoes	8%	19%
8. Bell peppers	3%	9%
9. Pears	9%	4%
10. Honeydew melon	12%	0%
11. Summer squash	9%	0%
12. Watermelon	6%	2%

Likelihood of Buying Produce Obtained at Pantry and Use of Produce

When asked how likely they were to buy their pantry's featured produce in the future, Tables 12 and 13 show that, across all types of produce, both groups were almost equally very likely and somewhat likely (~81%) to buy produce they obtained from their pantry. Indeed, there was no statistically significant difference in the likelihood of buying produce (p=.264). The most commonly chosen produce for purchase was cabbage, carrots, sweet corn, broccoli, and sweet potatoes.

Table 12. Treatment group likelihood of buying produce obtained at pantry, by type of produce. (N=201)

	Very likely	Somewhat	Not likely–too expensive	Not likely–Don't like	Not likely I can get it at pantry	Not likely other reason	I don't know	Response Count
Cabbage	62%	18%	5%	3%	8%	1%	4%	132
Carrots	55%	20%	5%	3%	11%	1%	5%	128
Sweet corn	67%	15%	1%	1%	9%	1%	6%	89
Sweet potatoes	52%	18%	3%	8%	10%	0%	8%	61
Broccoli	83%	15%	0%	0%	2%	0%	0%	54
Honeydew melon	56%	12%	3%	6%	15%	3%	6%	34
Celery	63%	23%	0%	3%	7%	0%	3%	30
Pears	73%	20%	0%	0%	0%	3%	3%	30
Bell peppers	68%	20%	0%	8%	4%	0%	0%	25
Tomatoes	64%	16%	4%	0%	8%	8%	0%	25
Summer squash	52%	13%	9%	4%	17%	0%	4%	23
Watermelon	23%	31%	15%	0%	23%	8%	0%	13
Total	62%	18%	3%	3%	9%	1%	4%	644

Table 13. Control group likelihood of buying produce obtained at pantry, by type of produce. Control (N=212)

	Very likely	Somewhat	Not likely–too expensive	Not likely–Don't like	Not likely I can get it at pantry	Not likely other reason	Response Count
Carrots	64%	20%	4%	6%	7%	0%	190
Cabbage	49%	29%	4%	11%	6%	1%	140
Broccoli	64%	19%	9%	2%	4%	2%	99
Sweet corn	72%	9%	3%	2%	14%	0%	58
Sweet potatoes	63%	14%	0%	6%	12%	4%	49
Celery	54%	29%	8%	8%	0%	0%	48
Tomatoes	92%	4%	4%	0%	0%	0%	48
Bell peppers	51%	27%	9%	9%	2%	2%	45
Pears	29%	53%	0%	18%	0%	0%	17
Watermelon	100%	0%	0%	0%	0%	0%	5
Honeydew melon	67%	0%	0%	0%	33%	0%	3
Total	61%	21%	5%	6%	6%	1%	702

When the four reasons for not buying certain fruits or vegetables distributed at a pantry are combined, overall there were no significant differences between the two groups. However, when responses are analyzed by each possible response category, the control group was more likely to not buy some produce because they did not like it.

Table 14. Reasons for Not Buying Featured Produce

	Intervention N=644*	Control N=702*	P Value
Too Expensive	3%	5%	.179
Don't like it	3%	6%	.006
Can get at pantry	9%	6%	.056
Other reasons	1%	1%	.669
All four reasons for not buying	16%	18%	.308

*N=total number of responses to question regarding likelihood of buying specific produce.
Note: Respondents could choose more than one answer. *Statistical significance* $p<0.05$.

When asked what they do with the fruits and vegetables obtained from their pantry, the control group was significantly more likely to eat all of the produce compared to the intervention group. However, the control group was more likely to throw away produce that spoiled or expired. There were no significant differences in giving food away, freezing the produce, or preserving the food, between the two groups.

Table 15. What people do with the produce they obtain from their pantry

	Intervention N=200	Control N=213	P Value
1=Eat all of it	74.5%	86.3%	.003
2=Give some to friends, other family, or neighbors	34.5%	43.6%	.059
3=Freeze some if it raw	18.5%	24.2%	.161
4= Cook and preserve or freeze some if it	22.5%	29.9%	.090
5=Throw some of it away if it spoils or expires	12.5%	20.9%	.023

Statistical significance $p<0.05$. Note: Respondents could choose more than one answer.

APPENDIX C

Year 2 and 3: Lesson Tracking Results

LESSON TRACKING RESULTS

Data were collected during two periods across 13 months. First between February 2015 and May 2015 and subsequently between September 2015 and March 2016. A total of 11 months' worth of data were collected from 20 different pantries. Data were not collected in June, July, and August as no PEP lessons were offered due to PEP evaluation activities occurring during those months. Optimally, across the 20 pantries and 11 months, they could have reported a total of 220 months in which lessons were taught. However, lessons were taught in 114 (51.6%) out of the possible 220 months due to staffing limitations and weather conditions, among other factors (please see Key Informant section of this report for additional information).

Table 1. CAFB PEP 2015-2016 PEP lesson tracking participants and number of months lessons taught

Food Pantry	Associated Food Bank	Months lessons taught	Months not taught
7th Day Adventist	Community Action Partnership of Kern County	4	1
Bakersfield New Life Center	Community Action Partnership of Kern County	10	1
Catholic Charities Bakersfield	Community Action Partnership of Kern County	10	1
El Sol Science/Arts Academy of Santa Ana	Second Harvest Food Bank of Orange County	2	4
Fallbrook Food Pantry	Feeding America San Diego	10	1
First Unitarian Church	Los Angeles Regional Food Bank	8	2
Grace Resources	Los Angeles Regional Food Bank	5	0
Immanuel Presbyterian Church	Los Angeles Regional Food Bank	7	0
La Purisima	Second Harvest Food Bank of Orange County	11	0
Native American United Methodist Church	Second Harvest Food Bank of Orange County	10	1
Newport Church	Second Harvest Food Bank of Orange County	4	0
Nineveh Outreach	Second Harvest Food Bank of San Joaquin and Stanislaus Counties	4	2
Pentecostal Church in Lamont	Community Action Partnership of Kern County	4	0
People's Self-Help Housing	Food Bank Coalition of San Luis Obispo County	8	0
Salvation Army	Food Bank Coalition of San Luis Obispo County	1	3
San Marcos	Feeding America San Diego	3	2
St. Anne Catholic Church	Westside Food Bank	5	3
St. Joseph's Center	Westside Food Bank	1	6
St. Vincent de Paul (Modesto)	Second Harvest Food Bank of San Joaquin and Stanislaus Counties	5	3
World of Pentecost	Community Action Partnership of Kern County	2	0
Total		114	30

The PEP educators were consistent at delivering the MyPlate 5 food groups and making half your plate fruits and vegetables messages. They also linked their lessons to the monthly featured specialty crop and the recipe cards. Only 8 of the 20 pantries were able to provide food tasting or sampling. Some of them also engaged the clients in sharing ideas for making healthy foods appealing.

Table 2. PEP MyPlate lesson components taught by pantry educators.

Q4. Which of the following PEP MyPlate lesson components did you teach in February? (choose all that apply)	Count	Percent
1. MyPlate is made up of 5 food groups: fruits, vegetables, grains, protein, and dairy	86	75.4%
2. Make half of your plate fruits and vegetables	83	72.8%
3. Had clients use interactive MyPlate poster to create a healthy meal	58	50.9%
4. Encourage clients to try the fruit or vegetable and the recipe talked about in the PEP lesson	61	53.5%
5. Distributed fruit or vegetable recipe card with lesson	91	79.8%
6. Provided fruit or vegetable tasting/sampling	16	14.0%
7. Other	2	1.8%

Respondent comments:

- *"Exchanged recipes; talked interactively with the children and their parents."*
- *"Cut up eggplant in little pieces so everyone could see what they could do with it and if it tasted good; a lot of people didn't know what to do with eggplant."*
- *"Shared recipes with each other in the group; talked with the children and young adults about eating fruits and vegetables."*
- *"Since we were doing a lesson on celery, we talked about using celery for healthy snacks and had celery sticks with peanut butter and cream cheese, a gluten free cheese spread and a gluten free low calorie ranch dip."*
- *"Encouraging clients to use fruits for snacks for children and adults instead of pastries and candy."*

Despite intending a uniform implementation across sites at the outset, due to unique circumstances at intervention sites PEP lessons were delivered in a variety of ways. As shown in Table 3, three quarters (78%) of PEP lessons were done in a food distribution line: a little more than half outdoors and one-quarter indoors. In addition, three-quarters of the lessons were conducted in groups of 4 to 7 (39%) and in groups of more than 7 (35%). The indoor lessons were most commonly conducted in food distribution lines with 1 to 3 clients at one time (68%). Ninety percent of all outdoor food distribution line lessons were conducted in groups of 4 or more people.

Table 3. PEP lesson delivery methods

	Q6. Usually, about how many people were taught the lesson at a time this month?						
Q5. Where the lessons were delivered this month?	1 client at a time	2 - 3 clients at a time	4 - 7 clients at a time	> 7 clients at a time	Other	Total	Percent
Clients in the food distribution line OUTDOORS	1	4	41	16	1	63	55%
Clients in a classroom-type setting OUTDOORS (in rows or circle of chairs?)	0	0	0	6	1	7	6%
Clients in the food distribution line INDOORS	7	14	4	2	0	27	23%
Clients in a classroom-type setting INDOORS (in rows or circle of chairs?)	0	0	0	15	1	16	14%
Other	0	0	0	1	1	2	2%
Total	8	18	45	40	4	115	
Percent	7%	16%	39%	35%	3%		

Respondents' comments:

- *"Taught indoors, but in plenary format (30-40 people at once)."*
- *"We ask 30 people to attend each lesson."*
- *"People are in line and then we pull them out of line to talk for a few minutes -- we ask if anyone would like to participate in the lessons."*
- *"The only problem that we have encountered recently is trying to get the lessons to the Russian people who have started to attend our Food Bank and attend our weekly distribution. It has become a problem due to the language barrier."*
- *"We have a patio where the classes take place but we do not provide chairs. The clients stand in a semi-circle facing the food chart and the educator speaks to them from her place next to the chart."*

Each month, respondents were asked to approximate the number of total people that heard the PEP lessons in a specific month. Sixty-five responses (57%) out of a possible 114 were received from the pantries. The results ranged from 10 clients to 650 with a monthly mean of 198 clients. In total, 12,871 people were reached by the lessons across the cumulative 65 months of data.

Among the 20 pantries that reported conducting PEP lessons, 20 distributed specialty crops. All of the featured specialty crops were distributed at least four times (i.e., watermelon), with the two most commonly distributed items, cabbage (43 times) and carrots (32 times), accounting for 35% of 15 produce items distributed. Nine of the eighteen pantries accounted for 83% of all produce distributed.

Among the 199 times in which recipe cards were distributed, on 20 occasions cards were distributed without a matching fruit or vegetable. However, 82% of the distributed specialty crops at these sites were accompanied with a matching recipe card. Less than 4% of distributed specialty crops were sampled or tasted.

Table 4. PEP lesson delivery methods and use of recipe cards

Specialty crop and recipe card	Pantry distributed this fruit/vegetable	Clients got this RECIPE CARD during lesson	Clients got a SAMPLING of this fruit/vegetable but NOT the exact recipe	Clients got a TASTING of this EXACT recipe
Cabbage (coleslaw recipe)	43	36	0	1
Carrot (vegetable stir-fry recipe)	32	18	1	0
Sweet potatoes (baked sweet potato fries recipe)	17	18	0	1
Tomato (egg sandwich recipe)	16	12	0	0
Celery (tuna salad sandwich recipe)	15	13	1	0
Winter squash (winter squash with beans recipe)	15	17	1	1
Sweet corn (corn and pepper salad recipe)	13	14	0	1
Pear (baked pear dessert recipe)	13	9	2	0
Broccoli (vegetable stir-fry recipe)	12	9	1	0
Bell pepper (roasted bell peppers and beans recipe)	9	12	0	0
Cauliflower (pasta with cauliflower recipe)	9	4	0	0
Cantaloupe (smoothie recipe)	7	11	0	0
Honeydew melon (smoothie recipe)	7	11	2	0
Summer squash (sautéed summer squash recipe)	6	7	0	0
Watermelon (watermelon salsa recipe)	4	8	0	0
Total	218	199	8	4

As shown in Table 5, most (82.5%) of the PEP lessons were conducted in one day each month. The remainder were conducted over two or more days[15] each month. Some pantry respondents commented that they also distributed kale, red potatoes, and oranges.

Table 5. Number of days PEP lesson were delivered by type of lesson

PEP Lesson	1 day	2 days	3+ days	Total	Percent
Cabbage	37	2	3	42	17.5%
Carrot	19	2	2	23	9.0%
Sweet potatoes	14	1	0	15	6.6%
Winter squash	13	3	0	16	6.2%
Bell Pepper	10	2	0	12	4.7%
Celery	10	2	2	14	4.7%
Pear	10	0	0	10	4.7%
Tomato	10	3	2	15	4.7%
Honeydew melon	9	0	0	9	4.3%
Broccoli	8	0	2	10	3.8%
Sweet corn	8	3	2	13	3.8%
Cantaloupe	6	0	1	7	2.8%
Watermelon	6	0	0	6	2.8%
Other	6	1	2	9	2.8%
Cauliflower	4	1	0	5	1.9%
Summer squash	4	0	1	5	1.9%
Total	174	20	17	211	
Percent	82.5%	9.5%	8.1%		

[15] CAFB stopped collecting lesson tracking forms in April 2016. Afterwards, PEP lessons for kale and oranges were developed and distributed.

APPENDIX D

Year 3: Key Informant Interview Results

FOOD BANK INTERVIEW SUMMARY

Evaluation Methods:

Two sets of interview questions were developed to identify best practices and lessons learned that could be used by any agency wishing to replicate the California Association of Food Banks (CAFB) Produce Education Program (PEP). The questionnaires targeted key informants at participating food banks, and food pantries. The interview questions were developed by Perales and Associates Evaluation Services in collaboration with CAFB.

Interviews with key informants were conducted in April and May of 2016. Six food banks were contacted to request a phone interview. Twenty-three food pantries were contacted for interviews. Among the 23 food pantries, 21 staff/volunteers from 20 pantries agreed to be interviewed (one pantry had two persons).

Key informants from the food banks included staff members with direct experience with PEP, including food bank directors, assistant directors, and food bank staff that coordinate regularly with food pantries. Key informants from the food pantries included pantry directors, food procurement staff, and pantry volunteers. Typed notes were taken during each phone interview. Interview transcripts are available upon request. Data were analyzed for key themes. The findings are summarized below by interview question.

Qualitative Response: Food Banks: n = 6

Question 1: ***What was your role with the PEP project and the food pantries affiliated with your food bank?***

The food bank respondents included food bank directors, agency coordinators (also referred to as liaisons-which are staff that have regular contact with the food pantries tied to that food bank), and one food solicitor. The respondents' role with the PEP project included identifying the best pantries for PEP, promoting the PEP program at pantries, routine correspondence with pantry sites regarding PEP, coordinating the produce with the lessons, supporting the pantries in implementing PEP, scheduling the PEP trainings, and administering PEP evaluations.

Question 2: ***What Challenges did your food bank experience in implementing PEP?***

Key Themes
Limited Resources
Pantry Adaptation

The analysis of the qualitative data for question two generated two major themes: *Limited Resources* and *Pantry Adaptation*. Half the respondents stated that agency buy in was a challenge due to various factors. For example, it was challenging for pantries with limited volunteer support to send a representative to participate in the PEP educator training. Enlisting volunteers to conduct the PEP education was a challenge for some food pantries and that would carry over to the food bank, who would step in to assist their pantries with recruitment. A few respondents indicated that pantries struggled with ongoing volunteer motivation, limited time commitment to the agency (such as university interns), and lack of stipends to compensate volunteers for conducting PEP. Additionally 2 out of 6 food banks stated that volunteers found the lessons were repetitive. One pantry had lack of access to translators or appropriate translation of PEP material into Russian and Korean, which constitute a large percentage of their client population.

Resource issues at the food banks affect the pantries. Two food banks indicated they struggle with getting the produce out to the pantries due to multiple factors, including variability in supply from Farm to Family, drought, and other supply issues. Two additional respondents further indicated the importance of a regular supply of produce. Supply issues created delayed communication with pantry sites, leading to challenges for the pantries in coordinating the lesson with the produce.

The second theme involved identifying and adapting a pantry to support PEP implementation. Thirty-three percent (2 out of 6) of food banks indicated the importance of identifying a pantry that had enough space to conduct PEP in the distribution line without disrupting the food distribution. If this was not possible, some pantries created a separate space to conduct PEP outside the line. Assessing pantries for these elements and helping pantries set up the distribution to incorporate PEP, ensured more successful client participation. One urban site had space limitations, making classroom style lessons conducted outside the line more optimal. Rural sites had longer lines, making lessons taught in the distribution line sometimes more effective. Competing priorities occur at distribution sites, such as client registration, other nutrition education - such as County Health Department or university-led nutrition campaigns – and other services including legal aid. Additionally, one food bank is transitioning their pantries towards a new distribution model called the Choice Model. This involves creating a supermarket-like environment where clients "shop" in the pantry and eliminates distribution lines. Volunteers' efforts are put towards stocking and maintaining the shelves, limiting their availability to conduct PEP. This transition is just beginning at the West Side Food Bank which has three participating pantries. The client benefits with this model, suggesting that other food banks may be transitioning to this in the future which could impact how PEP is delivered.

Question 3: ***How did you overcome the challenges? n = 6***

Three themes regarding overcoming challenges in implementing PEP included *communication, technical assistance* and *flexibility* in adapting PEP to a particular pantry, or changing the pantry to provide a better fit for PEP. Fifty percent of food bank respondents mentioned that it was critical to have clear communication with food pantries in advance regarding the type and quantity of the produce available so that the pantry could prepare to implement PEP. Several food banks stated the importance of meeting on site regularly with pantry staff, to provide guidance and support on implementing PEP. Two pantries opted to scale back to bi-weekly or monthly PEP lessons to avoid repetition with the same clients, or the same produce.

Key Themes
Communication
Technical Assistance
Flexibility

Food bank staff provided technical assistance to pantry staff as needed, updating volunteers regarding PEP training, and addressing other site specific concerns such space or crowd control issues. They indicated it was important to ask pantries what specifically they needed to make PEP successful. In some cases the location of the food distribution needed to change in order to improve PEP. This meant that food bank staff had to identify an alternate location for food distribution to ensure that PEP was successful. Some food bank staff members helped pantries to identify volunteers to implement PEP. Food bank staff mentioned that one urban location needed more support from CAFB regarding translation of educational materials into Russian. One pantry, with help from CAFB, reproduced the MyPlate board as a laminated handout since it was a pantry with a registration booth and no distribution line. They suggested that CAFB consider creating MyPlate handouts as an option for pantries that might find it useful. Two respondents suggested that the food banks themselves provided the volunteers specifically to implement PEP evaluations at the pantries, since pantry volunteers are often over-committed.

Respondents reported that it was important to allow for flexibility in implementation of the PEP program, depending on the uniqueness of the pantry and existing pantry resources. Food banks and pantries utilized a number of different strategies to ensure the success of PEP, including selecting a different distribution site altogether, moving the lesson away from the line into a small group setting, and providing more space so as not to impede the movement of the distribution line but to still allow for PEP to be implemented. One food bank used its own mobile pantry to control the logistics of implementing the PEP lessons, and in another instance, it was easier for the pantry to adapt PEP to only hand out the recipe cards with the corresponding produce. At the sites where produce samples or recipe tastings were distributed, PEP was well-received. Respondents reported that only a few sites have kitchens or refrigeration that is adequate to keep the produce fresh over a number of days. Finally one site had tremendous success by setting up the PEP lesson near the exit with a very colorful display table which drew clients to the PEP education as they were exiting the site.

Question 4: ***Did any of your member food pantries that signed up for PEP drop out? If yes, do you know why?*** **and Question 5:** ***Are you aware of any other challenges encountered by your food pantries in implementing PEP?***

The overarching themes from analyzing the qualitative data from question 4 and 5 include *resources* and *existing beliefs and perceptions* about nutrition. Of the participating food pantries, one pantry quit after one year but the reason was not specified. One stopped offering the PEP lessons and became a control site. One location did not work for conducting PEP so the food bank changed locations and the new location was more successful. Still another pantry stopped conducting lessons but continued to distribute recipe cards with the produce. And another pantry had a waiting room distribution model with no distribution line. This pantry also had other services being offered at the same time as PEP which drew people away from the PEP lesson. Regarding resources, 50% of food banks surveyed indicated that pantries did not have the ability to commit volunteers on an ongoing basis. There were volunteers willing to conduct PEP a few times, but not over a period of months or years. Additionally, finding bilingual volunteers was a challenge. Other resource issues involved the pantry sites themselves. Two out of six food banks stated that the pantries were too small which made them not conducive for PEP, and the lesson interfered with the distribution process. One food pantry had no line, but had a booth which was not successful. There were many competing activities at the site, such as a legal aid and government benefits booths. Another site handed out recipe cards and did a short lesson at intake. One site had extremely long lines which made it important to shorten the lesson so that more clients could participate in PEP. At least one food bank mentioned that their pantry did not have a kitchen which made preparing recipe tastings impossible, and simple cut up produce samples difficult.

In two different pantries, food bank staff identified that there was a perception by pantry volunteers that nutrition should not be an important priority in the food distribution setting. Additionally, some aspects of the PEP curriculum were not fitting for all food pantry clients. In one instance the population of the pantry was more elderly and they found the lesson too simplistic. In this case it made more sense to have a conversation with clients about nutrition to get their ideas, rather than utilize the MyPlate board. In another instance at a site with a large population of first generation Koreans, the material and method of education was not culturally appropriate. The food bank coordinator learned after interviewing a Korean volunteer that in the first generation Korean population, knowledge and behavior about nutrition had been influenced by cultural norms in their home country. They felt they had a deep knowledge of these nutrition concepts and that the lessons were not appropriate. Further, the elderly Koreans would not want to engage in a lesson taught by a younger volunteer.

Question 6: *What do you feel was successful about PEP? n = 6*

An overarching theme in response to question 6 was that implementing PEP has *contributed to the mission of participating organizations* through *building agency capacity* and *increasing the knowledge and skills* of the population they serve. Regarding the food banks' mission, conducting PEP means the pantries are asking for more produce, which makes it easier for the food bank to provide more produce to the communities. Additionally there is the perception by food bank representatives that they are introducing a healthy way of eating that will reach a lot of people and help with chronic illness.

One food bank liaison noted that PEP engages pantries with no previous exposure to nutrition education. Food banks and pantries have the opportunity to offer high quality educational materials. Another food bank reported using the PEP recipe cards in other nutrition education settings with good success.

It was mentioned that recipe cards were discarded at a pantry that did not offer the PEP interactive education and recipe tasting as compared with a site that did. Respondents indicated that combining program elements including produce sampling, lessons, recipe cards, and the interactive board contributes to the effectiveness of PEP. According to one food bank liaison, PEP is more comprehensive as compared to nutrition education offered by the county Health Department, which often only uses handouts. This liaison stated in the interview: "This is such a good tool. I love and hope it is successful in other counties. Even if I hit 20% of the pantry clients I would be ecstatic. I hope that it will grow and grow. Each month people are more and more tuned into [PEP]. Cooking sessions work but don't bring as many people. The resource center has recipes but not visuals or trainings. [PEP] has it all." Many of the food banks hope to reduce disease in the populations they serve. Increasing nutrition knowledge and access to fresh food is seen by survey participants as a way to support their food bank's mission. Sixty-seven percent of food banks were pleased with the utility of the recipe cards and stated they were accessible, colorful, appealing, low-literacy and available in Spanish. They noted that clients enjoy the cards and take them home. Additionally, respondents reported that some volunteer peer educators stated that by participating in PEP, they are becoming more knowledgeable about nutrition, leading to their own personal behavior change. Respondents mentioned that matching produce with educational material allows clients to be exposed to new fruits and vegetables and healthy food preparation practices. Clients appreciated the food samples and the opportunity at some sites to taste actual recipes.

Question 7: ***What else could California Association of Food Banks (CAFB) have done to support your program?*** **and Question 8*: What information or materials would your food pantry need to continue to conduct PEP without the support of CAFB?***

Key Themes
Technical Assistance
Additional Resources

The themes from questions 7 and 8, include the need for *technical assistance* and *additional resources*. Regarding technical assistance, two food banks indicated the importance of allowing for flexibility at each pantry, to address specific needs and requirements of that location. The food banks asked for several additional areas of support, including regular site visits by CAFB staff and instruction on how to continue in PEP long term, including incorporating new nutrition curriculum through PEP. One respondent asked that PEP include mandatory trainings and follow-ups from CAFB staff. Fifty percent of food banks insisted that ongoing training by CAFB would address challenges in implementing PEP due to staff and volunteer turnover at pantries. One respondent suggested an online training module for food bank or pantry volunteers that want to conduct PEP at their pantries or for participating food banks and pantries to train new volunteers. Finally, training in program evaluation could be used at the food banks for agency planning and reporting purposes.

Resources were requested in three different forms: educational materials, stipends or small grants, and additional produce. Half of food bank respondents indicated the importance of the recipe cards, including new or updated recipe cards. One responded asked to reproduce the MyPlate information as a laminated card to hand out, and/or make the MyPlate board a smaller size so that it could be used in various settings if only one volunteer was available and there was no cart or place to put the board. Another food bank liaison requested website updates including a client portal which could reinforce the PEP lesson and would include updated PEP material in different languages, online recipes, and an interactive area for children.

Some food pantries need support to recruit and retain volunteers. Small grants or stipends for volunteers was suggested, which would generate more interest at the pantries. One food bank liaison asked that CAFB consider providing more refrigeration units as an incentive at pantry sites for participating in PEP, since they often do not have any refrigeration space.

Half of respondents indicated that there was a need to increase the variety and quantity of produce. This would insure that the lessons at the pantries were varied, and that there was enough produce for all clients that want to participate in the PEP lesson.

Question 9: ***What advice would you give to your peers if they were thinking about implementing the PEP program?***

Two main themes for question 9 were captured in respondents' comments and reflect priorities regarding what food bank staff would recommend to peers that want to implement PEP. These themes include *program planning, implementation, evaluation* and *marketing*. There were a variety of suggestions for program planning, including the importance of understanding your food bank's priorities and what PEP specifically has to offer in order to address these priorities. Understanding the PEP program requirements from a food bank and pantry resource perspective, and understanding the timeline and so you can plan and budget accordingly. One respondent indicated the importance of dedicating the Agency Coordinator at the food bank to run PEP. It was clear from the interviews conducted by PAES that all of the participating food banks did this. This staff person needs to garner support, identify the best sites to conduct PEP, insure training is conducted for volunteers, order and disseminate recipe cards, help pantry staff with PEP implementation, and administer PEP client evaluations. One food bank representative estimated that for planning purposes, the volunteer time to administer PEP is about 2-3 hours per week. This respondent indicated that as the program was implemented over time, it became easier.

Regarding program implementation, 50% of respondents indicated that it is important to coordinate produce procurement and availability at the warehouse with the timing of the PEP lesson to be sure that the pantry picks up the correct type and sufficient amount of produce to conduct PEP. The more coordination done in advance with pantries, the greater the likelihood of PEP success. One food bank found it was necessary to supplement produce from other venues to match the recipe cards and to ensure variety in the PEP lessons. Food bank liaisons indicated it was important to allow sufficient time for pantries to adopt and adapt PEP in order to ensure its success.

Lastly, food banks need to dedicate volunteers to conduct program evaluation at the pantries. Pantries may not have the capacity to do this and considerations should be made regarding the timing of evaluations in order to avoid competing events, lack of volunteer capacity, time, and other resources at pantry sites.

There were several suggestions made regarding the importance of marketing PEP to other food banks. One respondent suggested promoting PEP to other pantry volunteers besides the director in order to find the right volunteer within the pantry that will be enthusiastic about implementing PEP. Another suggested visiting other food banks to promote PEP. Moreover, one food bank suggested reminding food bank staff and pantry volunteers that PEP is an avenue to address high rates of chronic disease by getting produce out to communities.

Another respondent includes marketing at quarterly agency partner meetings and other meeting opportunities where food bank staff can educate about the importance of nutrition education. One food bank successfully brought recipe tastings to the pantry location, resulting in the pantry joining PEP after seeing their clients' enthusiastic response.

One food bank noted that Farm to Family works well with PEP as they are mutually supportive. The respondent recommended making PEP a mandatory aspect of participating in Farm to Family and stated that *"If pantries hand out produce it is critical to have the nutrition education to go along with it". - Kirsten Salas, Second Harvest Food Bank of San Joaquin & Stanislaus*

"If you have good enthusiastic coordinators and [the food bank] can choose the correct site, the program will take off." - Maureen Andrews, Community Action Partnership of Kern County

Question 10: ***Do you have any additional comments*?**

The themes for this question were *mission enhancement* for food banks through improved organizational capacity, as well as *future opportunities* to partner with agencies to expand nutrition education and improve health in their communities.

Regarding enhanced capacity to support the food bank's mission, one liaison reported that after attending three trainings offered by CAFB, she felt comfortable in training volunteers in PEP curriculum. Respondents indicated that PEP supports the food banks' missions through ensuring increased access and consumption of fresh food in in the community and increasing clients' experience and knowledge about nutrition with the potential to improve health outcomes.

"We are attacking obesity and unhealthy issues in Kern County. The Produce education Program is really nice because we give the produce. At the other facility they have recipe cards but without the education. PEP is more tangible. "- Maureen Andrews Community Action partnership of Kern County

"It has been a good experience helping pantries reach families, and to support these agencies in achieving their goals." - Kelsey Ellis, Feeding America San Diego

"I have been working at the food bank for a year. Of all the programs this one seems to have the biggest impact." - Maureen Andrews, Community Action Partnership for Kern County

"The [PEP] recipe cards are the best cards I have ever seen. And we have seen a lot." - Kirsten Salas, Second Harvest Food Bank of San Joaquin & Stanislaus

One agency indicated that limited but ongoing support for food banks from CAFB is necessary to ensure the success of PEP. The model needs to be adapted to individual pantries. The respondent was concerned with how food banks would be able to continue to implement PEP given that the program is resource-intensive for pantries.

Regarding future directions, one respondent stated "I would like to see the program grow and expand its name recognition." Another food bank expressed interest in using PEP to partner with nutrition education programs at universities. This might allow for PEP materials to be used during other nutrition education opportunities in partnership with other agencies.

Food Pantry Interview Summary

Pantry Interview Results. Respondents: N=21.

Question 1: ***What is your role with the food pantry?***

Of the 21 pantry respondents, 6 identified themselves as pantry directors or coordinators. There was one assistant director, 4 volunteers, one food distribution coordinator, and one warehouse manager. The rest of respondents did not specify their role.

Question 2: ***Did you conduct PEP lessons at your food pantry in the past 12 months?***

There were 21 respondents. In the past 12 months, 3 did not conduct PEP and 18 conducted PEP.

Non-Participating Food Pantries

Respondents from three pantries that did not participate in PEP in the past 12 months were interviewed to determine the challenges they experienced that caused them to drop out of PEP. Below is a summary of their responses.

Question 3***: What challenges did you encounter that interfered with conducting PEP?***

Key Themes
Lack of volunteers
Pantry Capacity
Cultural Norms/ Perceptions

Two pantries noted they had a lack of volunteers. One pantry had difficulty finding volunteers that represented the ethnic population served by the food pantry. Another pantry noted that the volunteers want to work in food preparation and not in the emergency box food program. In the emergency food box program the volunteers are needed for the intake process.

One pantry stated that it would need to be organized to implement PEP and their pantry does not have that level of sophistication. The pantry has large groups of clients to serve in a three hour period and volunteers are overtaxed with food distribution. Another pantry did not think the PEP format worked well in their location. Their current outreach is workshop based. According to the respondent, clients are reluctant to engage in PEP while waiting for food. The respondent stated they might be more comfortable with a nutrition lecture.

One pantry stated that it has five ethnic congregations and PEP is not a good fit for all populations and the immigrant populations have fewer poor eating habits. The pantry also stated that the Filipino population likes the pantry for the social aspect and their nutritional knowledge is deep, so they might not be willing to engage in PEP.

Question 4: ***What could PEP or your affiliated food bank have done to make your PEP program work?***

Overall, two out of 3 respondents that did not conduct PEP in the past year asked for volunteer support. Additional comments from pantries that did not participate in PEP in the past 12 months included the suggestion from one pantry to rotate staff from the food bank or provide a stipend for a pantry volunteer to conduct PEP. One respondent is considering contacting the local university to find an intern that is bilingual to conduct PEP but is concerned that interns may not available during the summer. In addition, one pantry respondent mentioned that another organization they already worked with could provide a stipend or grant for one volunteer to go to 4-5 local food pantries to conduct PEP. The two other respondents asked that PEP or their food bank provide a committed volunteer. And one pantry asked for PEP to provide alternative training for their pantry volunteers to teach nutrition in a classroom with a lecture format.

Question 5: ***Do you have any additional comments?***

One respondent stated that they like PEP and the materials but that their clients were not responsive to the interactive lesson. Clients liked the produce but did not want to interact. In this instance the clients were given the recipe cards with the produce. Additionally, they liked the recipe tasting and the recipe cards but not the MyPlate board. One respondent noted that it is wonderful the food banks are moving in the direction of providing fresh produce due to the health benefits for clients.

Participating Food Pantries

Qualitative data analysis for food pantries that conducted PEP in the past 12 months. n=18.

Question 1: ***Who did the PEP education at your food pantry?***

Of the 18 respondents, three indicated that PEP was conducted by food pantry staff and 13 stated that PEP was conducted by volunteers. Two respondents did not answer.

Question 2: ***How were the educators trained?***

Twelve educators were trained by CAFB. One educator indicated they received training by CAFB and food bank staff, three educators were trained by food bank staff, one educator was trained by pantry staff, and one respondent did not specify.

Question 3: ***Overall, how well did you think the PEP program operated at your food pantry?***

Respondents were asked to rate how PEP worked in their food pantry on a scale of 1 to 5, with 1 = Not at all well, 2 = Fair, 3 = Good, 4 = Pretty Good, and 5 = Very well. Fifteen (83%) said PEP worked very well or good at their pantry.

Question 4: What challenges did your food pantry experience in implementing PEP?

Key Themes
Program Coordination
Resources
Cultural Norms/ Perceptions

Three themes were identified in analyzing the qualitative data from question 4. *Program coordination* between food banks and food pantries, adequate *resources* for program implementation, and variations in *cultural norms and perceptions* about nutrition education.

One-third of pantries indicated that they did not always receive enough produce or the right produce to correspond with a recipe card. One pantry noted that if they did not know what produce was being delivered they did not have time to prepare recipe tastings, cut samples, or have available the proper recipe cards for the PEP lesson. One respondent replied that there was one driver for multiple pantries, which meant that the produce order would sometimes get confused.

The second theme analyzed was available resources in the form of volunteer support at pantries. Thirty-three percent of pantries reported difficulty in finding bilingual volunteers. One pantry identified that 80% of their clients were Spanish-speaking, and only 10% of the Spanish speakers also spoke English. Other languages spoken at this pantry included Korean and Vietnamese. Another pantry has a large Russian population and they needed materials translated into Russian. One pantry had identified volunteers but stated it was difficult finding volunteers that will commit to more than just one or two distributions.

Cultural norms and perceptions about nutrition were an obstacle at some pantries. Three pantries indicated that initially clients were happy to engage, but that for subsequent PEP lessons they were not interested even if there was a different produce item. Clients appeared more interested in the food distribution. One pantry noted that at first there was the perception that PEP was slowing down the food distribution. At one pantry, promoting PEP with the Korean population was challenging. As mentioned in the food bank summary, the respondent noted that first generation Korean immigrants have been educated about nutrition in Korea, and for this generation, it would not be culturally acceptable to learn nutrition from younger educators. At two pantries, the volunteers were not willing to or enthusiastic about conducting PEP and did not see the value. Finally, one pantry had difficulty finding the right times to present PEP to encourage receptivity without disrupting the distribution.

Question 5: *How did you overcome the challenges*?

Four themes emerged after reviewing the qualitative data for question 5. One overarching theme was the lessons learned from implementing PEP regarding effective *coordination* to generate the best outcomes. Additionally overcoming challenges required identifying volunteers, supporting their *training, managing the volunteers* in preparing and implementing PEP, and *managing the PEP material*s. An additional theme

Key Themes		
Program Coordination		
Materials	Communication	Volunteer training and management

was effective *communication* within the pantry and between the pantry and the food bank.

Different pantries expressed different lessons learned regarding volunteers. One pantry reported that with the different languages spoken in their pantry they tried to balance which language group they would focus on for PEP on a given day. Another respondent had the PEP materials translated into Russian. Two pantries found Vietnamese and Spanish translators. One location reported that Asian clients were comfortable taking the English recipe cards. These clients likely had English speakers at home who could translate the recipes. Two pantries noted the importance of having a volunteer that manages the line, selects PEP participants, and is also bilingual. Two pantries teamed volunteers so that they had a translator and a PEP-trained educator to conduct PEP. Two pantries stated broadly that the ongoing training for volunteers was very important. One respondent added that it was helpful to train volunteers to be mindful of their tone and delivery of the educational message so it sounds important but not intimidating. One respondent highlighted that volunteers are also there to offer comfort, faith, hope and charity while doing the work. At one pantry the volunteer is very inclusive of the children and engaged them in MyPlate activities and crafts related to the MyPlate lesson. They noted that including the children in related activities is received well by parents participating in PEP.

Each pantry had different strategies to optimize their use of PEP materials. One pantry bought a tripod for the MyPlate interactive board. They noted it was easier to keep the PEP board stationary and engage clients in the distribution line as they passed by the board. One pantry noted the MyPlate board did not last long and so they ordered another one. One pantry volunteer stores PEP materials at home since there is no storage at the church. At two pantry locations the distributions are outside and the MyPlate board would blow over and recipe cards would scatter. At one of these locations, working in teams addressed outdoor challenges; one volunteer held the MyPlate board and the other volunteer conducted the lesson. Volunteers kept the recipe cards in apron pockets for distribution. One respondent noted that the incentives such as hats, aprons, and t-shirts were all very helpful in getting clients to engage. Volunteers also wore their Champions of Change hats and t-shirts to distributions and it helped to give them a sense of empowerment and ownership of their role. Finally, one pantry mentioned the importance of keeping all recipe cards stocked so that the pantry can be prepared to give a lesson with any produce that is delivered.

Program coordination and communication with the pantry's food bank contributed to the success of PEP. One respondent noted that if the food bank gave advanced notice regarding the amount and type of produce the pantry could prepare then the program goes smoothly. Another pantry mentioned that if they did not have produce that coincided with the recipe card they would use what food they had available in the pantry as a fill in and explained to clients that they can add these things to go with the recipe described on the card.

"*We tried to match produce with recipe cards but we are not as picky now. We do a lesson even if it does not match, to keep the program going. This is not a sprint but a long race." - Ruth Kennedy, Native American United Methodist Church.*

One pantry stated they were able to conduct the PEP lesson indoors if the weather was bad. Another pantry had the strategy of delaying the lesson so that people at the end of the line can receive the produce and the recipe cards. At one pantry, a large group presentation of 20-30 clients seemed to work the best for their distribution model. The large group meant losing some intimacy but it worked for this pantry. One pantry had a kitchen and could prepare produce samples which supported the lesson. When another pantry did not have the produce sample, they were still able to hand out the recipe cards with the produce. One pantry described setting up an appealing display right near the exit door that served to draw a crowd until there were enough clients to conduct a PEP lesson.

"PEP required trial and error. The more we did it, the smoother it got. The volunteers and clients became more familiar with the program. "- Jennifer Vetch, Fallbrook Food Pantry.

Question 6: ***Did you encounter any problems with the PEP materials?***

The key themes regarding question 6 included challenges with *materials translation* and *future needs* for pantries regarding materials. One pantry had a large Russian population and had the PEP materials translated into Russian. Two respondents indicated that Asian clients spoke English and took the English recipe cards but speculated that translation of cards into Asian languages such as Vietnamese, Korean, and Tagalog might be helpful. They further noted that most of their Vietnamese clients speak English or have someone who translates for them and that the Asian clients never refused the recipe cards.

Future needs regarding materials were reflected in the interview results. At one pantry, the MyPlate board was getting worn out. Another pantry stated that having more recipes for each recipe card and produce item would give clients more preparation options. One respondent from a pantry with no distribution line mentioned that the MyPlate board is too big to use at their intake booth. If the board was smaller they could conduct PEP from the booth during intake. Finally, one pantry mentioned that they could use more incentives or prizes (unspecified) to continue to engage clients in PEP over time.

"I love the materials. I feel so blessed." – Esau Canales, Church on Pearl

"The size of the board is challenging with our unique operation but our clients like the board. They like that you can make your own meal". - Matt Jacobs, Catholic Charities Diocese of Fresno

Question 7: ***What do you feel was successful about the PEP?***

The qualitative data for question 7 generated three themes that provide depth to respondents' answers to the question. Themes include the perception by volunteers of an *increase in knowledge and skills* among the pantry clients, an *increase in access to and consumption of fresh produce*, and the enhancement of *partnerships* between the food banks and pantries. Three pantries noted that PEP increases client knowledge about nutrition, preparation, and portions and that PEP starts a conversation with clients about different ways to prepare the produce. Twenty-eight percent of pantries indicated that they believed after implementing PEP their clients were more aware of the importance of eating fruits and vegetables. One client mentioned that PEP seems to lead to an increased demand for produce. Five pantries noted that clients are receptive to nutrition education through PEP. One respondent mentioned that PEP provided her with opportunity to show clients how easy it is to cut and prepare raw produce and add it to the family meal. One pantry noted that through PEP, clients are willing to try new foods, and one pantry found that the repetition of the PEP lesson over time was helpful. Four pantries responded that clients like the recipe cards. One pantry noted there were always enough cards for all clients. She stated that everyone in the pantry receives a recipe card and produce and the pantry serves about 200 people in a day. Additionally, volunteers liked that the recipes have changed over time. Regarding the lesson itself, pantries reported clients have been remembering the lesson and interaction with the MyPlate board from visit to visit. The pantry respondents found the interactive material and Velcro tabs helpful and board relatable, and that children responded to PEP as well. Finally, one respondent noted that clients think of PEP as entertainment while they wait for their food.

One pantry noted that participating in PEP improved their partnership with their food bank to better serve communities. Another respondent noted that other agencies or groups such as local university nursing students are exposed to PEP when they visit the food pantry and during their visit they are able to learn about the MyPlate board and the recipe cards.

"People liked the opportunity to gain knowledge. We are giving knowledge and knowledge is power. I hope [PEP] *never goes away" - Richard Leavitt, Newport Church Food Pantry*

"We didn't't give out a lot of produce before we had the produce education program. Stores found out we are educating people to make better choices and have been donating produce to us." -Bill Bennett, Grace Resource Center

"When PEP stops it won't really stop, because so many participants have had the lessons and received the cards and practiced preparing the foods." - Ruth Kennedy, Native American United Methodist Church

"Some of the moms told me the kids try new foods!" - Ruth Kennedy, Native American United Methodist Church

Question 8: ***How did you adapt PEP to your setting?***

There were two overlapping themes identified from analyzing the qualitative data for question 8.

Key Themes
Location of Pantry
Classroom or Distribution Line

Adapting PEP in each setting required choosing the *location* in terms of size and layout, as well as determining the type of presentation as either a *classroom* or in the *distribution line*. Of the 18 pantries interviewed that conducted PEP in the last 12 months, 22% (4 pantries) conducted PEP in the distribution line, 67% (12 pantries) took clients out of the distribution line into a "classroom" setting to conduct PEP with four or more people, and one pantry did not specify.

For the classroom approach, some instructed indoors and some outdoors. One pantry presented PEP to the group as a whole and decided to set up outside. Another pantry stated the importance of having a big enough location to conduct PEP in a large group. One pantry used PEP in the line and also in small groups outside the line. They indicated that the small group setting is more effective and they plan to go back to that model. Two pantries gave out numbers before moving clients to conduct the lesson in a classroom style, so that they do not worry about losing their place in line. One respondent was able to set up outside at a school with picnic tables and shade to conduct the PEP. Another outdoor site struggled with exposure in extreme weather and is trying to construct an overhang to conduct PEP and protect produce; they set out chairs outside before the pantry opens and teach PEP in a small group of 5-6 at their early morning distribution. Two pantries reported bringing the clients indoors to conduct PEP as a group and at one of these pantries they also had volunteers hand out cut samples in line. Two pantries noted the importance of including children in PEP. They indicated that parents are proud to see their children engaging in the lesson.

Three pantries reported conducting PEP in the distribution line. One stated that they have a line and deliver the food samples and recipe cards to the people in the front of the line until they run out of produce. Another pantry noted that the classroom style was not as appealing in their setting. As their clients file out to return to their cars, volunteers wear aprons and direct people to the exit display of produce and PEP materials which is colorful and grabs their attention. The respondent indicated that this approach draws crowds and the display table is very effective. Once there is a small group they conduct PEP. Still another pantry hands out bags after the Sunday hot meal (clients line up). The produce featured in the PEP lesson is also a part of their free Sunday meal. When clients line up to pick up their bag they get the PEP education and receive more produce.

"I think we just tried to make PEP appealing!" - Cynnde Lewis, World of Pentecost

Question 9: ***What else could PEP have done to support your program?***

The themes identified after analyzing the data for question 9 included *resource* requests and ongoing *technical assistance.* Resource requests included: more recipe cards, more recipe resources, reusable grocery bags, more produce, and incentives for volunteers to be trained in and facilitate PEP, such as extra food items or prizes.

Additional requests to CAFB from pantry volunteers came in the form of technical assistance. Three pantries requested more in-depth nutrition training for volunteers, including more nutrition facts about how produce consumption affects health. One pantry requested more site visits from CAFB staff, to re-energize volunteers. Another respondent asked: "How can we change it up so clients don't hear the same lesson each time?" Finally one respondent indicated that if you want to set up PEP at a pantry location that does not have a distribution line then find a dedicated volunteer or staff person to be available to work longer hours and conduct PEP for clients in these settings.

"CAFB is doing a great job and is an asset to our community." - JJ Goldrick, St. Anne's Catholic Church and Shrine

Question 10: What can your pantry do to continue doing PEP?

In reviewing the qualitative data from question 10, the primary themes identified included *maintaining resources, continuing volunteer education,* enhancing existing *partnerships* and establishing new ones. One pantry stated it would like to have more volunteers trained to deliver PEP weekly and in a short time window. Another pantry noted that if there were new teaching areas identified for PEP they would be willing to implement new material.

Regarding resources, two respondents indicated that if they had recipe cards, produce, and volunteers they can continue PEP. Another pantry requested a new MyPlate board. One pantry recognized they need to find out which produce items are coming in order to make the recipe tasting the night before the distribution. And one pantry stated that managing materials would be easier if CAFB allowed them to order smaller amounts of recipe cards.

Two pantries expressed a desire to further collaborate with their food bank and with other agencies regarding PEP. One pantry stated they would like to continue to do PEP and work with the food bank and CAFB to determine what other distribution options they have after drought relief distribution is over.[16] One pantry would like to collaborate with other agencies to do PEP in smaller settings while clients have a health screening and indicated they would like to find the right volunteers through collaboration with other agencies concerned with health outcomes.

Question 11: *What advice would you give to your peers if they were thinking about implementing PEP?*

One overarching theme and two sub-themes emerged from analyzing the qualitative data for question 11. Respondents described *promising practices* in program implementation for their pantry. Promising practices fell under two different themes, including *commitment* from pantry staff, and the importance of a *vision for success* among PEP volunteers. Two pantry respondents indicated the need to adapt the PEP lesson to suit the individual pantry. One respondent highlighted the importance of recognizing that it takes time to become successful, and that PEP volunteers might keep lower expectations initially until the program has been running for some time.

Another respondent stressed the need to ensure willingness of volunteers to participate and PEP will be effective. Another pantry added that it is important to have support from pantry leadership to conduct PEP.

Several respondents stressed the importance of having a vision for how PEP would be implemented. Three pantries indicated that a team approach is best so the work can be shared.

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[16] Drought relief came in the form of funding in 2015 awarded to CAFB from Bank of America to support ten food banks in some of California's most drought-affected communities. Food banks used these funds to purchase food which is providing the equivalent of 3 million much-needed meals for Californians affected by the drought. Fresh produce was the most commonly purchased item, with food banks adding fresh fruits and vegetables to the drought-relief food boxes they provided at disaster distributions. When the drought relief program is finished, this respondent indicated it would like to continue to work with its local food bank, conducting PEP and distributing produce.

Three pantries noted that the PEP educator has to be engaging and have good presentation skills and that volunteers need to be friendly, interactive, and enthusiastic. Four pantries expressed that volunteers need to make PEP appealing and exciting and make clients feel welcome so they stay engaged. And at least one pantry reiterated the need for volunteers to be bilingual. One respondent highlighted the need to have direction, initiative, and drive about what you are getting into. Another pantry advised to take your time with the lessons. Other comments included using the classroom model instead of walking the distribution line, as it is less tedious; trying to find a certified kitchen so you can provide recipe tastings and prepare them in advance of the PEP lesson; looking for opportunities to conduct PEP in other community settings besides pantries; and using the local faith-based network to promote PEP at other pantries.

"Just remember that people [coming to the food pantry] are human. They have needs just like you do and sometimes they feel that their needs are not being met. If you show them that you are meeting their needs they will be accepting of PEP. "- Gina Surber, Native American United Methodist Church

Regarding volunteer enthusiasm for PEP: *"You don't want [volunteers] to [conduct PEP] just because they were asked! It is too special. It is changing the course of history." - Richard Leavitt, Newport Church Food Pantry*

Question 12: *How could your Food Bank support you in continuing PEP?*

Key Themes
Communication
Resources

The themes identified in question 12 included ongoing *communication* between pantry and food bank and additional *resources* to support PEP. Forty-four percent of pantry respondents highlighted the need for improving communication between the pantry and the food bank regarding produce acquisition, including type of produce, delivery date, and quantity. One respondent requested communication with the food bank to identify other distribution opportunities after targeted drought relief distributions end. Still another pantry wanted to work with their food bank to expand outreach to include another pantry location in order to reach more Native American families.

Five pantries stated the importance of ongoing resources from the food bank, including a continuous and ample supply of fresh produce. One pantry stated that their location was in need of adequate refrigeration in order to be able to keep fresh produce over several days between delivery and distribution. One pantry that did not have a distribution line indicated they needed a dedicated volunteer from the food bank that could work longer hours to conduct PEP because the pantry is open many hours with a steady inflow of clients.

Question 13*: Do you have any additional comments?*

Two broad themes emerged for question 13. One set of comments provided more details regarding *program implementation* at different pantry sites. The other comments spoke to the fact that conduction PEP has helped pantries to fulfill their mission.

Key Themes
Program Implementation
Pantry Mission

With regards to program implementation, the following comments were given by individual pantries: One pantry receives produce from the food bank every other week but feels they could conduct PEP if they received produce weekly. Another stated when the pantry moves locations they would like to offer samples of the produce and recipe tastings when the pantry moves to a new location. One respondent had to be creative to use the food on hand if the produce provided did not match the recipe card.

Several representative commented that PEP engages volunteers. One pantry said their "volunteers are very enthusiastic" about delivering the PEP education. One Food bank respondent also said that their volunteers want the PEP training and "love the board because it is easy to use". At one pantry, volunteers met to discuss how the PEP program was going and what changes needed to be made to improve it for that particular pantry. Two pantries saw the value in engaging the parents through involving their children. Volunteers read stories and assisted the children in easy crafts or tooth brushing demonstrations and MyPlate lessons. The children used paper plates to draw the MyPlate portions and participated in other simple art projects that involved fruit and vegetables. According to one pantry, exposure to new produce taught the children to try new foods. Another pantry noted that they hoped that by engaging children, the children would influence what the parents buy and prepare. One pantry volunteer noted that perhaps PEP could be adapted to be used in schools.

Implementing PEP and collaborating with their food banks appears to have enhanced the pantries' missions. One pantry appreciated that now that they implement PEP, their food bank always provides them with a good supply of produce. Another respondent noted that their pantry helps the food bank move produce and the food bank provides support to deliver it to clients, so both agencies benefit.
Additionally with regards to pantry missions, one respondent noted that clients tell them that they use more fruits and vegetables in their meals. Another pantry stated that clients often don't have access to the internet so PEP is a way of increasing their knowledge of nutrition and their skills in preparing recipes from fresh produce.

"This program has come at a good time. People eat fast food instead of cooking at home." - Bill Bennett, Grace Resource Center Food Pantry

"I think the program is awesome. For a while celery was coming back because they did not know what to do with it. Now with PEP, no produce is being returned." - Connie Totten, Community Action Partnership of Kern County

"I feel privileged to be a part of PEP. The broader the brush the more ground we cover. It just takes a little. There is always a change of people in the organizations but that is ok. Just keep it fresh." Richard Leavitt, Newport Church Food Pantry

"The food bank brings the produce when they bring the other food. This frees up my staff to do PEP and sign people in. The food bank has been fantastic to work with. We would not be where we are today without them." - Cynnde Lewis, World of Pentecost

"We appreciate the opportunity to participate. " - Jennifer Vetch, Fallbrook Food Pantry.

"PEP exceeded our expectations."- Cynnde Lewis, World of Pentecost Food Pantry

FOOD commons FRESNO

CDFA Update
January 26, 2016

Agenda

- Overview
- Produce aggregation and sales
- Processing
- Human resources
- Trust
- What’s next
- Q&A

Overview

- Goals
- Outcomes
- Impact

Project Goals

1. Expand **access** to healthy, safe California specialty crops at school, at work and in the neighborhoods of Fresno County residents
2. Enhance the marketability and competitiveness of specialty crops through the development of **local markets** for Fresno and San Joaquin Valley producers.
3. Expand **stewardship** practices and invest in the next generation of specialty crop producers in Fresno County and the San Joaquin Valley

Supporting resources and partners

- CDFA Specialty Crop Block Grant Program
- 11th Hour Project
- TomKat Charitable Trust
- T&D Willey Farms
- Wells Fargo/National Fish & Wildlife Federation
- USDA Local Food Promotion Program
- Central Valley Community Foundation
- Centers for Disease Control/County of Fresno Public Health Department
- Cal Fresh Works Fund

Outcomes

- Ooooby Fresno launched May 2015
- Food Commons Fresno Wholesale Hub launched October 2015
- Sales $345,000 over first 7 months of operations
- 917 direct customers, 30 restaurants/retailers/institutions
- 26 specialty crop producers
- Marketing and education campaign launched
- Producer certification process developed
- Hiring, training and advancing new leaders and team members

Impact


MOTO 7 THE MOV
SAT OCT
RALPHIE MAY WE


Oooby


PRODUCT
For delivery on:
November 9, 2015
Order #
LO-15-FOODCOMMONSFRESNO-0000018
Buyer
Fresno Economic Opportunities Commission
Product
Braeburn Apples, 198 ct
9.0 Bushels, 198 count | Lot #36273
Supplier
K.M.K. Organic Farms

706

Impact on Communities

Impact on Farmers

Impact on Neighborhood

709

Produce Aggregation and Sales

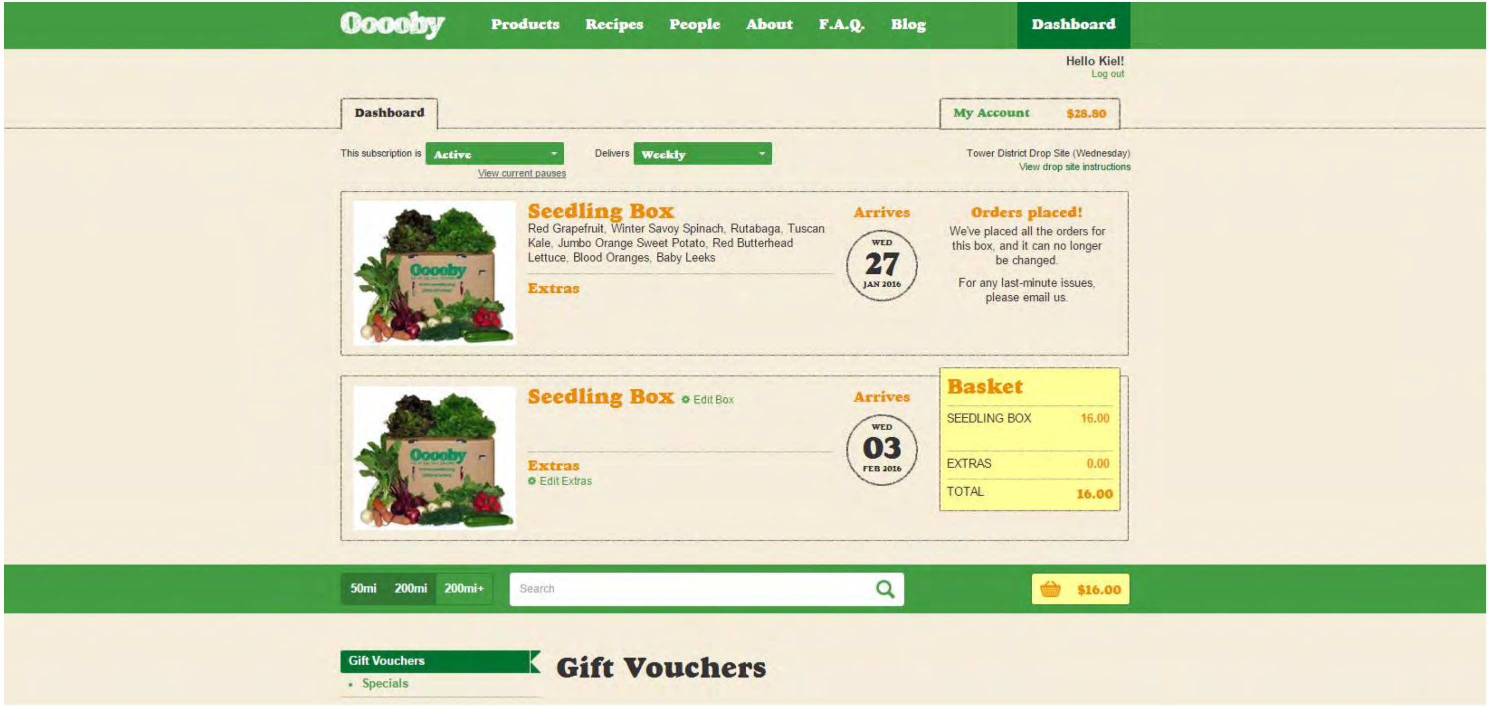
- Ooooby Fresno
- Wholesale Hub
- Mobile Market
- Future plans

1 Hub, 2 Businesses

Ooooby launch

- transition of T&D Willey Farm CSA
- no interruption in service
- highlighted at State of City Address
- 13,372+ produce boxes delivered
- 917+ families served

Online customer interface



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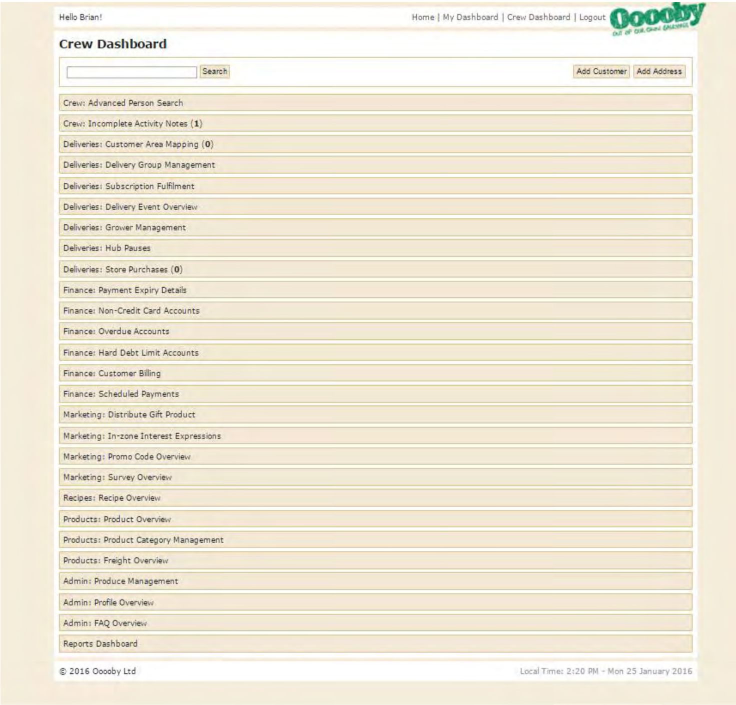
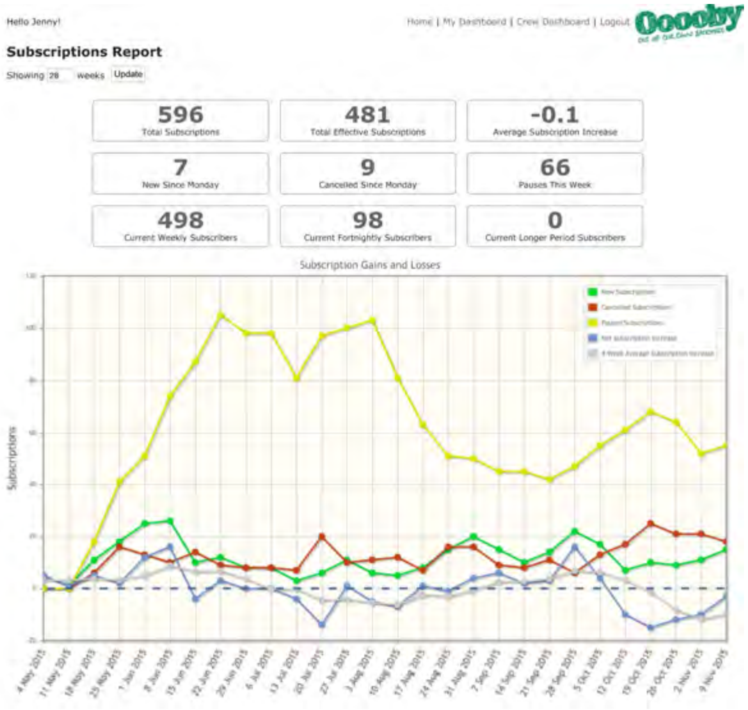
Backend Tools





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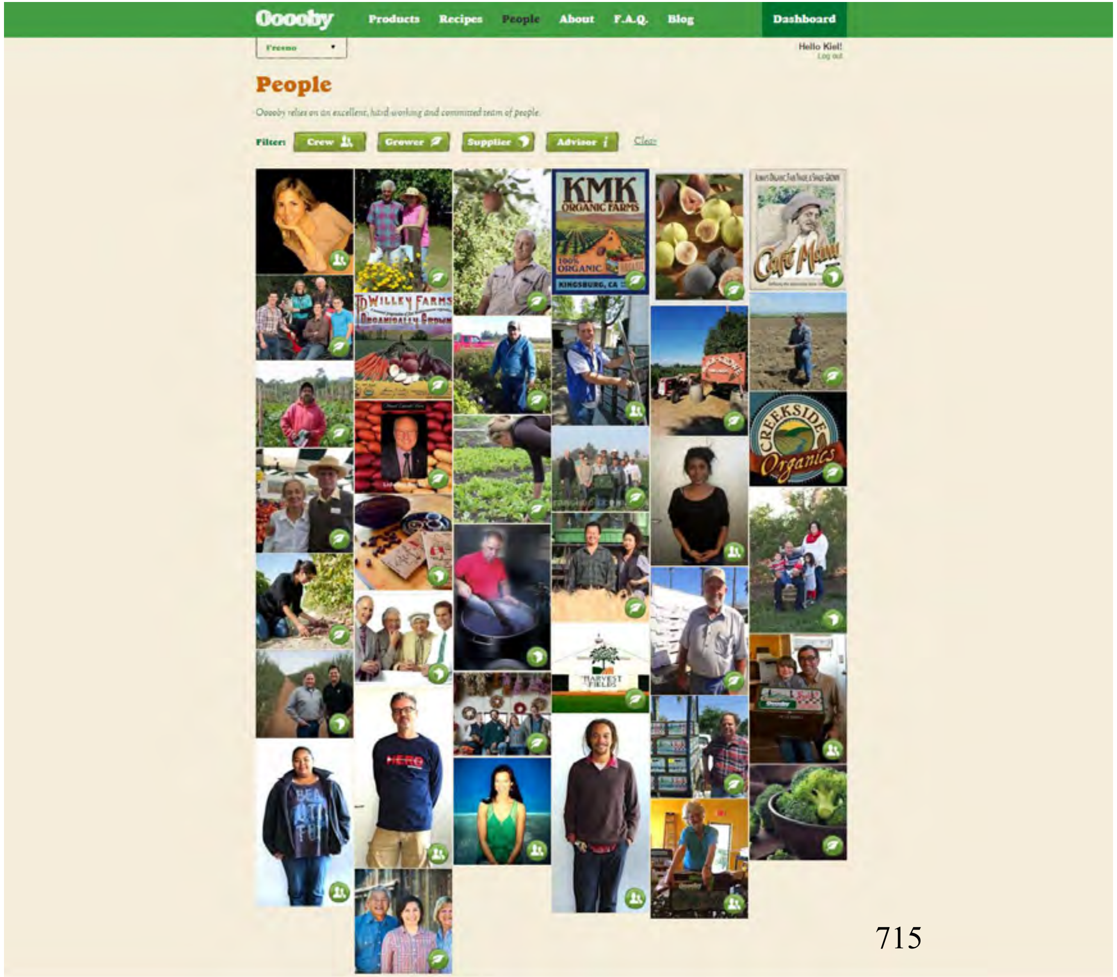

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People

23 certified organic farms

6 value added producers

6 advisors

5 produce packers

1 customer happiness assoc.

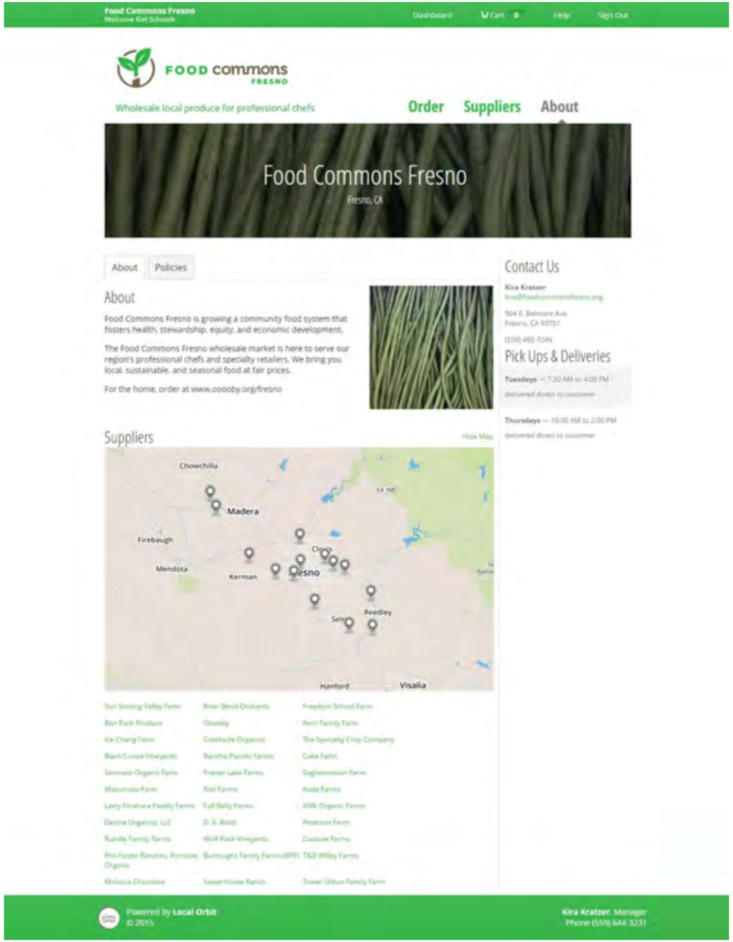
1 supply coordinator

1 driver

1 operations manager

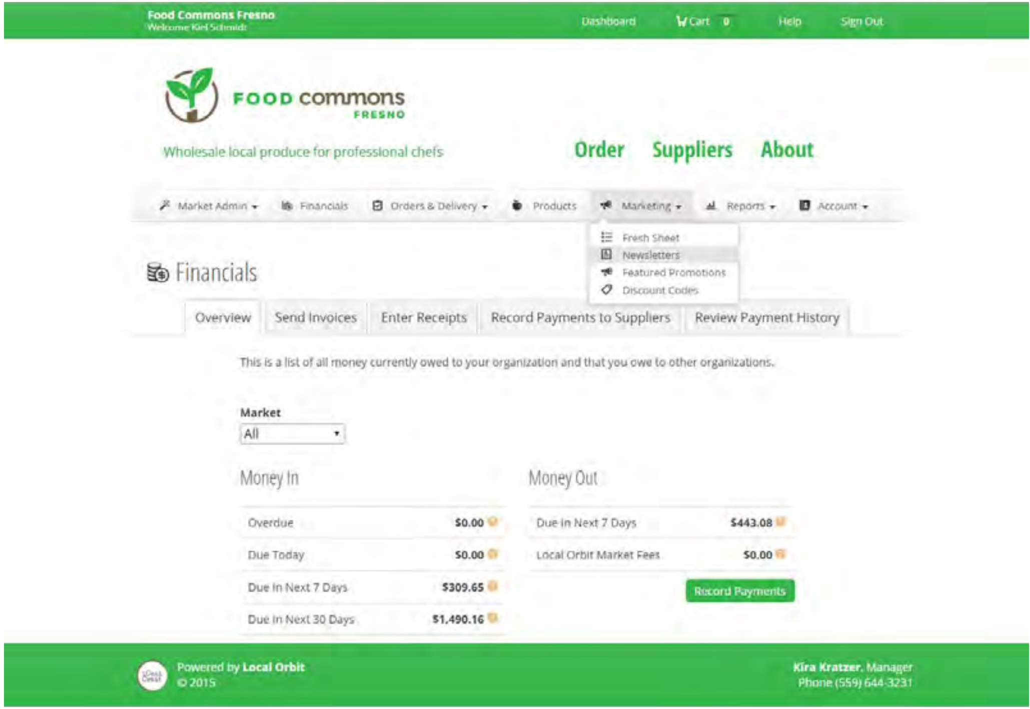
Wholesale launch

- Partnered with Tower Urban Family Farm
- May 2015, 1st sales of Ooooby surplus
- October 2015, full web sales platform
- High level of customer service for chefs
- Flexibility to work with farms of all scales
- $44,500 in sales to date



https://foodcommonsfresno.localorbit.com

- 3rd party
- Flat annual fee
- Marketing tools
- Real time availability/inventory
- Automated invoicing
- Formated pick lists & packing labels
- Accessible to buyers & suppliers



717

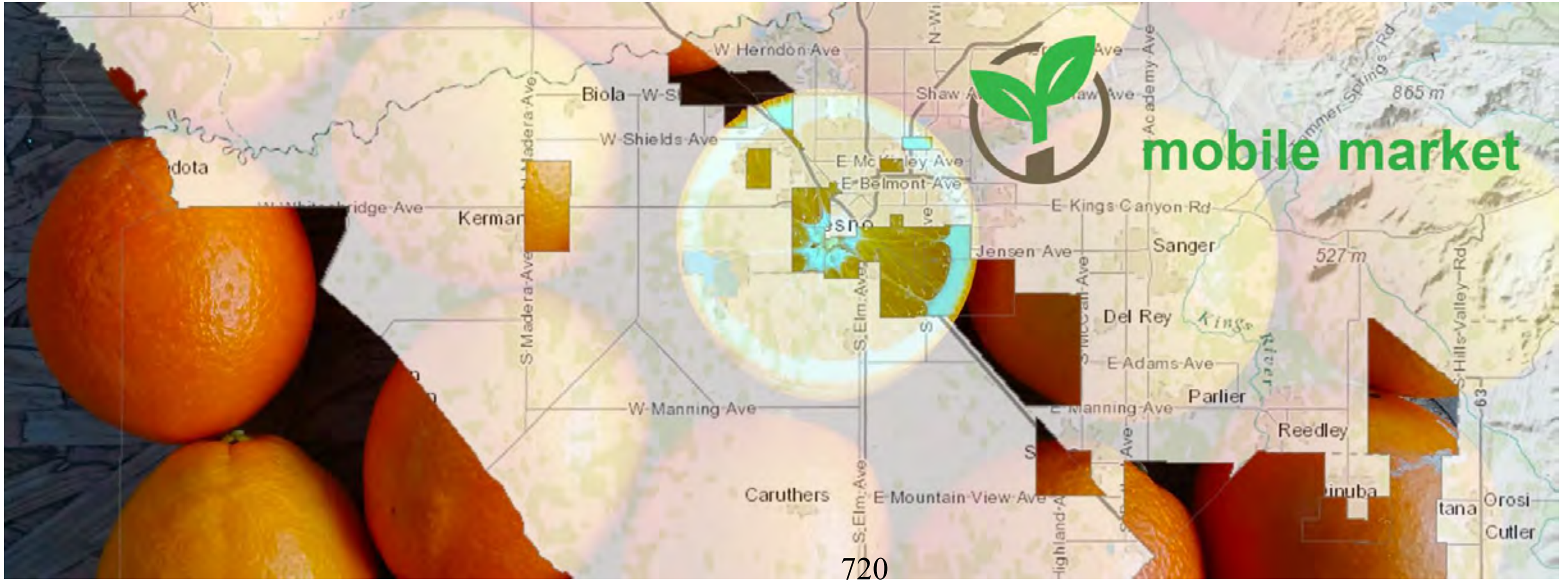
Wholesale Customers

- 10 restaurants
- 3 Farm CSAs
- 3 food trucks
- 3 nonprofits
- 2 retail
- 2 institutions


PRODUCT
For delivery on:
November 9, 2015
Order #:
LO-15-FOODCOMMONSFRESNO-0000018
Buyer
Fresno Economic Opportunities Commission
Product
Braeburn Apples, 198 ct
9.0 Bushels, 198 count | Lot #36273
Supplier
K.M.K. Organic Farms
FOOD commons

Mobile Market

- Outreach & data collection
- Market held in 8 of 12 Fresno County food deserts



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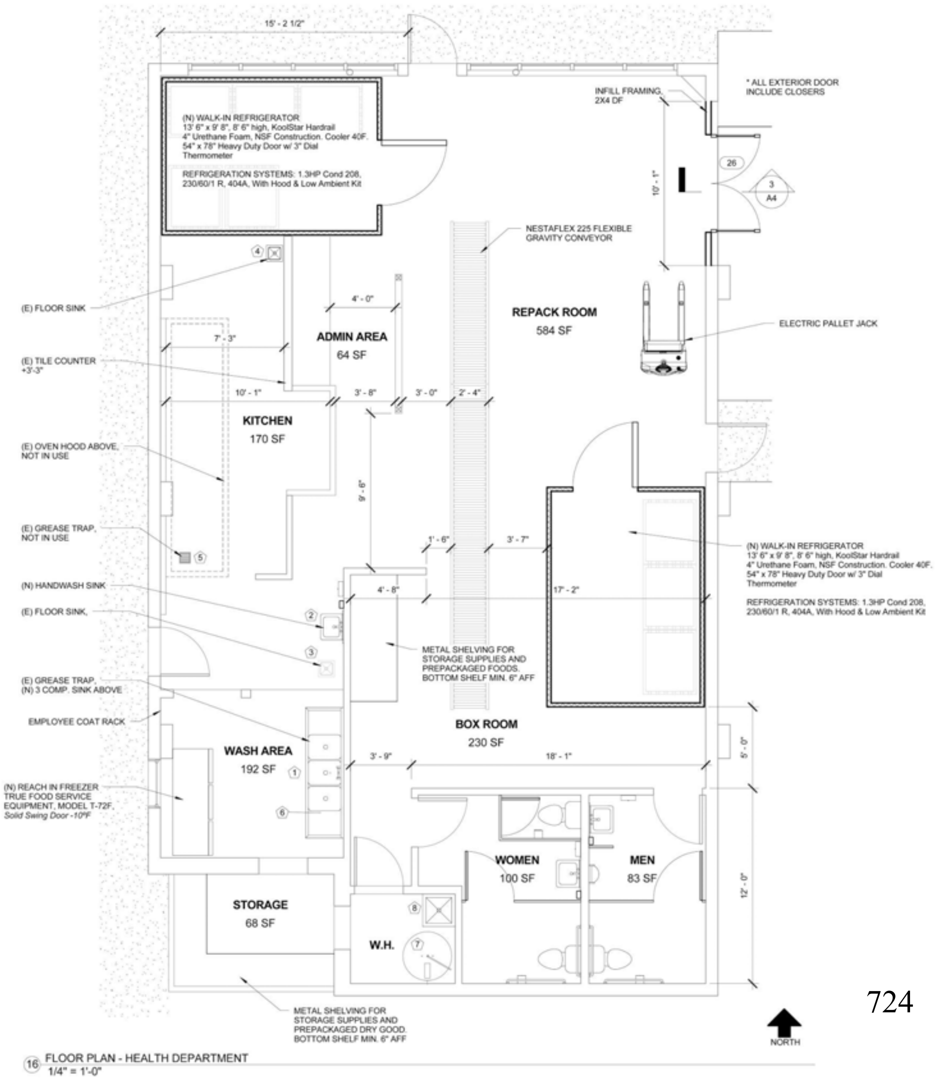
Processing

- Opportunities
- Next steps

Processing Opportunity

- Surplus produce from operations could be processed to value added goods.
- Major infrastructure at existing hub
- Extend hours of hub
- Commissary for food truck & carts
- Partnership with Cultiva La Salud, FNV campaign & CA Fresh Works Fund



Processing Next Steps

- Food facility plan revisions
- Plumbing modifications
- New equipment
- Additional storage
- CA Fresh Works opportunity

Training and Human Resource Program Development

- HR program design and development
- Grower certification

Human Resources

- Experienced management team
- Collaboration
- Neighborhood hiring emphasis
- Fresno Adult School food service program
- Promoting from within
- Training needs and resources
- HR policies and procedures

Training and Grower Standards

Food Commons Farm Interview Report

Interview Date: 2/27/15
Operation Name: Harvest Fields Organic Farm
Operation Location (Primary): 5397 E. Olive Ave., Fresno, CA 93727
Operation Mailing Address: 5397 E. Olive Ave., Fresno, CA 93727
Main Contact/Position: David Obermiller/Farm Manager
Contact Phone: 559-824-4506
Contact Email: grow@harvestfields.com
Website: N/A
Registrations & Certifications: Organic certification (CCOF, ft479)
Interviewer: Tom Matott

Introduction (include general information about the operation, including site locations, acreage, crops, number of employees, current sales venues, unique situations, etc.):
Harvest Fields Organic Farm is a 12 acre working farm located on the campus of the Fresno Adventist Academy. The school purchased the property from a dairy farm many years ago. 8 acres is dedicated to mixed vegetable production (4.5 acres currently in production) and 4 acres of citrus (navel orange). Two high tunnels are also on site and are used for seedling production and season extension. The operation currently has 30 hens. The hens are used for egg production, weed management, and pest management. The hens are rotated throughout the orange grove in chicken tractors. Bees are also kept in a small set up. Bees are used for pollination. The operation also have a small shop, storage space, office, packing line, and cold storage container. The farm is supported by the Academy and is used as an educational activity for students. The farm also has limited sales to members of the school, but is developing a CSA program as the primary source of revenue production.

Site Descriptions: The farm is located on 12 acres of a 40 acre parcel that also houses the Fresno Adventist Academy. Vegetable production areas are located on the south eastern side of the property and consist of three sections. One section is used for perennial plants, the other two are used for annual crop rotation or fallow. The shop, packing house, storage space, office, high tunnels, orange groves, and hens are distributed across the north side. There is an open field located adjacent to the buildings on the north side of the property that the school is considering planting with turf for an athletic field. This has not been finalized.

Crops Grown: Harvest Fields Organic Farm is a diverse mixed vegetable operation that grows over 30 annual and perennial vegetables (see CCOF client profile in attachments), as well as navel oranges and eggs. Not all items listed are grown each year. The majority of seeds are started in field or propagated on site. Perennial produce currently consists of artichokes. The farmer will be planting asparagus soon.

Soil Management: Harvest Fields Organic Farm incorporates many organic practices in regards to soil management. Cover crops are used for fertility, increasing organic matter and as living mulch. Mechanical cultivation is used minimally, primarily for some weed management and bed shaping. All plant matter is incorporated into the soil when a crop is done and the grower will occasionally inoculate the soil with mycorrhizae (also a part of fertility, disease resistance, and water conservation). Some

il testing is done annually to determine

hods into their soil management activities.
compost, and crop rotation are standard for
ount of micronutrients when soil testing
health plays a large role in crop health. The
re helps to feed the trees.

on keeping plants healthy in order to
eeded. Insectaries and habitat for
will be permanent and serve to promote
and pests. Lady Beetles are released to
anagement and proper fertility to keep
ure is trying to tell you something," is part of
e IPM activities. All inputs are kept in a

Control
, Lady Beetle releases, ant control
et Liquid Ant Bait
sue, nothing used

n is Bermuda grass. The farm has converted
rass of choice for the grass. Mechanical and
ed in the greenhouses and fields to suppress
mulch.

n an urban setting, surrounded by Olive Ave.
industry on the north and west. The
ties or is consistent with urban
ee hives that are used for pollination.

plies. The farm uses drip irrigation or micro-
moisture sensors to assist with accurate

Food Safety: The farm has a packing line and cold storage space on site. Both are very well maintained and no evidence of pests or rodents were evident. Cleaning logs for the packing line was hanging on the wall and clearly used.

Labor Management & Training: The farm has four full time employees that receive healthcare and retirement. The fulltime positions are considered part of the school staff. The farm also benefits from

Orange Grove
Future Expansion Space or Athletic Field
Farmer and High Tunnels
High Tunnel Interior
High Tunnel Interior
Open Production Field
rea
Line
Employees at Sizing Table
Cold Storage

Trust Development

- Governance
- Strategic plan

Trust development

- Formation of Trust and governance structure
- Strategic plan
- Ongoing investigation of acquisition opportunities

What’s next?

Wrapping up

- Continue growing sales and supplier base
- Continue marketing and education campaign
- Refine processing and retail business plans
- Formalize HR policies and procedures
- Continue researching/developing acquisition opportunities

Looking ahead

- Expansion to school drop sites
- Food Access Fund implementation
- Community Food Hub planning and development
- Asset acquisition and supply chain development
- Broad-based community investment and ownership

Thanks to CDFA!

Food Commons Fresno could not have accomplished these outcomes and be in the growth position it is without the support of the California Department of Food and Agriculture.

Q&A

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FRESNO

CDFA Update
January 26, 2016

Following the “4 R’s” can improve nitrogen delivery to tree nuts

Dennis Pollock, Contributing Writer

Apr 20, 2016

“I know you guys have heard more about nitrogen in the past two years than you ever wanted to,” said Katherine Pope, a University of California (UC) Cooperative Extension farm advisor in Sacramento, Solano, and Yolo counties.

Credit: Pawel_Czaja/iStock/ThinkStock

The need to quantify nitrogen (N) usage to address regulations on the amount of nitrates in drinking water has spawned the development of budgets and research on how best to deliver N to tree nuts and other crops.

“I know you guys have heard more about nitrogen in the past two years than you ever wanted to,” said Katherine Pope, a University of California (UC) Cooperative Extension farm advisor in Sacramento, Solano, and Yolo counties.

Speaking to walnut growers in Visalia, Pope then proceeded to tell them still more about the subject, starting with what is being termed the “4 R’s” of N management. Many of the same principles apply to growing almonds and other crops.

The R’s include:

Right rate

Research led by Pope and funded by the California Department of Food and Agriculture and the California Walnut Board examined the amount of N found on average in every ton of in-shell walnuts with 8 percent moisture at harvest. This amounted to 29 pounds.

Pope looked at six mature, moderate-to-high-yielding orchards, three Chandler and three Tulare, in the northern Sacramento Valley, northern San Joaquin County, and Hanford.

Researchers drilled into trees, dug up roots, and looked at the N amount in branches. The objective: match supply with demand. Calculate the amount of organic N, the amount in water, and the amount in compost and manure.

Pope said more research this season will seek to put more exact numbers to N removed at harvest and new growth.

Right time

Pope said it’s ideal to apply N to walnut trees four times during the season. She recommends adding 25 percent of needed nitrogen in May, June, July, and August.

“Remember that nitrogen can only be taken up when there are leaves on the tree,” she said. “The first month of growth uses stored nitrogen, not nitrogen from the soil, and demand during the rest of the season is evenly spread out.”

Right place

Delivery should be to the active roots. N in any form moves with water, Pope said. Half of the N in ammonia will turn into nitrates.

The idea is to minimize movement below the root zone, which is in the top 2-3 feet of soil.

Right source

In experiments by Patrick Brown, UC Davis professor of plant nutrition in almonds, there was no difference in yield between equal amounts of N as urea ammonium nitrate and calcium ammonium nitrate.

Material choice is more a function of price per unit of N and other needs particular to an orchard, like pH impact.

Pope walked growers through use of a N budgeting worksheet used by UC to determine how much N should be added annually.

The worksheet takes into account the amount of N removed in the crop, N contributions from irrigation water, N contributions from manure or compost, N contributions from cover crops, total N from non-fertilizer sources, additional N needed, and N fertilizer application rate.

Pope said “spoon feeding” – using small amounts more frequently – increases N use efficiency.

Brown cited an almond study that likewise found that it is more efficient to run small amounts of N through the drip line frequently throughout the season, rather than large amounts a few times. Another study demonstrated the nitrates in well water are as useful to almond trees as the N in fertilizer.

Pope recommends leaf monitoring for N deficiency, with sampling in July of only terminal leaflets that are 6-8 feet from the ground at the tree periphery. She recommends sampling 50 scattered leaflets.

N deficiency will show earlier in the leaf than in yield, she said.

Pope pointed out that the N budgeting formula and other information on the 4 R’s are available online at http://ceyolo.ucanr.edu/files/200738.pdf.

Tomato Study for Biobased Matrix with Encapsulated Microbes as Substitute for Synthetic Fertilizer Project

Greg Glenn and Bor-Sen Chiou

Introduction

Producing more food with fewer inputs is critical as global populations continue to increase and resources become more scarce and expensive. Some estimates project that agricultural production will need to increase 70% to 100% to meet the world demand for food in the next 35 years (*1*). The American Academy of Microbiology is calling for a 20% increase in global agricultural production while reducing fertilizer and pesticide use by 20% by the year 2033 (*1*). Estimates indicate that only 40% of nitrogen fertilizer applied to soils is taken up by crop plants (*2, 3*). Most of the nitrogen is lost by the volatilization of ammonia, nitrification, denitrification, leaching and runoff (*3-5*). The loss of agricultural phosphorous (P) fertilizers due to runoff into surface waters is considered a major cause of P eutrophication of aquatic ecosystems (*6*). In most soils, the P content is in an inorganic form that is generally unavailable to plants (*7, 8*). However, in some soils that are high in organic matter, more than 50% of the phosphate reserve may be bound primarily in the form of inositol phosphate (soil phytate) (*8*). Phosphorous from fertilizers quickly forms complexes in the soil with oxides and hydroxides of iron and aluminum ions at low pH and with calcium in basic soils (*8*). As a result, much of the phosphorous reserve in the soil including that from fertilizers is unavailable for plant use (*7-9*).

Plant-microbe interaction holds the key to reducing chemical inputs that can benefit consumers, farmers, and the environment (*10*). The rhizosphere that comprises the soil fraction that is in close proximity with plant roots can contain up to 10^{11} microbes per gram of soil (*2*). Beneficial soil bacteria as a category are commonly referred to as plant growth promoting bacteria or PGPB. PGPB microbes have been identified that fix nitrogen, solubilize phosphorous complexes, maximize nutrient uptake by plant roots, stimulate plant growth, confer resistance to environmental stress, and suppress disease (*8, 10*).

Inoculating soils with PS bacteria and/or AMF has been reported to increase crop yields significantly, sometimes by more than 25% (*11-13*). A critical mass of a given bacteria is needed to be able to have the desired effect in the rhyzosphere. For instance, the estimated cell counts per plant of *Azospirillum brasilense* for a desired plant response was reported in the range of 10^6-10^7 (*14*). Results from inoculation treatments have proven to be inconsistent (*15*). In many cases, suspensions of PGPB have been added to the soil directly without the benefit of a proper carrier. In such cases, it is common for populations of the beneficial microbes to decline rapidly (*16*). This decline in viable PGPB may be due to the inherent heterogeneity of the soil where the introduced bacteria cannot find an empty niche to fill. The plant root system serves not only for providing mechanical support and nutrient and water uptake but it also serves to interact in a dynamic fashion with the soil microbiome (*10, 17*). Root exudates that include carbohydrates, amino acids, flavonoids, fatty acids, and protein complexes such as arabinogalactan proteins play a large role in the interactions between the plant roots and soil microbes (*17*). The root exudates promote the growth of microbes. The concentration and composition of the exudates can change with the age of the plant or in response to stimuli from the environment such as soil type or pH and thus favor a change in the microbial populations and profile (*18*).

The PGPB inoculant must compete with the native microflora that is better adapted to the specific soil conditions and crops. The bacteria must also withstand predation of the soil microfauna (*19*). For PGPB inoculants to be effective, a carrier is needed to provide a suitable microenvironment and physical protection to prevent the rapid decline in the beneficial microbe population (*16*). Some carriers used in inoculants include liquid formulations, peat, charcoal, vermicompost, sawdust, wheat bran, oat bran, grape bagasse, crop waste, clays, perlite, starches, and alginates (*16*). Typically, additives are also used that include starches, gums, humic acids etc. (*20, 21*). A starch/gypsum carrier was developed in our laboratory for delivering soil microbes in the field. The carrier is granulated or extruded to form pellets or granules that encapsulate beneficial soil microbes. The encapsulation matrix is designed to protect the beneficial soil microbes and prolong their viability in the field for more than one growing season. The objective of this study was to encapsulate various commercial formulations of beneficial soil microbes in the starch/gypsum matrix and to apply the products in the field to test whether they are effective in improving the yields and quality of processing tomatoes.

Materials and Methods.

Two commercial formulations of beneficial soil microbes were acquired including Inogro (Dallas, TX) and Sentinel (Sentinel Biologixs, Inc, Woodlands, TX). Inogro is marketed as a synergistic formulation of naturally occurring microbes selected for their ability to improve plant health and growth through improved soil fertility. The microbes in Inogro benefit the soil and plants by fixing nitrogen, solubilizing phosphorous, producing phytohormones, promoting a healthy pH, protecting plants by minimizing damage from plant pathogens, and they exhibit sufficient vigor to compete with other bacteria for a niche in the soil rhizosphere. The microbes are dispersed in a liquid of humic acids (6%). The Inogro product is recommended at a rate of 1-3 gallons per acre depending on the crop. The HL treatment shown as treatment #12 in table 4 below is a control that consists of the Inogro liquid product that was autoclaved a total of three times for 45 min each to completely deactivate any microbes. The intent of this treatment was to observe the effects of the Inogro product without the effect of the microbes. The Sentinel product is a mixture of six spore forming bacteria with unspecified beneficial characteristics. Unlike the Inogro product, the Sentinel liquid does not contain humic acids. The Sentinel product recommended application rate is one half gallon per acre. Premium 6 is a liquid product containing humic acids (8.5%) derived from KOH extraction of lignite coal from Canada. It is a product sold by Biogro headquartered in Mabton, WA. and contains no beneficial soil microbes.

Encapsulation.

Corn starch powder was dispersed in water to form an aqueous slurry containing 15% starch (w/w). The slurry was heated to 92°C forming a clear, viscous mixture. The slurry was placed in a refrigerator overnight to allow the starch to form a rigid gel. Batches of encapsulated microbes were made by weighing a quantity of starch gel (2.576 kg) and blending in the commercial microbial liquid at the desired concentration. The ingredients were thoroughly mixed in a Hobart paddle mixer. Gypsum power was added gradually while mixing at the lowest speed until a granulated product was formed. The granulated product was sieved to remove the large particles and air-dried. The encapsulated Inogro granules prepared in this manner constituted the treatment FG (see table 1 below) and were used in treatments 7, 9, 11, and 15 (see table 4 below).

The following tables provide details about the treatments described in Table 4. The liquid treatments are all from products detailed in the materials section. The liquids come in concentrated form and must be diluted for field applications. The dilutions required for each liquid is detailed in the notes section of Table 4. For the treatments using dry granules of encapsulated microbes, Tables 1-3 provide the details on the proportions. The methods used to prepare the samples are described in the methods section above.

Table 1. FG treatment. Formulation and material cost for Inogro encapsulated in starch/gypsum granules are provided. The estimated dry weight of the batch was 12.50 Kg. Final estimated material cost for dry granules is $0.78/kg.

Material	Amount (kg)	Percentage	Cost ($/kg)	Total Cost
Melogel Starch	0.3864	2%	1.10	$0.43
Water	2.1896	14%	-	-
Gypsum	12.058	78%	0.21	$2.52
Inogro Liquid	0.864	6%	7.89	$6.82
TOTAL WET WT	15.498	100%		$9.77

The SG encapsulant was prepared in a similar manner to the FG product except that the microbes encapsulated were from the Sentinel product. The proportions and cost estimates of this product are included in table 2. The SG encapsulant was used in treatment 5 shown in table 4 below.

Table 2. SG treatment. Formulation and material cost for Sentinel encapsulated in starch/gypsum granules are provided. The estimated dry weight of the batch was 12.50 Kg. Final estimated material cost for dry granules is $0.35/kg.

Material	Amount (kg)	Percentage	Cost ($/kg)	Total Cost
Melogel Starch	0.3864	2%	1.10	$0.43
Water	2.1896	14%	-	-
Gypsum	12.70	82%	0.21	$2.52
Sentinel	0.207	1%	6.00	$1.24
TOTAL WET WT	15.483	100%		$4.32

The concentrated FG encapsulante was prepared using a pregelatinized starch powder. No water was added to make this formulation. Instead the pregelatinized starch was mixed at room temperature with the Inogro liquid to create a slurry. The gypsum was then gradually added as described previously and mixed until granules formed.

Table 3. Concentrated FG treatment. Formulation and material cost for Inogro encapsulated in starch/gypsum granules are provided. The estimated dry weight of the batch was 14.74 Kg. Final estimated material cost for dry granules is $1.89/kg.

Material	Amount (kg)	Percentage	Cost ($/kg)	Total Cost
Pregel Starch	0.3864	2%	2.20	$0.85
Gypsum	12.058	78%	0.21	$2.52
Inogro Liquid	3.1	20%	7.89	$24.46
TOTAL WET WT	15.54	100%		$27.83

Experimental Design

There were 16 treatments tested in the tomato trials for 2014. The plants were transplanted into the field on 4/23/2014 at which time they also received treatment. The treatments and their importance to the study are listed below:

Treatment 1 consisted of a control with normal amounts of fertilizer (100%). This treatment is the standard by which we compare the microbe-based treatments.

Treatment 2 is a control with only 50% of the normal fertilization (50%). The literature reports that beneficial soil microbes may not provide nutrients if the nutrient level of the soil is already high from chemical fertilizers. Consequently, most of the treatments will have 50% fertilizer rates so as to not inhibit the benefit of the microbes and to also demonstrate whether beneficial microbes can elevate production above that of the 50% control.

Treatment 3 is a control without any fertilizer (Control 0%). In the event that 50% fertilization is also inhibitory on the action of the microbes, a control without fertilizer was tested to ensure that no inhibition would be seen. It would be fully expected that if the beneficial microbes were active, they would increase the tomato production above the control without any fertilizer.

Treatment 4 is the Sentinel commercial microbial liquid product (SL) which was applied at a rate slightly higher than the rate recommended by the manufacturer (0.86 gal/A). This treatment was tested at 50% of the normal fertilization rate. This treatment was necessary to provide a benchmark with which to compare the encapsulated Sentinel product. If this product is effective, we anticipate it will result in higher tomato yields than the control with 50% fertilization (treatment 2).

Treatment 5 is the dry starch/gypsum granule product containing the microbes of the Sentinel liquid (SG). This treatment is tested at 50% of the normal fertilization. The granular product contains approximately the same number of microbes as the liquid application. If the encapsulated product is effective, treatment 5 should have higher tomato yields than the control with 50% fertilization (treatment 2) and possibly equal or higher yields than the liquid product.

Treatment 6 is the liquid Inogro product (FL) with 100% of the normal fertilization. This treatment is expected to have yields equal to or greater than the control with 100% fertilization.

Treatment 7 is the dry starch/gypsum granule product containing the microbes of the Inogro product (FG). This treatment has a 100% fertilization rate and should result in crop yield equal or higher than the control with the normal (100%) fertilizer rate.

Treatment 8 is the liquid Inogro product (FL) with 50% of the normal fertilization. This treatment is expected to have yields equal to or greater than the control with 50% fertilization.

Treatment 9 is the dry starch/gypsum granule product containing the microbes of the Inogro product (FG). This treatment has a 50% fertilization rate and should result in crop yield equal or higher than the control with the 50% fertilizer rate.

Treatment 10 is the liquid Inogro product (FL) with 0% of the normal fertilization. This treatment is expected to have yields equal to or greater than the control with no fertilization.

Treatment 11 is the dry starch/gypsum granule product containing the microbes of the Inogro product (FG). This treatment has no chemical fertilization and should result in crop yield equal or higher than the control without chemical fertilizers.

Treatment 12 is the Inogro liquid product that has been autoclaved three times to ensure the microbes are inactive (HL). This treatment received 50% of normal fertilization and should product tomato yields equal or higher than the control receiving 50% of the normal fertilization. This treatment should help discern the effect of active microbes on crop yield. There was some question as to whether the humic acids in the product could increase yields. This treatment will demonstrate whether the humates can increase production compared to the control (50%) of the liquid product with active microbes (treatment 8).

Treatment 13 is a product that contains only humic acids (Premium 6). If humic acids are effective in increasing crop yields, it is expected that the results will be similar to those of treatment 12.

Treatment 14 consists of two applications (FL+FL) of the Inogro liquid product; once in the greenhouse about 2 weeks before transplanting (4/9/2014) and again at the time of transplantation to the field (4/23/2014). The rationale for this treatment is that inoculation of the seedlings in the greenhouse will give the microbes a better chance of colonizing and establishing populations before transplantation and could help promote colonization in the rhyzosphere of the plant once it is growing in the field.

Treatment 15 consists of a liquid treatment in the greenhouse (4/9/2014) and granule treatment in the field (4/23/2014) (FL+FG). Again, it is hoped that inoculation in the greenhouse will help the microbes to establish population early in development. The granule application at the time of transplanting is similar the previous applications of FG at the time of transplantation.

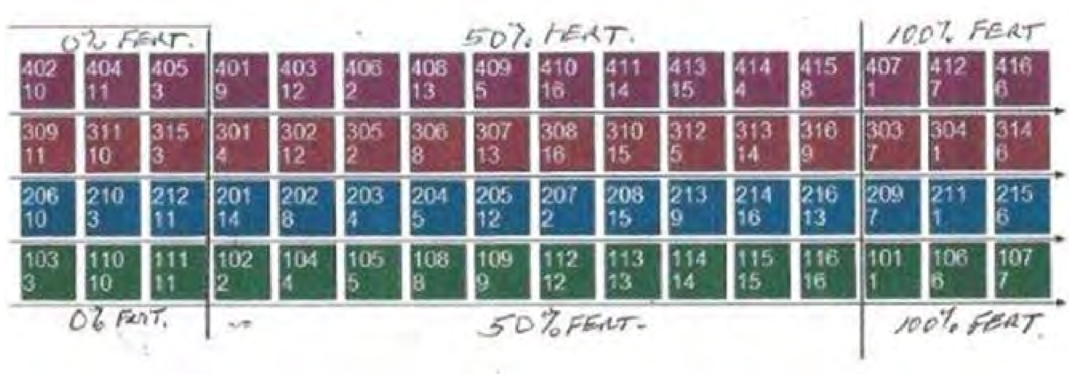
Treatment 16 is with concentrated FG granules as described in Table 3. This treatment contains more than three times the amount of Inogro liquid than FG granules described in Table 1. This treatment should give higher yields than the control (50% fertilization) and Treatment 9 if the microbes are active and effective.

The tomatoes were seeded in plastic trays with wells in March and were treated on 4/9/2014 for treatments 14 and 15. The seedlings were grown in a greenhouse for approximately 4 weeks before being transplanted into the field on 4/23/2014.

Figure 1. Photo of the tomato seedlings being grown in the greenhouse in preparation for planting in the field. Two treatments including inoculation of seedings with microbial products. The photo was taken on April 17, 2014.

The fields for the tomao trials consisted of a sandy loam soil. A cover crop was grown on the field during the fall and winter and then disked into the soil to allow the vegetative material to decompose and provide organic matter for the spring crop of tomatoes. The field was fertilized with a preplant treatment of 15-15-15 fertilizer at a rate of 100 lbs/acre. After the transplants were planted, fertilizer applications were applied 1st bloom (May 27th = 11 lbs N), full bloom (June 17th = 14lbs N), early fruit set (July 7th = 12 lbs N), and 1st color = July 25th = 12 lbs N). The fertilizer was Can 17 or 17-0-0 ($5Ca(NO_3)_2 \cdot NH_4NO_3 \cdot 10H_2O$). The 50% fertilizer rate is half of the amount but same number of applications. The block with 0% fertilizer received no applications of fertilizer other than the preplant fertilizer treatment. The layout of the experiment was setup with 64 plots which were randomized within the fertilization scheme selected. A copy of the plot design is included below. The actual planting date of the transplants into the field was April 23, 2014.

Figure 2. Layout design of field plots for tomato trials. The rows contain 16 plots. The four rows are for the four replicates. The treatments were randomized within each row and within the appropriate fertilizer treatment.



The soil analysis of the field showed that the nitrogen content was generally in the medium range (18-23ppm) except for one plot that was particularly low (9ppm). The organic matter of the soil ranged from very low to low (0.3% to 0.9%). The phosphorous content of the soil was very high (63-82ppm). The potassium, magnesium, and calcium levels in the soil were generally high as was copper. Boron levels were very low. In general, the soil was slightly basic with a pH of 7.3-7.5. See figure 3.

Figure 3. Results of soil analysis from four plots before the transplants were planted.

USDA - Pre Application

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 14-118-073

CLIENT NO: 2271-D

SEND TO: TWO BEES AG
20592 AYERS AVENUE
ESCALON, CA 95320-

SUBMITTED BY:

GROWER:

DATE OF REPORT: 05/02/14

SOIL ANALYSIS REPORT

PAGE: 1

SAMPLE ID	LAB NUMBER	Organic Matter * % Rating	Organic Matter ** ENR lbs/A	Phosphorus *P1 (Weak Bray) **** * ppm	Phosphorus NaHCO$_3$-P (Olsen Method) **** * ppm	Potassium K ***** * ppm	Magnesium Mg *** * ppm	Calcium Ca *** * ppm	Sodium Na *** * ppm	pH Soil pH	pH Buffer Index	Hydrogen H meq/100g	Cation Exchange Capacity C.E.C. meq/100g	PERCENT CATION SATURATION (COMPUTED) K %	Mg %	Ca %	H %	Na %
100	54553	0.7L	44	63VH	50VH	155M	231H	1193H	43L	7.3		0.0	8.4	4.7	22.5	70.6	0.0	2.2
200	54554	0.3VL	37	69VH	31VH	189H	199H	936M	34L	7.5		0.0	6.9	7.0	23.6	67.3	0.0	2.1
300	54555	0.9L	49	82VH	41VH	208H	225H	990M	39L	7.3		0.0	7.5	7.1	24.7	66.0	0.0	2.3
400	54556	0.7L	44	75VH	33VH	208H	259H	1139M	45L	7.4		0.0	8.5	6.2	24.9	66.6	0.0	2.3

SAMPLE NUMBER	Nitrogen NO$_3$-N ppm	Sulfur SO$_4$-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
100	23M	17M	1.4M	3M	8L	1.4H	0.3VL	L	1.0M			63	19	18	SANDY LOAM
200	9L	19M	0.9L	2L	8L	1.6H	0.2VL	L	0.6L			65	19	16	SANDY LOAM
300	18M	11M	1.4M	2L	11M	2.8VH	0.3VL	L	0.7M			65	19	16	SANDY LOAM
400	18M	11M	1.1M	2L	9L	2.2H	0.3VL	L	0.7M			63	17	20	SANDY LOAM

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

M Buttress
Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

Figure 4. Photo of the field before planting that was used for the tomato trials. Photo taken April 17, 2014.

The 16 treatments that were applied to the field are detailed in Table 4. As mentioned earlier, the field received a preplant application of 15-15-15 fertilizer at a rate of 100 lbs/acre. Once the transplants were planted, the additional fertilizer application totals are noted in the "fertilizer amount" indicated in table 4. The application notes provide the information on how the treatments were applied for each of the 16 treatments.

Table 4. Table containing the 16 treatments tested in the tomato trial at two-bees farm.

Sample #	Treatment	Product	Rate Acre	Fertilizer Amount*	Application Notes
1	Control	0	0	100% (49lbs N/A)	1 liter of WATER was added to transplant trays before planting. One quarter cup of WATER was added to each hole before planting transplant.
2	Control	0	0	50% (25lbs N/A)	1 liter of WATER was added to transplant trays before planting. One quarter cup of WATER was added to each hole before planting transplant.
3	Control	0	0	0%	1 liter of WATER was added to transplant trays before planting. One quarter cup of WATER was added to each hole before planting transplant.
4	SL	(Sentinel liquid)	0.86gal /A	50% (25lbs N/A)	Add 24 grams of concentrate to water to make one gallon. Add ¼ cup of liquid to transplant hole before planting.
5	SG	Sentinel granule	680 lbs/A (Equivalent to 1 gal/A)	50% (25lbs N/A)	Add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.
6	FL	Inogro liquid	3.2gal/ A	100% (49lbs N/A)	Add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.
7	FG	Inogro in granule	680 lbs/A (Equivalent to 3.2 gal/A)	100% (49lbs N/A)	Add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.
8	FL	Inogro liquid	3.2gal/ A	50% (25lbs N/A)	Add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.

9	FG	Inogro in granule	680 lbs/A (Equivalent to 3.2 gal/A)	50% (25lbs N/A)	Add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.
10	FL	Inogro liquid	3.2gal/A	0%	Add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.
11	FG	Inogro in granule	680 lbs/A (Equivalent to 3.2 gal/A)	0%	Add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.
12	HL	Autoclaved Inogro	3.2gal/A	50% (25lbs N/A)	Add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.
13	Premium 6	Biogro Premium 6	3.2gal/A	50% (25lbs N/A)	Add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.
14	FL+FL	Liquid in GH, Liquid in field	3.3gal/A Plus inoculation in greenhouse.	50% (25lbs N/A)	Add 1 liter of liquid (23g of concentrate per liter) to tray 2 weeks before transplanting. On day of transplanting, add 1 liter of liquid (88.7g concentrate per gallon) to tray before transplanting. Add ¼ of liquid to transplant hole before planting transplant.
15	FL+FG	Liquid in GH-Granule in field	680 lbs/A (Equivalent to 3.3 gal) Greenhouse inoculation	50% (25lbs N/A)	Add 1 liter of liquid (23g of concentrate per liter) to tray 2 weeks before transplanting. On day of transplanting add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.
16	Concentrated FG	Made with Pregel pwdr	680 lbs/A (equivalent to 6.6 gal/A)	50% (25lbs N/A)	Add 1 liter of WATER to transplant tray before transplanting. Add two tablespoons of granules in transplant hole. Add ¼ cup to transplant hole then mix well with soil before adding transplant.

*Fertilization before the experiment started was done by applying 15-15-15 at a rate of 100lbs/acre. After planting, fertilizer was applied 1st bloom (May 27th = 11 lbs N), full bloom (June 17th = 14lbs N), early fruit set (July 7th = 12 lbs N), and 1st color = July 25th = 12 lbs N). The fertilizer was Can 17 or 17-0-0 ($5Ca(NO_3)_2 \cdot NH_4NO_3 \cdot 10H_2O$). The 50% fertilizer rate is half of the amount but same number of applications.

Figure 5. Photo of tomato trials on May 28 which is about the time of first bloom. This photo was taken about one month after the tomato seedlings were taken from the greenhouse and transplanted into the field.

Results.

Two tissue analyses were performed from samples of all 16 treatments at two times during the experiment. The first tissue analysis was finished on 6/26/2014. The second tissue analysis was finished 8/6/2014. The results did not show any nutrient levels that correlated with the treatments. It was somewhat unexpected to see nutrient ranges from the first analysis completely different than the ranges from the second analysis. For instance, nitrogen levels from the first analysis were generally double the level found in the tissue from the second analysis. The same was true for phosphorous and potassium levels. Conversely, the levels of sulfur, calcium, and magnesium in the second analysis were double the values of the first analysis. These changes may reflect natural fluctuations in nutrient levels and indicate that other factors influence mineral content of tissue much more than the treatments we applied. Even the nutrient level in tissue receiving no fertilizer was comparable to the nutrient level in plants receiving 100% of normal fertilization. The tissue analyses are presented in the following three tables.

Table 5. This table contains the results from tissue analysis for nitrogen, sulfur, phosphorous, and potassium. The tissue analyses was done on June 26, 2014 and August 6, 2014.

#	Treatment	26-Jun Nitrogen (%) N	6-Aug Nitrogen (%) N	26-Jun Sulfur (%) S	6-Aug Sulfur (%) S	26-Jun Phosphorus (%) P	6-Aug Phosphorus (%) P	26-Jun Potassium (%) K	6-Aug Potassium (%) K
1	Control	4.71	2.24	0.93	1.41	0.27	0.16	2.29	0.73
2	Control	4.38	2.62	1.02	1.57	0.28	0.15	2.33	0.62
3	Control	2.34	2.26	1.39	1.91	0.24	0.15	1.73	0.55
4	SL	3.14	2.25	1.28	1.57	0.25	0.14	2.46	0.45
5	SG	4.34	2.4	0.91	1.7	0.28	0.14	2.32	0.47
6	FL	4.12	2.26	0.89	1.6	0.27	0.14	2.18	0.58
7	FG	4.69	1.98	0.96	1.55	0.29	0.13	2.36	0.47
8	FL	4.26	2.48	1.14	1.88	0.28	0.13	2.06	0.4
9	FG	4.15	2.24	1.13	1.63	0.28	0.13	2.38	0.5
10	FL	3.65	2.37	1.35	2.56	0.26	0.15	2.44	0.74
11	FG	3.28	2.12	1.49	2.46	0.26	0.14	1.98	0.7
12	HL	3.31	2.03	1.31	2.15	0.25	0.12	2.31	0.46
13	Prem 6	3.38	2.08	1.2	1.89	0.23	0.12	2.18	0.39
14	FL+FL	4.13	2.25	1.01	1.65	0.27	0.13	2.2	0.45
15	FL+FG	4.42	1.99	1.06	1.95	0.27	0.12	2.51	0.46
16	Concen.	4.13	2.22	0.96	1.82	0.28	0.12	2.75	0.47

Table 6. This table contains the results from tissue analysis for magnesium, calcium, sodium and iron. The tissue analyses was done on June 26, 2014 and August 6, 2014.

		26-Jun	6-Aug	26-Jun	6-Aug	26-Jun	6-Aug	26-Jun	6-Aug
#	Treatment	(%) Mg	(%) Mg	(%) Ca	(%) Ca	(%) Na	(%) Na	PPM Fe	PPM Fe
1	Control	0.76	1.52	2.69	5.35	0.06	0.14	144	221
2	Control	0.74	1.42	2.65	5.26	0.07	0.17	129	176
3	Control	0.86	1.56	3.35	5.62	0.06	0.19	100	122
4	SL	0.76	1.57	2.82	5.49	0.06	0.18	132	130
5	SG	0.74	1.57	2.51	5.49	0.08	0.18	146	161
6	FL	0.75	1.47	2.5	5.68	0.06	0.15	146	137
7	FG	0.75	1.49	2.7	5.62	0.08	0.2	148	141
8	FL	0.93	1.39	3.36	5.85	0.11	0.17	129	202
9	FG	0.78	1.37	2.79	5.23	0.08	0.17	132	164
10	FL	0.71	1.39	2.77	5.76	0.06	0.14	113	152
11	FG	0.69	1.41	2.92	5.82	0.06	0.16	114	169
12	HL	0.86	1.45	3.13	5.54	0.08	0.14	122	171
13	Premium6	0.81	1.52	2.87	5.87	0.07	0.19	111	130
14	FL+FL	0.97	1.44	3.3	5.39	0.12	0.2	129	151
15	FL+FG	0.8	1.63	2.81	5.79	0.09	0.16	122	122
16	Concen.	0.72	1.35	2.39	5.51	0.06	0.16	128	146

Table 7. This table contains the results from tissue analysis for aluminum, manganese, boron, copper and zinc. The tissue analyses was done on June 26, 2014 and August 6, 2014.

		26-Jun	6-Aug	26-Jun	6-Aug	26-Jun	6-Aug	26-Jun	6-Aug	26-Jun	6-Aug
#	Treatment	PPM Al	PPM Al	PPM Mn	PPM Mn	PPM B	PPM B	PPM Cu	PPM Cu	PPM Zn	PPM Zn
1	Control	48	97	62	102	35	35	13	10	28	27
2	Control	40	80	59	111	30	39	13	11	24	21
3	Control	49	71	61	88	32	32	9	9	18	13
4	SL	56	69	52	99	28	36	11	9	20	12
5	SG	46	72	62	126	27	35	13	11	25	16
6	FL	47	69	54	96	35	39	13	8	25	13
7	FG	46	76	56	98	30	42	13	7	24	13
8	FL	47	120	62	89	31	34	14	10	21	13
9	FG	47	98	53	89	26	35	13	8	21	12
10	FL	44	72	45	100	23	30	11	8	18	13
11	FG	45	61	50	80	25	28	10	7	17	11
12	HL	45	69	58	84	25	25	12	7	24	10
13	Premium6	47	63	57	102	37	28	11	5	21	11
14	FL+FL	36	69	66	107	28	32	13	7	23	12
15	FL+FG	34	58	58	110	31	26	14	6	23	11
16	Concen.	32	82	54	115	26	29	12	6	23	11

The following tables contain the data for the parameters measured during the growing season and at harvest time. Table 8 compares the plant height and leaf size starting on May 13, 2014.

Plant height and leaf size on 5/13/2014. The first fertilizer application wasn't until 5/27/2014 so we shouldn't expect any fertilizer affect by this time. In other words, the 0%, 50%, 100% fertilizer controls are all the same since the first fertilizer application came later. The variation in the values of plant height were such that no significant difference was detected in the data.

Since none of the controls and treatments had received a fertilizer application, we can compare the treatments against all three controls. Also, treatments 6, 8, and 10 were identical to this point. Treatment 8 was significantly higher than the controls. However, treatments 6 and 10 were not. If the treatment were having a real effect, it should have been observed in all three treatments. My conclusion is that there is no real difference between the controls and treatments at this point.

Table 8. Samples measured on 5/13/2014. Plant size where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is bigger and less than 5 is smaller. Also, leaf size where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is bigger leaf size and less than 5 is smaller leaf size. Values followed by a different letter are significantly different at $p<0.05$.

No.	**Name**	**Plant Height 1-10**		**Leaf Size 1-10**	
1	UNT. CONTROL - FERT 100%	5.8	a	5.5	cde
2	UNT. CONTROL - FERT 50%	6.3	a	6	b-e
3	UNT. CONTROL - FERT 0%	5	a	5	e
4	SL - FERT 50%	6.3	a	6.8	ab
5	SG - FERT 50%	6	a	5.3	de
6	FL - FERT 100%	6	a	5.3	de
7	FG - FERT 100%	7	a	6.5	abc
8	FL - FERT 50%	6.8	a	7	a
9	FG - FERT 50%	6	a	5.5	cde
10	FL - FERT 0%	6.3	a	5.5	cde
11	FG - FERT 0%	6.5	a	6.3	a-d
12	HL - FERT 50%	6.8	a	6.5	abc
13	PL - FERT 50%	6.3	a	5.5	cde
14	FL - FERT 50%	6	a	6.5	abc
15	FL - FERT 50%	6.5	a	6	b-e
16	MFG - FERT 50%	6.3	a	5.5	cde

Plant vigor. The fertilizer application dates were 5/27, 6/17, 7/7, and 7/21. The data for the three controls are confusing since they should all be equal. They are not equal which brings to question how useful the measurements are. They are subjective based on the person making the measurements. The treatments are not significantly different than the three controls so there is little evidence of a treatment effect by 5/13.

Looking at the data for 7/15, there had already been two fertilizer applications so you expect the vigor to show a fertilizer effect on the controls. Both the 50% and 100% fertilizer treatments show more vigor than the 0% control. This was expected but we also expected to see a difference between 50% and 100% fertilizer. There was no difference which may suggest that the fertilizer application rates are too high. There may be no basis for adding more fertilizer than the amount used for 50% fertilization. Treatments 15 and 16 were the only treatments significantly higher than the controls.

Table 9. Plant vigor where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is more vigor and less than 5 is less vigor. Values followed by a different letter are significantly different at $p<0.05$.

No.	Name	5/13 Vigor 1-10		6/5 Vigor 1-10		7/9 Vigor 1-10		7/15 Vigor 1-10	
1	UNT. CONTROL - FERT 100%	6.3	c	6.5	bc	6.8	bcd	6.5	bc
2	UNT. CONTROL - FERT 50%	7.3	abc	6.5	bc	6	de	6.5	bc
3	UNT. CONTROL - FERT 0%	5	d	5	d	5	e	5	d
4	SL - FERT 50%	7.5	ab	7.8	ab	7	a-d	7.3	abc
5	SG - FERT 50%	6.3	c	7.3	abc	7.3	a-d	7.8	ab
6	FL - FERT 100%	6.3	c	6.5	bc	7	a-d	6.8	abc
7	FG - FERT 100%	7	abc	7.5	abc	7.3	a-d	7.8	ab
8	FL - FERT 50%	7.3	abc	7.8	ab	7.5	abc	7.5	abc
9	FG - FERT 50%	6.5	bc	7.3	abc	7.8	abc	7.8	ab
10	FL - FERT 0%	6.3	c	6	cd	6.8	bcd	6.3	c
11	FG - FERT 0%	7	abc	7.3	abc	7	a-d	6.5	bc
12	HL - FERT 50%	7.8	a	7.5	abc	6.5	cd	7.5	abc
13	PL - FERT 50%	6.5	bc	6.5	bc	7.3	a-d	7.3	abc
14	FL - FERT 50%	7	abc	8	ab	7.3	a-d	7.5	abc
15	FL - FERT 50%	7.8	a	8.5	a	8	ab	8	a
16	MFG - FERT 50%	6.3	c	6.5	bc	8.3	a	8	a

Plant bloom. The fertilizer application dates were 5/27, 6/17, 7/7, and 7/21. The plant blossoms were counted on 6/5/2014 which is about a week after the first fertilization application. You would probably not expect any differences between the controls based on a week span from the fertilization step. Surprisingly, the control with no fertilization had lower flower counts than the other two controls. This seems a little hard to believe since flower buds were formed long before the fertilizer application was made.

The treatments were all within the range of the controls except for treatments 12 and 15 which were higher than the controls.

Table 10. Plant bloom on 6/5/2014 where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is more bloom and less than 5 is less bloom. Values followed by a different letter are significantly different at $p<0.05$.

No.	**Name**	**Plant Bloom 0-10**	
1	UNT. CONTROL - FERT 100%	6	b
2	UNT. CONTROL - FERT 50%	6.3	b
3	UNT. CONTROL - FERT 0%	5	c
4	SL - FERT 50%	6.8	ab
5	SG - FERT 50%	7	ab
6	FL - FERT 100%	6.5	ab
7	FG - FERT 100%	6.8	ab
8	FL - FERT 50%	7	ab
9	FG - FERT 50%	6.5	ab
10	FL - FERT 0%	6.3	b
11	FG - FERT 0%	7	ab
12	HL - FERT 50%	7.5	a
13	PL - FERT 50%	6.3	b
14	FL - FERT 50%	6.8	ab
15	FL - FERT 50%	7.5	a
16	MFG - FERT 50%	7	ab

Plant Color. This parameter seems a little confusing. I suppose it means the plants that are greener. Regardless, there were no differences observed based on the readings. The results are shown in table 5. The samples were taken on 6/5/2014 which was about a week after the first fertilizer application. It is interesting that the fertilization did not affect the plant color. That raises the question of whether the fertilization rates were higher than needed for optimum plant growth and yield.

Table 11. Samples taken on 6/5/2014. Plant color where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is more color and less than 5 is less color. Values followed by a different letter are significantly different at $p<0.05$.

No.	Treatment Name	Plant Color 0-10	
1	UNT. CONTROL - FERT 100%	5	a
2	UNT. CONTROL - FERT 50%	5	a
3	UNT. CONTROL - FERT 0%	5	a
4	SL - FERT 50%	5	a
5	SG - FERT 50%	5	a
6	FL - FERT 100%	5	a
7	FG - FERT 100%	5	a
8	FL - FERT 50%	5	a
9	FG - FERT 50%	5	a
10	FL - FERT 0%	5	a
11	FG - FERT 0%	5.3	a
12	HL - FERT 50%	5	a
13	PL - FERT 50%	5	a
14	FL - FERT 50%	5	a
15	FL - FERT 50%	5	a
16	MFG - FERT 50%	5	a

Fruit Set. The fertilizer application dates were 5/27, 6/17, 7/7, and 7/21. Fruit set was on 7/9/2014 which was after the third fertilizer application. The fertilizer applications had no effect on fruit set. However, most of the treatments produced a higher fruit set than the controls.

Table 12. Fruit set on 7/9/2014 where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is more fruit set and less than 5 is less fruit set. Values followed by a different letter are significantly different at $p<0.05$.

No.	Treatment Name	Fruit Set 0-10	
1	UNT. CONTROL - FERT 100%	5.3	bc
2	UNT. CONTROL - FERT 50%	5.3	bc
3	UNT. CONTROL - FERT 0%	5	c
4	SL - FERT 50%	7.3	a
5	SG - FERT 50%	6.5	ab
6	FL - FERT 100%	6.3	abc
7	FG - FERT 100%	6.8	a
8	FL - FERT 50%	7	a
9	FG - FERT 50%	6.3	abc
10	FL - FERT 0%	7	a
11	FG - FERT 0%	7	a
12	HL - FERT 50%	7.3	a
13	PL - FERT 50%	7.3	a
14	FL - FERT 50%	6.8	a
15	FL - FERT 50%	6.8	a
16	MFG - FERT 50%	7.3	a

Plant Density. The fertilizer application dates were 5/27, 6/17, 7/7, and 7/21. The plant density was determined on 7/9/2014. There was no treatment affect on plant density.

Table 13. Samples taken 7/9/2014. Plant density where the untreated control with no fertilizer is assigned a value of 5 and all other plots rated against this value. Higher than 5 is more dense and less than 5 is less dense. Values followed by a different letter are significantly different at p<0.05.

No.	Name	Density 0-10	
1	UNT. CONTROL - FERT 100%	5.8	a
2	UNT. CONTROL - FERT 50%	5.5	a
3	UNT. CONTROL - FERT 0%	5	a
4	SL - FERT 50%	6.3	a
5	SG - FERT 50%	5.8	a
6	FL - FERT 100%	5.5	a
7	FG - FERT 100%	6.3	a
8	FL - FERT 50%	6.5	a
9	FG - FERT 50%	6.5	a
10	FL - FERT 0%	5.8	a
11	FG - FERT 0%	5.5	a
12	HL - FERT 50%	5.5	a
13	PL - FERT 50%	6.3	a
14	FL - FERT 50%	6.3	a
15	FL - FERT 50%	6.5	a
16	MFG - FERT 50%	6.5	a

Percent Red Fruit Per Plot. The fertilizer application dates were 5/27, 6/17, 7/7, and 7/21. The percent red fruit per plot was measured on 7/9, 7/15, and 7/22. There seemed to be some treatment effects on the fruit color for only the measurements of 7/15. The treatments generally had more red fruit than the controls but the differences were probably variable so the differences were not significant.

Table 14. Samples taken 7/9, 7/15, 7/22. Percent red fruit per plot. Values followed by a different letter are significantly different at $p<0.05$.

No.	Name	7/9 %		7/15 %		7/22 %	
1	UNT. CONTROL - FERT 100%	0.3	a	2.8	cd	6	a
2	UNT. CONTROL - FERT 50%	0	a	1.5	d	5.8	a
3	UNT. CONTROL - FERT 0%	0	a	4.3	a-d	5.3	a
4	SL - FERT 50%	1.3	a	5.3	abc	6.5	a
5	SG - FERT 50%	0.5	a	3.3	bcd	7	a
6	FL - FERT 100%	1	a	3.3	bcd	7.5	a
7	FG - FERT 100%	1	a	3.3	bcd	7.8	a
8	FL - FERT 50%	0.5	a	5	abc	9.5	a
9	FG - FERT 50%	0	a	3.5	a-d	6.5	a
10	FL - FERT 0%	1.8	a	4.8	abc	7	a
11	FG - FERT 0%	1.3	a	5.8	ab	7.8	a
12	HL - FERT 50%	0.5	a	5.5	abc	10	a
13	PL - FERT 50%	1	a	4	a-d	9	a
14	FL - FERT 50%	1.8	a	6.3	a	7.5	a
15	FL - FERT 50%	1	a	5.5	abc	7.5	a
16	MFG - FERT 50%	1.3	a	4.5	abc	8.3	a

Yield Data. Crop yield is the most important parameter measured in the study and is the general focus of farmers. Treatments that increase yield are of great interest. Surprisingly, among the controls, there was a lower yield for 100% fertilization than for the control with no fertilization. This is a baffling result. The 50% fertilization rate had the highest yield of the control group. This result would suggest that there was no rationale for applying fertilizers to this field. It was an added expense and it did not increase yields. The results with Inogro were inconsistent. The lowest yield was with Inogro and 100% fertilization (treatment #6). The highest yield was with Inogro and 50% fertilization (treatment #8). Inogro with no fertilization was similar to the control with no fertilization. The second largest yield was with the Sentinel liquid product and the autoclaved Inogro and 50% fertilization.

Table 15. Yield data taken over four day periord from august 11 to august 14. Values followed by a different letter are significantly different at p<0.05.

No.	Name	Red Fruit LB		Green Fruit LB		Cull Fruit LB		Total
1	UNT. CONTROL - FERT 100%	120.6	cd	8.2	c	2.9	de	131.7
2	UNT. CONTROL - FERT 50%	155.1	ab	9.5	abc	3.7	de	168.3
3	UNT. CONTROL - FERT 0%	130.7	bcd	14	ab	6.6	ab	151.3
4	SL - FERT 50%	154.8	ab	12.9	ab	4	cde	171.7
5	SG - FERT 50%	142.3	bc	10.8	abc	2.3	e	155.4
6	FL - FERT 100%	107.4	d	10.5	abc	2.2	e	120.1
7	FG - FERT 100%	129.4	bcd	11.6	abc	2.5	de	143.5
8	FL - FERT 50%	172.8	a	13.7	ab	3.8	de	190.3
9	FG - FERT 50%	131.3	bcd	9.4	bc	4.8	bcd	145.5
10	FL - FERT 0%	136.4	bc	14	a	6.1	abc	156.5
11	FG - FERT 0%	136.8	bc	13.5	ab	7.1	a	157.4
12	HL - FERT 50%	156.2	ab	10.9	abc	3.7	de	170.8
13	PL - FERT 50%	143.5	bc	13.5	ab	2.4	e	159.4
14	FL - FERT 50%	133.8	bc	9.5	abc	4.4	cde	147.7
15	FL - FERT 50%	145.6	bc	8.4	c	2.9	de	156.9
16	MFG - FERT 50%	145.2	bc	11.4	abc	2.5	de	159.1

The data below is for the tomato yield totals which were not provided by the 2-Bees farms. The data show that 100% of the normal fertilization did not increase crop yield. It begs the question of whether the soil was over-fertilized. That would explain why yield did not increase with higher rates of fertiization.

Table 16. Mean and Standard Deviation (STD) for controls getting 100%, 50%, or 0% fertilization. Values are total tomato yield of plots.

	Rep 1	Rep 2	Rep 3	Rep 4	Mean	STD
Control Fert--100%	118.5	116.6	123.6	167.9	131.7	24.3
Control Fert--50%	177.9	151.1	196	147.9	168.2	22.9
Control Fert--0%	144.1	138.6	181	141.2	151.2	20.0

Table 17. Soluble solids content. The level of fertilization did not have a significant effect on yield.

Trt Treat #	Treatment Name	100	200	300	400	Mean	STD
2	UNT. CONTROL - FERT 50%	8	8	7.4	8	7.85	0.30
8	FL - FERT 50%	8.2	7.8	7	7.2	7.55	0.55
9	FG - FERT 50%	8.2	8.2	8.4	7.4	8.05	0.44
12	HL - FERT 50%	8.4	8.2	8	8	8.15	0.19
13	PL - FERT 50%	8.4	8.4	7.8	8.2	8.20	0.28
14	FL - FERT 50%	8.2	8.4	8.4	8	8.25	0.19
15	FL - FERT 50%	8.4	8.2	8.6	8.2	8.35	0.19
16	MFG - FERT 50%	8.4	8.4	8.6	8.6	8.50	0.12

Weight of 25 fruit. This parameter is interesting because it gives a measure of the fruit size. If plants yield the same number of fruit but have larger fruit, the total yield will be greater. The results of this test indicate that there is no significant difference in the fruit size. It would stand to reason then that the treatments with the highest fruit set will also have the highest yield. We found this to be generally true but not exactly so that illustrates some of the inconsistencies in the data.

Table 22. Weight of 25 red fruit harvested on 8/11/2014. Values followed by a different letter are significantly different at p<0.05.

No.	Treatment Name	Wt of 25 fruit LB	
1	UNT. CONTROL - FERT 100%	3.2	a
2	UNT. CONTROL - FERT 50%	3.5	a
3	UNT. CONTROL - FERT 0%	3.8	a
4	SL - FERT 50%	3.6	a
5	SG - FERT 50%	3.5	a
6	FL - FERT 100%	3.1	a
7	FG - FERT 100%	3.5	a
8	FL - FERT 50%	3.7	a
9	FG - FERT 50%	3.4	a
10	FL - FERT 0%	3.4	a
11	FG - FERT 0%	3.4	a
12	HL - FERT 50%	3.6	a
13	PL - FERT 50%	3.4	a
14	FL - FERT 50%	3.6	a
15	FL - FERT 50%	3.8	a
16	MFG - FERT 50%	3.4	A

Fresh Weight of Plants. Another interesting parameter to study is the fresh weight of the plants in the field. The results indicate that there was no significant difference in the plant weight due to treatments.

Table 23. Samples taken 8/11/2014. Weight of plants from six feet of plot including all above ground plant parts. Values followed by a different letter are significantly different at $p<0.05$.

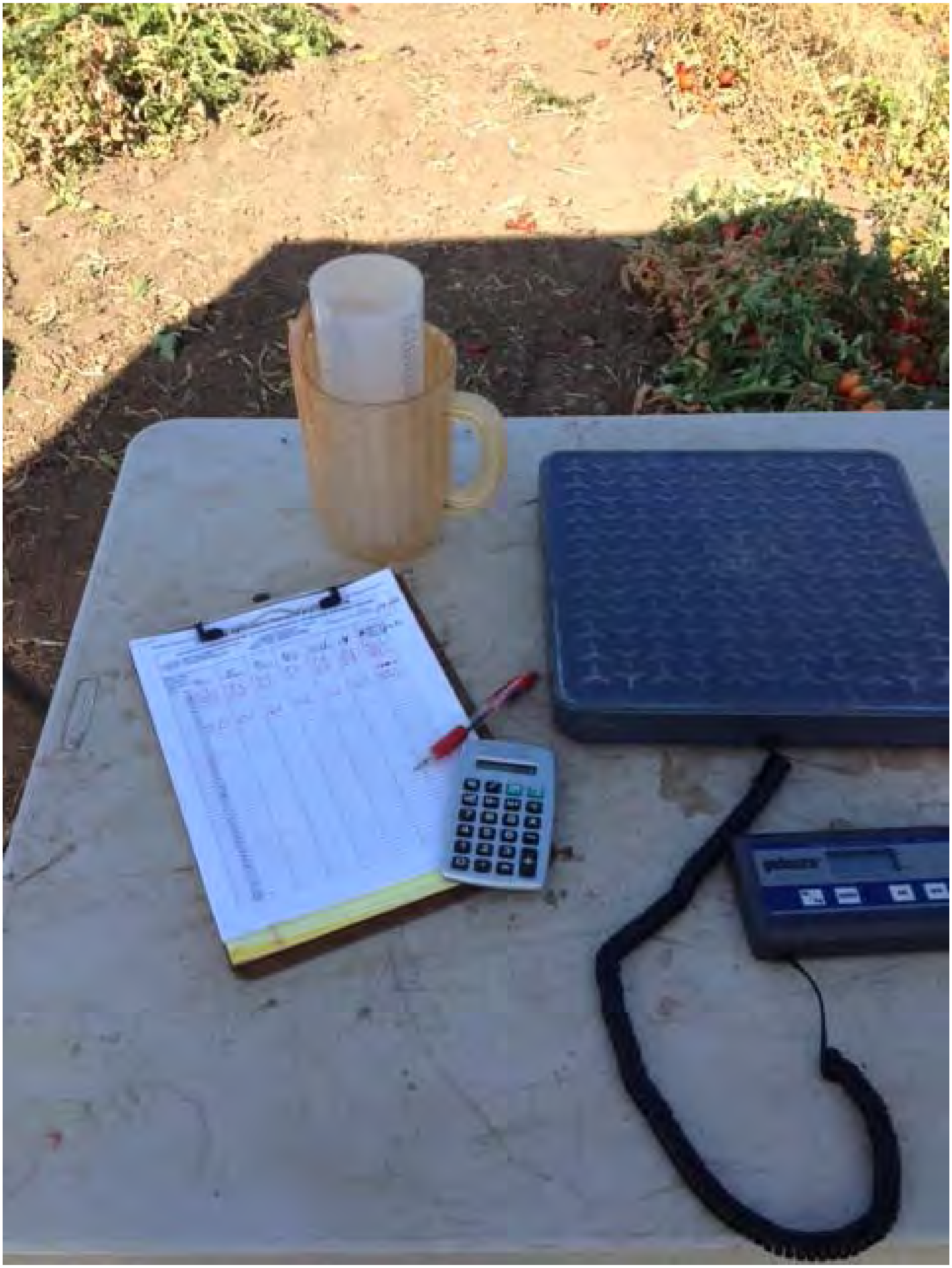
No.	**Treatment Name**	**Wt. of Plants LB**	
1	UNT. CONTROL - FERT 100%	34.8	A
2	UNT. CONTROL - FERT 50%	43.9	a
3	UNT. CONTROL - FERT 0%	43.4	a
4	SL - FERT 50%	51.4	a
5	SG - FERT 50%	40.2	a
6	FL - FERT 100%	31.9	a
7	FG - FERT 100%	38.1	a
8	FL - FERT 50%	48.2	a
9	FG - FERT 50%	37	a
10	FL - FERT 0%	36.8	a
11	FG - FERT 0%	42.9	a
12	HL - FERT 50%	45.6	a
13	PL - FERT 50%	41.9	a
14	FL - FERT 50%	39.1	a
15	FL - FERT 50%	37.5	a
16	MFG - FERT 50%	39.2	a

Conclusions. The results of the study were inconsistent. In some cases, the crop yields increased due to treatment and in other cases the yield was comparable to the control. What was surprising was that normal fertilization treatments did not increase yields. It is reasonable to conclude that the level of residual fertilization in the field was much higher than was needed for optimum crop yields. The presence of high levels of fertilization could limit the effectiveness of microbial products in the field as has been reported in the literature. If this experiment were to be repeated, it would be preferable to avoid the pre-plant fertilizer application.

1. *How Microbes Can Help Feed the World*; American Academy of Microbiology: Washington D.C., 2013; pp 1-32.
2. Bhardwaj, D.; Ansari, M.; Sahoo, R.; Tuteja, N., Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity. *Microb Cell Fact* **2014,** *13*, 1-10.
3. Yu, Q.; Ma, J.; Zou, P.; Lin, H.; Sun, W.; Yin, J.; Fu, J., Effects of combined application of organic and inorganic fertilizers plus nitrification inhibitor DMPP on nitrogen runoff loss in vegetable soils. *Environ Sci Pollut Res* **2014**, 1-10.
4. Bouwman, A. F.; Boumans, L. J. M.; Batjes, N. H., Estimation of global NH3 volatilization loss from synthetic fertilizers and animal manure applied to arable lands and grasslands. *Global Biogeochemical Cycles* **2002,** *16*, 8-1-8-14.
5. Streets, D. G.; Bond, T. C.; Carmichael, G. R.; Fernandes, S. D.; Fu, Q.; He, D.; Klimont, Z.; Nelson, S. M.; Tsai, N. Y.; Wang, M. Q.; Woo, J. H.; Yarber, K. F., An inventory of gaseous and primary aerosol emissions in Asia in the year 2000. *Journal of Geophysical Research: Atmospheres* **2003,** *108*, 8809.
6. Kleinman, P. A.; Sharpley, A.; McDowell, R.; Flaten, D.; Buda, A.; Tao, L.; Bergstrom, L.; Zhu, Q., Managing agricultural phosphorus for water quality protection: principles for progress. *Plant Soil* **2011,** *349*, 169-182.
7. Shen, J.; Yuan, L.; Zhang, J.; Li, H.; Bai, Z.; Chen, X.; Zhang, W.; Zhang, F., Phosphorus Dynamics: From Soil to Plant. *Plant Physiology* **2011,** *156*, 997-1005.
8. Rodríguez, H.; Fraga, R., Phosphate solubilizing bacteria and their role in plant growth promotion. *Biotechnology Advances* **1999,** *17*, 319-339.
9. Richardson, A. E.; Simpson, R. J., Soil Microorganisms Mediating Phosphorus Availability Update on Microbial Phosphorus. *Plant Physiology* **2011,** *156*, 989-996.
10. Chaparro, J.; Sheflin, A.; Manter, D.; Vivanco, J., Manipulating the soil microbiome to increase soil health and plant fertility. *Biol Fertil Soils* **2012,** *48*, 489-499.
11. Abdul Wahid, O. A.; Mehana, T. A., Impact of phosphate-solubilizing fungi on the yield and phosphorus-uptake by wheat and faba bean plants. *Microbiological Research* **2000,** *155*, 221-227.
12. Kim, K.; Jordan, D.; McDonald, G., Effect of phosphate-solubilizing bacteria and vesicular-arbuscular mycorrhizae on tomato growth and soil microbial activity. *Biol Fertil Soils* **1997,** *26*, 79-87.
13. Zhao, Q.; Shen, Q.; Ran, W.; Xiao, T.; Xu, D.; Xu, Y., Inoculation of soil by Bacillus subtilis Y-IVI improves plant growth and colonization of the rhizosphere and interior tissues of muskmelon (Cucumis melo L.). *Biol Fertil Soils* **2011,** *47*, 507-514.
14. Bashan, Y., Significance of timing and level of inoculation with rhizosphere bacteria on wheat plants. *Soil Biology and Biochemistry* **1986,** *18*, 297-301.
15. Pindi, P. K.; Satyanarayana, S., Liquid Microbial Consortium-A Potential Tool for Sustainable Soil Health. *Journal of Biofertilizers & Biopesticides* **2012,** *3*, 1-9.
16. Bashan, Y.; de-Bashan, L. E.; Prabhu, S.; Hernandez, J.-P., Advances in plant growth-promoting bacterial inoculant technology: formulations and practical perspectives (1998–2013). *Plant Soil* **2014,** *378*, 1-33.
17. Nguema-Ona, E.; Vicré-Gibouin, M.; Cannesan, M.-A.; Driouich, A., Arabinogalactan proteins in root–microbe interactions. *Trends in Plant Science* **2013,** *18*, 440-449.
18. Bais, H. P.; Weir, T. L.; Perry, L. G.; Gilroy, S.; Vivanco, J. M., THE ROLE OF ROOT EXUDATES IN RHIZOSPHERE INTERACTIONS WITH PLANTS AND OTHER ORGANISMS. *Annual Review of Plant Biology* **2006,** *57*, 233-266.
19. Clarholm, M., Protozoan grazing of bacteria in soil—impact and importance. *Microbial Ecology* **1981,** *7*, 343-350.

20. Schoebitz, M.; Simonin, H.; Poncelet, D., Starch filler and osmoprotectants improve the survival of rhizobacteria in dried alginate beads. *Journal of microencapsulation* **2012,** *29*, 532-538.

21. Rekha, P.; Lai, W.-A.; Arun, A.; Young, C.-C., Effect of free and encapsulated< i> Pseudomonas putida</i> CC-FR2-4 and< i> Bacillus subtilis</i> CC-pg104 on plant growth under gnotobiotic conditions. *Bioresource technology* **2007,** *98*, 447-451.



ONION TRIAL

ONION TRIAL #1

For the onions, the plot size is 250sq ft. There is 43,560 sq ft per acre so 250/43,560 = 0.00574 acres. Each plot should then get 171 g/A X 0.00574 Acres = 0.98 grams of dry ingredient for each plot. We will dilute 1 gram to 3 liters which will be sprayed on the plot followed by sprinkler irrigation.

For Bontera granules used for onions, we will weigh out the correct amount of granules. Since an acre is 43560 sq ft, and one plot is 250 sq ft, 250/43560 = 0.00574 acres X 50lbs/Acre = 0.287 lbs or 130 grams per plot. This amount of granules will be applied using a fertilizer spreader. Once it is applied to the plot, a rake will be used to work it into the ground. This will be done prior to sowing the onion seed.
The work plan called for the onions to be harvested in August 2015. Since the onions were a later variety and were planted later in the year, the onions were harvested near the end of September. The onions received no pesticide treatment during the growing season. The onion yield was recorded for each treatment. The onion root structure and condition was observed. There were no infections observed in any of the treatments or controls. The yield data for each treatment was analyzed. The results showed that there were no treatment differences. The variability in the data was excessive in our opinion. The coefficient of variation (CV) should be less than 15% for field trials. When the CV is much higher than that, there is a risk that real differences will not be detected. The CV for the onion yield data ranged from 9.8% to 66.3%. The data of only two of the treatments had a CV of 15% or below. The results indicate that neither fertilizer nor the matrix treatments significantly affect onion yields.

Conclusions: The effect of the matrix treatment on disease and bulb rot was not apparent from the data because there was no disease or rot in any of the treatments including the controls that did not receive the matrix treatment. The data variability for the onion was higher than that of the tomato trials. This is probably due to the fact that the tomato trials were planted with seedling transplants from the greenhouse. The onion trials were seeded in the field which inherently introduces more variability. The onion data indicated that neither fertilizer nor the matrix treatment affect yield. The poor yield response to fertilization could be due to the high level of soil nutrition when the study began. The pre-plant soil analysis indicated very high levels of P, medium to high levels of K, and medium levels of N. A greater fertilizer and matrix response could be expected in trials performed on nutrient-poor soils. The matrix or any other microbial product will not be as effective on nutrient rich soils.

The first Expected Measurable Outcome was a reduction in the amount of fertilizers and pesticides needed to produce onions and tomatoes by using the matrix formulation. For the onions, the farmer applied no pesticides and there was no incidence of root rot or pest infestation. This result suggests that perhaps the pesticides are not needed in every instance. The onions for this project were grown on small plots that had not been planted in onions before. Large onion farms may have different challenges. Plant pathogens can build-up in soil where onions have been grown previously. In such cases, pesticides may be necessary. The incidence of disease and pest invasion may also be more of an issue with different varieties of onions. Pesticides were not needed for any of the treatments we tested on our selected onion variety. Therefore, further testing would be required to adequately determine whether the matrix treatment will reduce the need for pesticides industry-wide. Regarding onion yield, we did not see a significant increase due to the Matrix treatment (Table 1). Due to the data variation, none of the treatments are significantly different. The extreme of this result is most clearly illustrated in the Matrix-70% treatment where the range in yield was from 78 to 330.5 lbs/plot.

	Onion Yield (lbs/plot)								
	Control-0%	Matrix-0%	Control-40%	Liquid-40%	Matrix-40%	Control-70%	Liquid-70%	Matrix-70%	Control-100%
	186	285.5	262.5	219	171.5	154	231.5	330.5	254.5
	213	124.5	161	233	199.5	237.5	107.5	78	238.5
	180	229.5	95.5	256.5	190	89	260.5	149.5	165.5
	131.5	174.5	171	204	237	243.5	140.5	116.5	250
Avg.	**177.6**	**203.5**	**172.5**	**228.1**	**199.5**	**181.0**	**185.0**	**168.6**	**227.1**
STDD	**33.9**	**69.5**	**68.7**	**22.3**	**27.6**	**73.7**	**72.7**	**111.8**	**41.6**
CV (%)	**19.1**	**34.1**	**39.8**	**9.8**	**13.8**	**40.7**	**39.3**	**66.3**	**18.3**

Table 1. Onion yield per plot. The percentage (%) in the column titles represent the percentage of normal fertilization. There were no significant differences among mean values due to the variation among plots within each treatment. A CV (%) value less than 15 is desirable to avoid the risk of concluding there are no treatment effects when, in fact, there are effects.

Taken July 13, 2015

ONION TRIAL #2

Onion trial #2 was located in Guadalupe, CA and services were contracted with Pacific Ag Research. The trial consisted of 16 treatments with six replicates using plots that were 3.3 feet by 30 feet. A randomized complete block experimental design was used. The trial was initiated on 3/16/2016 and terminated on 7/12/2016. The plot soil was 79% sand, 10% silt, and 11% clay, the pH was 7.3, cation exchange capacity was 6.9 meq/100g, and organic matter content was 0.2%. The trial was planted with onion transplants (cv. Walla Walla) on 3/26/2016 using a mechanical transplanter. Plant spacing within rows was 4 inches with 40 inches between rows. The planting density was 78,486 plants per acre (see Figure 4).

The trial contains 16 treatments and four different fertilization levels (Table 1). This trial was designed with six replicates in an effort to try to better detect treatment differences. Also, onion transplants were used rather than sowing seed. This was done to also reduce data variation so that treatment differences can be better detected. There are three granular products that were applied with commercial equipment as a continuous band of material (roughly 150 lbs/Acre). The granular material was added at the time of transplanting.

For the liquid treatment (BL, see table 1)), we sent two pouches of powder concentrate. When the plots were ready for treatment, 1 gram of powder was applied to each plot receiving the treatment. To do this, 1 gram of powder was added to the amount of water needed for one plot. The BL treatment was applied at the time of transplanting and then again after 4 weeks and again after 8 weeks. Also, at 8 weeks one foliar application was made to the BL treatment. This was done by adding 10 grams of powder to 5 liters of water and mix thoroughly. This liquid was sprayed on the foliage of the plots for the BL treatment.

Table 1. Treatment table for onion trial #2.

Treatment number	Treatment	Treatment (grams)	Treatment (lbs/Acre)	Fertilizer (18-6-12)	Fertilizer (lbs/Acre)
1	Control	0	0	0%	0
2	GG*	3	150	0%	0
3	BG**	3	150	0%	0
4	LHG***	3	150	0%	0
5	BL****	30	2L/A	0%	0
6	Control	0	2L/A	40%	240
7	GG	3	150	40%	240
8	BG	3	150	40%	240
9	LHG	3	150	40%	240
10	BL	30	2L/A	40%	240
11	Control	0	2L/A	70%	420
12	GG	3	150	70%	420
13	BG	3	150	70%	420
14	LHG	3	150	70%	420
15	BL	30	2L/A	70%	420
16	Control	0	2L/A	100%	600

*GG=Gypsum granules
**BG=Bontera Granules
***LHG=LH Organics Granules
****BL=Bontera Liquid

Figure 1. Photograph taken March 29, 2016 just 3 days after transplanting onion seedlings to the field.

Figure 2. The trial was sprinkler irrigated the first week to help establish the new onion transplants (see aluminum sprinkler pipes). The drip lines were then aligned in the center of the rows to provide irrigation for the remainder of the season.

Figure 3. Photograph taken May 17, 2016. Differences in the vigor of the plants can be seen in plots.

Figure 4. Photograph from May 17, 2016 showing the position of drip-lines down the center of rows.

Figure 5. Photograph taken June 27, 2016 of onion trial approximately 2 weeks before harvest.

Figure 6. Photograph taken June 27, 2016 illustrates the overall vigor of the onion trial. There were some visible treatment differences but they are difficult to detect from photos.

Figure 7. Photograph taken on June 27. The onion bulbs were forming nicely and the trial was nearly ready for harvest.

The trial was harvested on July 12, 2016. The onions were sized and weighed and the data were recorded.

Results.

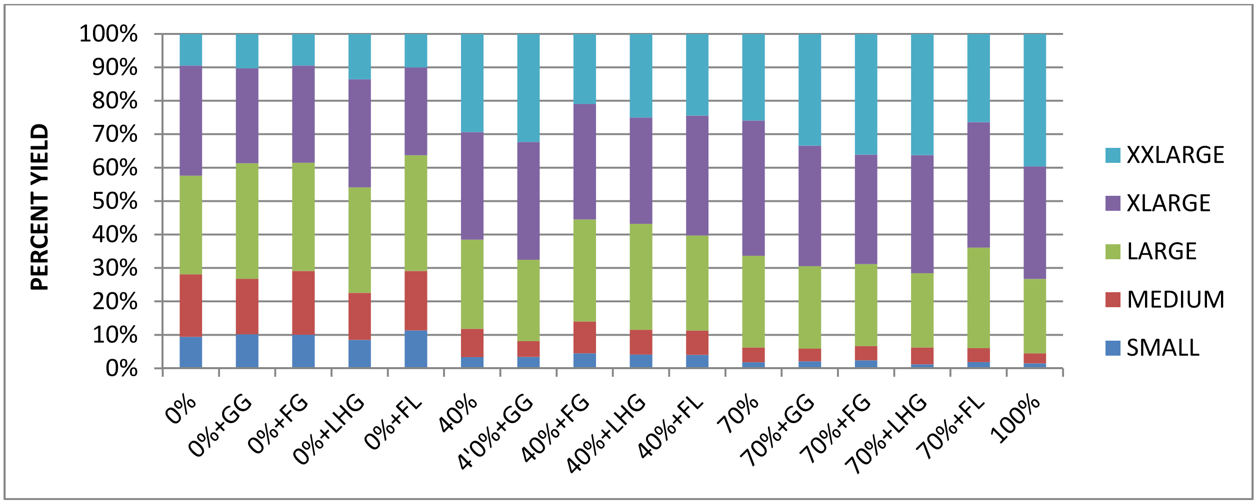
The onions were harvested from each plot and sized as shown in table 2. The effect of the fertilizer was very apparent. The trials with no fertilizer had higher amounts of small and medium-sized onions. The fertilized plots had higher amounts of L, XL, XXL onions.

Table 2.

#	Treatment	Fertilizer	Small	Medium	Large	X-Large	XX-Large
1	Control	0%	6.15 a	12.47 a	19.86 f	22.16 g	6.4 g
2	GG	0%	6.61 a	10.75 abc	24.02 def	20.02 g	8.13 fg
3	BG	0%	6.21 a	12.41 a	22.59 ef	20.94 g	7.47 g
4	LHG	0%	6.07 ab	10.13 a-d	23.05 ef	23.99 fg	10.16 fg
5	BL	0%	6.83 a	11.42 ab	24.95 c-f	20.23 g	8.39 fg
6	Control	40%	3.56 cde	9.02 b-e	31.39 b-e	38.9 cde	37.08 bcd
7	GG	40%	4.01 c	5.42 ghi	28.74 b-f	41.14 b-e	39.03 bcd
8	BG	40%	3.87 cd	8.62 b-f	29.55 b-f	35.01 de	21.44 ef
9	LHG	40%	4.18 bc	7.43 d-h	32.68 b-e	32.39 ef	25.94 de
10	BL	40%	4.13 c	8.29 c-g	34.27 a-d	44.18 bcd	30.18 de
11	Control	70%	2.46 cde	6.11 e-i	37.74 ab	55.71 a	35.68 cd
12	GG	70%	2.95 cde	5.38 ghi	35.13 abc	50.05 ab	46.11 abc
13	BG	70%	2.91 cde	5.09 hi	30.23 b-e	41.1 b-e	47.54 abc
14	LHG	70%	1.63 e	6.74 e-i	30.21 b-e	48.82 ab	49.78 ab
15	BL	70%	2.64 cde	6.01 f-i	43.57 a	54.29 a	38.69 bcd
16	Control	Control	2.06 de	4.24 i	30.99 b-e	48.26 abc	57.17 a

*GG=Gypsum granules
**BG=Bontera Granules
***LHG=LH Organics Granules
****BL=Bontera Liquid

Figure 8. This graph shows the percentage of the harvested onions in each treatment that were sized as small, medium, large, xlarge, and xxlarge.



In figure 8, it is clear that nearly 30% of the onions with no fertilizer are medium size or smaller. The plots receiving fertilizer had a much higher percentage of xxlarge onions, especially the plot receiving 100% fertilization. The plots receiving 70% fertilization had a very low percentage of medium or small size onions. These results show a clear fertilizer effect.

Figure 9. The dollar value of onions produced for each of the 16 treatments ($/Acre).

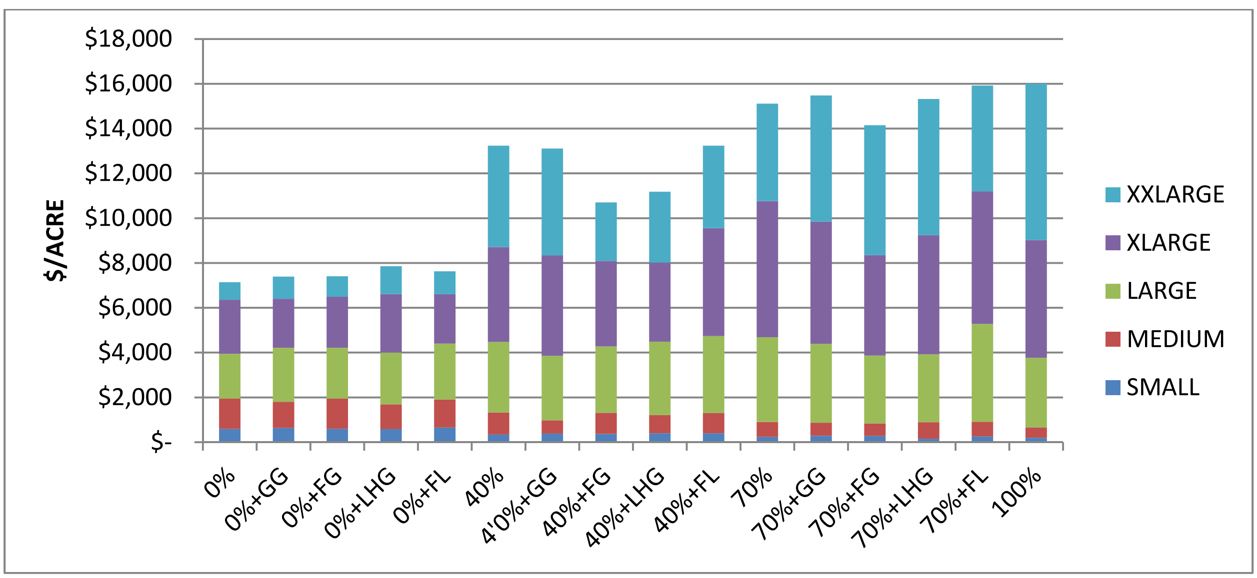


Figure 9 shows the dollar value of onions grown for each plot calculated for an entire acre. Again, it is clear that the fertilizer treatment improved the productivity of the crop. The contrast was greatest between plots receiving no fertilization and plots receiving 40% fertilization. Plot receiving 70% or 100% fertilization were even more productive but the difference was not as great between 40% and 70% or 70% and 100%. The results indicate that there are diminishing returns when adding fertilizer beyond 40% and especially between 70% and 100% fertilization (Figure 10). The results suggest that perhaps farmers fertilize beyond what is needed for good yields.

Figure 10. Onion product at different levels of fertilization.

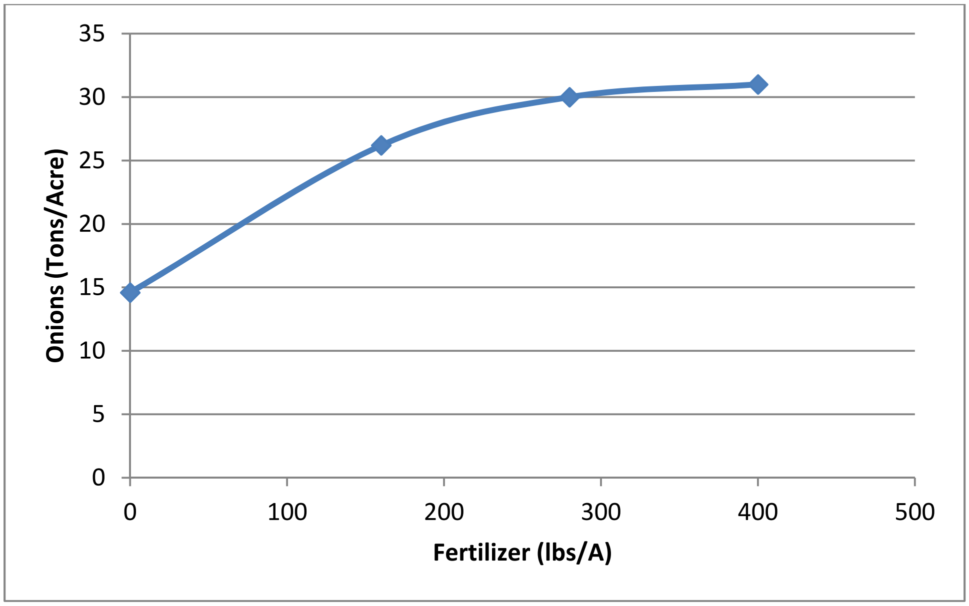


Table 3. Effect of treatments on onion yields.

#	Treatment	Fertilizer	Kg/Plot	Tons/Acre
1	Control	0%	67.1 g	14.6 g
2	GG	0%	69.5 g	15.2 g
3	BG	0%	69.6 g	15.2 g
4	LHG	0%	73.4 g	16.0 g
5	BL	0%	71.8 g	15.7 g
6	Control	40%	120.0 d	26.2 d
7	GG	40%	118.3 de	25.8 de
8	BG	40%	98.5 f	21.5 f
9	LHG	40%	102.6 ef	22.4 ef
10	BL	40%	121.1 cd	26.4 cd
11	Control	70%	137.7 ab	30.0 ab
12	GG	70%	139.6 ab	30.4 ab
13	BG	70%	126.9 bcd	27.7 bcd
14	LHG	70%	137.2 abc	29.9 abc
15	BL	70%	145.2 a	31.7 a
16	Control	Control	142.7 ab	31.1 ab

*GG=Gypsum granules
**BG=Bontera Granules

***LHG=LH Organics Granules
****BL=Bontera Liquid

The results shown in table 3 show the statistical analysis of the 16 treatments. The control treatments (1, 6, 11, 16) show the effect of the fertilizer treatments independent of the microbial treatments. Control 0% is significantly smaller than Control 40%. Control 70% is significantly higher than Control 0% or 40%. Control 100% has a higher value than Control 70% but the difference in not significant.

A second control (GG) consists of a starch/gypsum matrix without any microbes. This control was used to detect whether the starch/gypsum matrix by itself could affect yields. There was some variation in the data but there was no significant difference between the GG treatments and the primary Control treatments.

The Bontera granule product (BG) was applied in treatments 3, 8, and 13. At 0% fertilization, the BG treatment had a yield similar to the control. However, at 40% fertilization the BG was significantly lower than the control. A more in-depth look at the data showed that the BG treatment had a much lower yield in xxlarge onions. This may have been somewhat of an anomaly because at 70% fertilization, the BG treatment was lower than the control but it was not a significant difference.

The LHG treatment basically mirrored the BG treatment. The mean value at 0% fertilization was slightly higher than the control but the difference was not statistically different. At the 40% fertilization rate, the LHG treatment was a little higher than the BG treatment but the difference was not significant. The LHG treatment at 40% fertilization was significantly lower than the control. At 70% fertilization, the LHG treatment was comparable to the control. It was higher than the BG treatment but the difference was not significant. There was no significant difference among any of the treatments receiving the 70% fertilization rate.

The BL treatment was a liquid product that was added 3 times during the season compared to a single application of the GG, BG, and LHG granules. The BL data was consistently higher than the control treatment at each of the four fertilization rates. However, the BL values were not significantly higher than the control. The BL was not significantly different from the control at 100% fertilization.

Conclusion.

Based on the fertilizer response seen in figure 10, it is readily apparent that adding fertilizer beyond 70% of the recommended rate will give only a small response if any. There was no significant difference between the controls with 70% and 100% fertilization. Farmers may feel justified adding the 100% recommendation because they may get larger onions or slightly higher yields even if the differences are not statistically significant. Microbial products could have the most benefit if they would work at 0% fertilization. A 1/3 increase in fertility yields a 2/3 increase in yield at the low end of fertilization. In contrast, a 1/3 increase in fertility at the higher end of the fertilization curve may only provide a minor increase in production. In the present study, only the BL treatment was consistent in giving an increase in onion yield. However, the effect was minor and not statistically different from the control.

Field Results of Strawberry Trials

STRAWBERRY TRIAL #1

Strawberry trial #1 was located in Arroyo Grande, CA and services were contracted with Pacific Ag Research. The trial consisted of nine treatments with four replicates using plots that were 3.3 feet by 40 feet. A randomized complete block experimental design was used (see design in figure below) and the trial was initiated on 7/08/2015 and terminated on 12/10/2015. The plot soil was 84% sand, 10% silt, and 6% clay, the pH was 6.1, cation exchange capacity was 10 meq/100g, and organic matter content was 1.1%. The soil was not fumigated before transplantation. The trial was planted with strawberry transplants (cv. Portola) on 7/10/2015 on raised beds covered with white polyethylene film. Plant spacing within rows was 14 inches and planting density was 22,420 plants per acre.

It should be noted that the plots were not pretreated with fumigant before transplanting the strawberries into the field. The trial was located adjacent to a trial that had a soil fumigant treatment before planting. The microbial products tested in this trial include the Bontera granules (BG) and Bontera liquid (BL). The BG is made by encapsulating BL in a gypsum matrix developed by the USDA. A detailed description of how the microbial product was encapsulated in the gypsum matrix was provided earlier. The treatments for the first strawberry trial are indicated in the table below. One-half teaspoon (about 3 grams) of BG was added to the transplant hole at the time of planting.

Table 1. Treatment description for strawberry trial #1.

Treatment number	Treatment	Treatment (grams)	Treatment (lbs/Acre)	Fertilizer (18-6-12)	Fertilizer Added (lbs/Acre)
1	Control	0	0	0%	0
2	BG*	3	150	0%	0
3	Control	0	0	40%	240
4	BG	3	150	40%	240
5	BL	30	150	40%	240
6	Control	0	0	70%	420
7	BG	3	150	70%	420
8	BL	30	150	70%	420
9	Control	0	0	100%	600

*BG=Bontera Granules

**BL=Bontera Liquid

Figure 1. Randomized complete block design used for the first strawberry trial.

There are 9 treatments

FERTILIZER: There are four levels of fertilization (0%, 40%, 70%, 100%). There are controls for each level of fertilization. The 100% fertilization rate is the amount of fertilizer normally provided by the grower for optimum yields.

BONTERA GRANULES (BG): There are three BG treatments. They are as follow: BG+0% fertilizer, BG+40% fertilizer, BG+70% fertilizer. This treatment entails adding a heaping ½ teaspoon (about 3 grams) of the granular product to the transplant hole of each plant in all three treatments. (68 plants per plot with 4 reps = 272 plants per treatment times 3 treatments = 816 (total plants treated).

BONTERA LIQUID (BL): There are two BL treatments: BL+40% fertilizer; BL+70% fertilizer. Since there are 272 plants per treatment, there are 272 X 2 = 544 Plants total for the two BL treatments.

STOCK: A stock solution is made by adding 1.3g of powder to 5 gallons of water.

BL TREATMENTS:

TRANSPLANT: This treatment entails adding 30ml of stock solution to the transplant hole of each plant. Approximately 4.25 gallons of stock solution are needed per treatment or 8.5 gallons of stock total for both treatments (including the 4 reps).

4 WEEKS: Four weeks after transplantation, 4.25 gallons of stock solution is added through the drip system to each treatment (that includes the 4 reps). In other words, 1.06 gallons are used per plot receiving the BL treatment. Since there are 2 treatments, there are 8 plots to treat or 8.5 gallons total.

8 WEEKS: (same as 4 week treatments).

Results.

The following photos were taken of the plots on 11/3/2015. The plots were in poor condition with many plants having died (see Figure 2). Plots from a different experimental trial had been planted in fumigated soil (see Figure 3). It is evident from these two photographs that the treatments were not effective in precluding the need for soil fumigation. Fumigated soil was much more productive in terms of yield as seen in Figure 3.

Figure 2. Photograph of plots taken November 3, 2015. Note how sparse the plots are. There were many plants that had died as is evident by the empty holes in the polyethylene film.


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Figure 3. Photo of plots taken November 3, 2015. The rows in the white polyethylene film on the left in the photo contain our plots. The four rows on the right are part of a different study but were planted in fumigated soil.

Due to the effect of soil pathogens on the growth and survival of the strawberry plants in our trial, it was necessary to restrict the harvest to only the areas within the plots that were productive. The amount of data variability that is normal in field trials was exacerbated by the effect of pathogens on the vigor of the plants. As a result of the data variability, there were no significant treatment effects observed in the yield data (see table 2). The objective of our study is to determine whether the application of the microbial product can substitute for some portion of the fertilizer requirement. In this strawberry trial, the variability in the data was such that even the effect of a fertilizer treatment could not be detected let alone a positive effect from the microbial product.

Table 2. Average amount (Kg) of marketable, unmarketable (culls), and total fruit harvested per plot for each of the nine treatments.

#	Treatment	Fertilizer	Marketable (Kg)	Culls (Kg)	Total (Kg)
1.	Control	0%	14.4 a	3.16 a	17.5 a
2.	BG	0%	16.7 a	3.05 a	19.7 a
3.	Control	40%	17.6 a	2.90 a	20.5 a
4.	BG	40%	19.8 a	3.62 a	23.4 a
5.	BL	40%	19.3 a	3.35 a	22.7 a
6.	Control	70%	17.2 a	3.21 a	20.4 a
7.	BG	70%	16.1 a	3.34 a	19.4 a
8.	BL	70%	17.3 a	3.15 a	20.4 a
9.	Control	100%	17.5 a	3.15 a	20.7 a

Values followed by different letters within a column are statistically different.

Table 3. Average percentage of marketable and unmarketable (culls) fruit for each of the nine treatments.

#	Treatment	Fertilizer	Marketable (%)	Culls (%)
1.	Control	0%	81.9 a	18.1 a
2.	BG	0%	84.3 a	15.7 a
3.	Control	40%	84.0 a	16.0 a
4.	BG	40%	83.9 a	16.1 a
5.	BL	40%	83.7 a	16.3 a
6.	Control	70%	83.0 a	17.0 a
7.	BG	70%	82.0 a	18.0 a
8.	BL	70%	83.9 a	16.1 a
9.	Control	100%	84.2 a	15.8 a

Values followed by different letters within a column are statistically different.

Table 4. Calculated average yield (lbs/acre) and dollar value ($/acre) for each of the nine treatments.

#	Treatment	Fertilizer	Lbs/Acre	$/Acre
1.	Control	0%	23,704	$35,555
2.	BG	0%	27,506	$41,259
3.	Control	40%	28,983	$43,475
4.	BG	40%	32,578	$48,867
5.	BL	40%	31,811	$47,717
6.	Control	70%	28,357	$42,535
7.	BG	70%	26,456	$39,684
8.	BL	70%	28,456	$42,684
9.	Control	100%	28,880	$43,320

Values followed by different letters within a column are statistically different.

Conclusion: Due to the variability of the data, it was not possible to detect any treatment effects from the microbial treatment as well as from fertilizer treatment. It is apparent that the microbial treatment is not effective in controlling soil borne pathogens that are typically controlled by the use of soil fumigants. A second strawberry trial is needed that utilizes the pre-plant soil fumigation treatment to determine whether the microbial product can replace some of the fertilization requirement for growing strawberries.

STRAWBERRY TRIAL #2

Strawberry trial #2 was located in Guadalupe, CA and services were contracted with Pacific Ag Research. The trial consisted of ten treatments with four replicates using plots that were 3.3 feet by 50 feet. A randomized complete block experimental design was used. The trial was initiated on 11/15/2015 and terminated on 7/9/2016. The plot soil was 79% sand, 10% silt, and 11% clay, the pH was 7.3, cation exchange capacity was 6.9 meq/100g, and organic matter content was 0.6%. The soil was fumigated with PicChlor 60 EC at 30gal/acre three weeks before transplantation. The trial was planted with strawberry transplants (cv. Monterey) on 11/30/2015 on raised beds covered with polyethylene film as is typical for the industry. Plant spacing within rows was 14 inches and planting density was 22,500 plants per acre (see Figure 4).

The treatments are indicated in the table 5 below. One-half teaspoon (about 3 grams) of either BG or LHG was added to the transplant hole at the time of planting just before adding the transplant.

Table 5. Treatment description for strawberry trial #2. This trial included granules with encapsulated soil microbes provided from the Bontera product (BG) and the encapsulated soil microbes provided from LH Organics (LHG). The encapsulated microbial product was made as described earlier for the tomato trials.

Treatment number	Treatment	Treatment (grams)	Treatment (lbs/Acre)	Fertilizer (18-6-12)	Fertilizer (lbs/Acre)
1	Control	0	0	0%	0
2	BG*	3	150	0%	0
3	LHG**	3	150	0%	0
4	Control	0	0	40%	240
5	BG	3	150	40%	240
6	LHG	3	150	40%	240
7	Control	0	0	70%	420
8	BG	3	150	70%	420
9	LHG	3	150	70%	420
10	Control	0	0	100%	600

*BG=Bontera Granules

**LHG=LH Organics Granules

Figure 4. Photograph of the strawberry trial #2 taken on March 29, 2016. The soil was fumigated before the plants were transplanted into the field. Vigor and plant survival markedly contrast that of trial #1.

The plants were drip irrigated with drip lines setup through the center of each row. Each of the fertilizer treatments was administered through the drip system.

Figure 5. Photograph of the drip system with reservoirs for adding fertilizer and a series of valves for controlling which plots received a given treatment.

The drip lines were fed from a water line with treatments metered in from polyethylene containers as illustrated above. The fertilizer treatments were added through the drip system on a weekly basis. The drip system was operated at 8 psi and the mix size was 415 gallons which was equivalent of 1 acre inch.

Figure 6. Photograph of the strawberry plants that were fed by drip lines located under the polyethylene film. The orange stakes were used to mark each plot in the trial. The photograph was taken on March 29, 2016.

Figure 7. Photograph of strawberry trial #2 taken on May 17, 2016. Plant vigor was very good and few if any plants showed signs of disease or stress.

Figure 8. Photograph of fruit bin nearly full of fruit harvested from the strawberry trial #2.

The weight of fruit harvested from each plot was taken and recorded. The treated fruit was discarded into the bin once the pertinent data were recorded. A total of 13 harvests were made during the months of April, June, and July. The weight of marketable fruit was recorded for each harvest date.

Figure 9. Photograph taken May 17, 2016 showing large and extra large fruit growing on trial #2.

Figure 10. Photograph taken June 27, 2016 as the trial was nearing an end. The trial was still vigorous and very few plants showed any symptoms of disease or stress.

Results.

The experimental trial was well managed and the data are much better compared to trial #1. The results show that fertilizer is a major factor in improving the crop yields. All of the trials that received no fertilizer were different from the fertilized plots (Table 6). However, there was not a significant difference in plots receiving 40% fertilization and plots receiving 100% fertilization. These results suggest that perhaps farmers are adding much more fertilization than is merited based on fruit production. In other words, a farmer could have used only 40% of the normally recommended amount of fertilizer and harvested just as much fruit as if 100% of the recommended amount of fertilizer was applied. The second observation was that BG and LHG did not increase production compared to the control treatment. A 70% fertilization, the LHG treatment had significantly lower yield than the control at 70% fertilization.

It was interesting to find that at 0% fertilization the LHG treatment had a significantly lower percentage of marketable fruit than the BG treatment (Table 7).

Table 6. Average amount (Kg) of marketable, cull, and total fruit harvested per plot for each of the ten treatments.

#	Treatment	Fertilizer	Marketable	Culls	Total
1.	Control	0%	37.9 c	5.73 a	43.6 cd
2.	BG	0%	37.2 c	4.81 a	42.0 d
3.	LHG	0%	33.5 c	6.08 a	39.6 d
4.	Control	40%	47.5 ab	5.17 a	52.7 ab
5.	BG	40%	48.8 ab	5.42 a	54.2 ab
6.	LHG	40%	44.7 b	5.62 a	50.4 b
7.	Control	70%	52.1 a	6.76 a	57.9 a
8.	BG	70%	48.1 ab	5.05 a	53.2 ab
9.	LHG	70%	44.7 b	4.71 a	49.5 bc
10.	Control	100%	49.4 ab	4.95 a	54.3 ab

Values followed by different letters within a column are statistically different.

Table 7. The percentage of marketable and unmarketable fruit per treatment.

#	Treatment	Fertilizer	Marketable Fruit (%)	Unmarketable Fruit (%)
1.	Control	0%	86.9 bc	13.1 ab
2.	BG	0%	88.5 ab	11.5 bc
3.	LHG	0%	84.6 c	15.4 a
4.	Control	40%	90.2 a	9.8 c
5.	BG	40%	89.9 ab	10.1 c
6.	LHG	40%	88.9 a	11.1 bc
7.	Control	70%	90.0 a	10.0 c
8.	BG	70%	90.4 a	9.6 c
9.	LHG	70%	90.4 a	9.6 c
10.	Control	100%	90.9 a	9.1 c

Values followed by different letters within a column are statistically different.

Table 8. The calculated pounds of fruit produced per acre and its dollar value for each treatment.

#	Treatment	Fertilizer	Fruit produced (lbs/A)	Value of Fruit ($/A)
1.	Control	0%	27,335 c	24,297 c
2.	BG	0%	26,799 c	23,821 c
3.	LHG	0%	24,175 c	21,489 c
4.	Control	40%	34,234 ab	30,430 ab
5.	BG	40%	35,189 ab	31,279 ab
6.	LHG	40%	32,263 b	28,678 b
7.	Control	70%	37,583 a	33,407 a
8.	BG	70%	34,679 ab	30,826 ab
9.	LHG	70%	32,261 b	28,676 b
10.	Control	100%	35,589 ab	31,635 ab

Values followed by different letters within a column are statistically different.

Conclusion. There was a significant treatment effect seen in trial #2 that can largely be explained by the fertilization treatment. The BG did not increase the yield and $/A compared to the control. However, the LHG yield and $/A was significantly lower than the control at 70% fertilization. Based on these results, farmers would not expect an increase in production by using either BG or LHG on their strawberries.

Attachment 1

University of California, Davis
Project 57 - Mechanisms, distribution, and invasion potential of glyphosate-resistant junglerice and other summer grass weeds in California tree and vine cropping systems.

Major sections in this appendix include:

1. List of project-related presentations, publications, and outreach efforts during the project period (all project collaborators).
2. Junglerice sampling and initial greenhouse screening information (UC Davis).
3. Genetic, enzyeme, and translocation assays on GR and GS jungerice (UC Davis).
4. Junglerice phenology and productivity in response to shade in common garden experiments (UC Davis and CSU Frenso).
5. Junglerice germination and growth in response to temperature (UC Davis).
6. Comparisions of GR and GS junglerice response to temperature, salinity, nitrogen uptake, and osmotic stress (CSU Fresno).
7. Effects of shade or moisture conditions on herbicide on junglerice (CSU Fresno).
8. Herbicide performance evaluations and demonstration in commercial orchards and vineyards (UC Davis and UCCE).
9. Draft of an "in preparation" manuscript expected to be submitted for journal review in winter 2016/17. *Sosnoskie et al. "Germination and growth of five junglerice asccessions in response to temperature".*

Attachment 1

Section 1. Publications, presentations, and outreach activities.

PD Hanson, and PIs Wright, Hembree, Sosnoskie, and Roncoroni all have extension responsibilities. They routinely participate and share applicable results via presentations, online outreach activities, and individual consultations with growers, pest control advisors, and others involved in specialty crop weed management via UC Cooperative Extension. A partial list of extension presentations during this project period that included aspects of this work include:

- Roncoroni presented project information to an audience of (~300) pesticide applicators in Anaheim, California on October 21, 2014;
- Roncoroni spoke about resistant grasses to an audience of (~40) viticulture pest advisors in Napa, California on November 6, 2014;
- Hanson, Hembree, and Shrestha presented project information in the Tree and Vine session (~75 in attendance) at the California Weed Science Society meeting in Santa Barbara, California on January 22, 2015;
- Moretti (a PhD student in Hanson's program) spoke about glyphosate resistance at an extension meeting (~30 in attendance) in Colusa, California on February 5, 2015 and at a Pesticide Applicators Professional Association (PAPA) seminar in Redding, California on February 19, 2015 (~75 in attendance);
- Sosnoskie spoke to several hundred participants at a Pesticide Applicators Professional Association (PAPA) meeting about herbicide resistance in weeds, including junglerice, on February 10th, 2015 in Stockton, California;
- Hanson spoke about resistance management in orchard crops to 200 walnut and cherry growers in Stockton, California February 24, 2015;
- Roncoroni spoke about glyphosate resistance to ~ 40 viticulturists in Paso Robles, California March 3, 2015;
- Morran presented research results to an audience of about 60 at the Western Society of Weed Science meeting in Portland, Oregon on March 10, 2015.
- Roncoroni presented project information to an audience of 300 pesticide applicators in Anaheim, California on October 21, 2014;
- Roncoroni spoke about resistant grasses to an audience of 40 viticulture pest advisors in Napa, California on November 6, 2014;
- Hanson, Hembree, and Shrestha presented project information in the Tree and Vine session (75 in attendance) at the California Weed Science Society meeting in Santa Barbara, California on January 22, 2015;
- Moretti (a PhD student in Hanson's program) spoke about glyphosate resistance at an extension meeting (30 in attendance) in Colusa, California on February 5, 2015 and at a Pesticide Applicators Professional Association (PAPA) seminar in Redding, California on February 19, 2015 (75 in attendance);
- Sosnoskie spoke to several hundred participants at a Pesticide Applicators Professional Association (PAPA) meeting about herbicide resistance in weeds, including junglerice, on February 10th, 2015 in Stockton, California;
- Hanson spoke about resistance management in orchard crops to 200 walnut and cherry growers in Stockton, California February 24, 2015;
- Roncoroni spoke about glyphosate resistance to 40 viticulturists in Paso Robles, California March 3, 2015;

- Morran presented research results to an audience of about 60 at the Western Society of Weed Science meeting in Portland, Oregon on March 10, 2015.
- Hanson and Hembree presented project-related information in field tours near Fresno and Stockton to about 15 pest control industry cooperators on April 15, 2015.
- Roncoroni presented project related information to growers at a meeting in Lodi, CA on April 21, 2015
- Hanson presented project-related information to about 20 scientists and several project collaborators (T. Gaines lab group) at a meeting in Fort Collins, Colorado on April 29, 2015
- Hanson and PhD student Caio Brunharo presented project related information to about 200 growers at a field tour near Arbuckle, CA on May 6, 2015
- Hanson presented project related information to a group of growers and representatives of the California Fig Industry at a meeting in Madera, CA on May 13, 2015.
- Hanson and PhD student Mariano Galla presented information on managing glyphosate resistant weeds in orchards to a group of farmers, olive industry representatives, UC Cooperative Extension personnel at a field meeting near Orland, CA on June 9, 2015
- Roncoroni presented project related information to growers at a field day near Isleton CA on June 30, 2015
- Hanson, Sosnoskie, Morran and three other members (PhD students and postdocs) of Hanson's research group and Sarah Parry from Shrestha's research group made presentations on work related to glyphosate resistance in orchard crops at the annual UC Weed Science Field Day in Davis, CA which was attended by about 150 growers and pest control industry personnel.
- Hanson presented project related information to an audience of about 120 growers and pest control advisors at a field day near Fresno, CA on July 22, 2015.
- Hanson presented project-related information to an audience of about 125 growers and regulators at the Western Plant Health Association annual meeting in Sacramento, CA on July 28, 2015.
- Sosnoskie, Hanson, Morran, Hembree, and Roncoroni each discussed aspects of resistance and resistance management to 60 attendees at the semi-annual Weed Science School held August 20, 2015 in Davis, CA.
- Roncoroni presented project related information to growers at a Sonoma county growers meeting in Santa Rosa on July 31, 2015
- Roncoroni presented project related information to growers at Farm Bureau meeting in Napa, CA October 27, 2015.
- Roncoroni presented project related information to growers and pest control advisors at a CAPCA meeting in Sacramento, CA November 4, 2015.
- Hanson presented project-related information to about 300 growers at the "Tree and Vine Expo" in Turlock, CA. on November 10, 2015.
- Hanson presented project-related information to about 275 growers at the "Walnut Production Shortcourse" in Davis, CA on November 11, 2015.
- Wright presented project related information at the Tulare/Kings CAPCA meeting attended by about 400 growers on November 12, 2015.
- Hanson presented project-related information to about 275 growers at the "Walnut Production Shortcourse Field tour in Davis, CA on November 12, 2015.
- Roncoroni presented project related information to growers and pest control advisors at a Grape Expo in Cloverdale, CA November 13, 2015.

- Roncoroni presented project related information to growers and pest control advisors at a CAPCA meeting in Napa, CA November 18, 2015.
- Hanson presented project-related information to about 40 future vineyard managers in Davis, CA on November 24, 2015.
- Hanson and PhD student lab members presented project related information to several thousand growers at the Almond Conference in Sacramento, CA on December 10, 2015
- Hanson and PhD student lab member presented project related information to 20 growers and commodity board members at the California Dried Plum meeting in Sacramento, CA on December 17, 2015.
- A student in Shrestha's program presented project information to over 200 growers and pest control advisors at the California Weed Science Society meeting in Sacramento, CA. on January 12, 2016.
- A student in Hanson's program presented project information to over 200 growers and pest control advisors at the California Weed Science Society meeting in Sacramento, CA. on January 13, 2016.
- Sosnoskie presented project information to over 200 growers and pest control advisors at the California Weed Science Society meeting in Sacramento, CA. on January 13, 2016.
- Hanson presented project information to over 200 growers and pest control advisors at the California Weed Science Society meeting in Sacramento, CA. on January 13, 2016.
- Shrestha presented project information to over 200 growers and pest control advisors at the California Weed Science Society meeting in Sacramento, CA. on January 14, 2016.
- Hanson presented project related information to an audience of about 100 growers and pest control advisors at a PCA meeting in Chico, CA on January 26, 2016
- Hanson presented project related information to an audience of about 75 growers at the Plant and Soil Conference in Fresno, CA on February 2, 2016.
- Hanson presented project related information to two audiences of about 50 each at UCCE meetings in Woodland and Colusa, CA on February 3, 2016.
- Sosnoskie presented project information to an audience of 150 scientists at the Weed Science Society of America meeting in San Juan, Puerto Rico on February 9, 2016.
- Two students in Shrestha's program presented project information to an audience of 150 scientists at the Weed Science Society of America meeting in San Juan, Puerto Rico on February 9, 2016.
- Morran presented project information to an audience of 150 scientists at the Weed Science Society of America meeting in San Juan, Puerto Rico on February 10, 2016.
- Hanson presented project information to an audience of 150 scientists at the Weed Science Society of America meeting in San Juan, Puerto Rico on February 10, 2016.
- Roncoroni presented project related information to growers at a meeting in Clarksburg, CA on March 6, 2016
- Morran presented project information to an audience of 100 scientists at the Western Society of Weed Science Society meeting in Albuquerque, NM on March 7, 2016.
- Shrestha presented project related information to and audience of about 50 at the Fresno-Madera CAPCA meeting in Fresno, CA on March 17, 2016.
- Hanson presented a herbicide resistance training session to UCCE Farm Advisors in Davis, CA on March 18, 2016 and March 22, 2016.
- Hanson posted a blog post on management of grass weeds on the UC Weed Science blog on March 31, 2016.
- Roncoroni presented project related information to growers at a meeting in Calaveras, CA on April 1, 2016

- Sosnoskie posted a blog post junglerice biology on the UC Weed Science blog on May 1, 2016.
- Morran posted a blog junglerice resistance on the UC Weed Science blog on May 1, 2016.
- Hanson spoke to an audience of 20 at a herbicide company field day on May 3, 2016 in Davis, CA.
- Hanson spoke to an audience of 30 growers and UCCE Advisors at a field day on May 12, 2016 in Davis, CA.
- Hanson spoke to an audience of 12 at a herbicide company field day on May 19, 2016 in Esparto, CA.
- Hanson spoke to an audience of 10 at a herbicide company field day on May 24, 2016 in Arbuckle, CA.
- Roncoroni presented project related information to growers at a meeting in Santa Cruz, CA on June 1, 2016
- Six members of Hanson's program spoke about herbicide resistance research at the UC Weed Science field day attended by about 150 growers and advisors in Davis, CA on July 7, 2016.
- Hanson spoke to an audience of 12 at a herbicide company field tour on August 1, 2016 in Davis, CA.

Section 2. Junglerice sampling and initial greenhouse screening information (UC Davis).

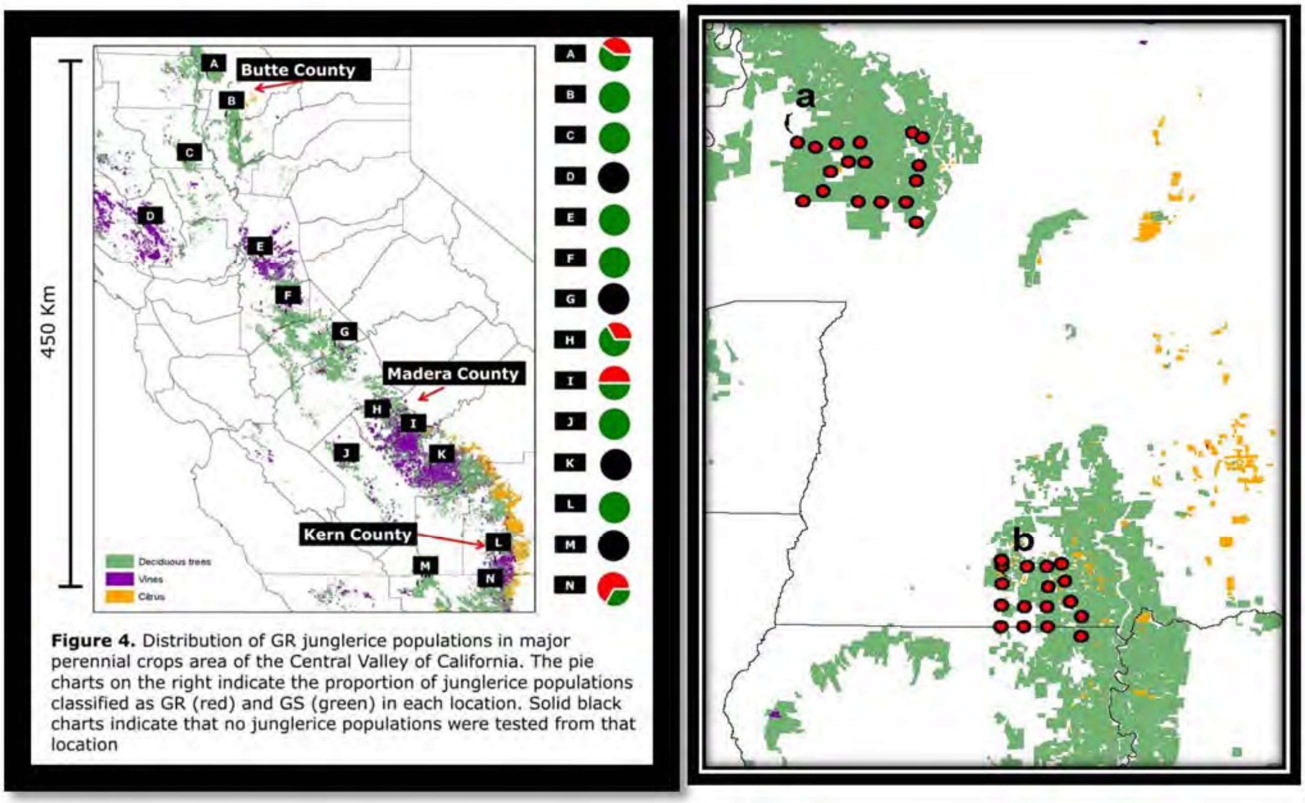


Figure 2.1. *During a two year sampling period, over 200 commercial orchard and vineyards were surveyed for junglerice and other weeds. Mature junglrice seed was collected from 28 orchards and screened for resistance. The left figure shows the sampling "regions" in the Central Valley and the left figure shows the 16 1 by 1 mile grid sampling "sites'with two of the regions (Moretti and Hanson).*

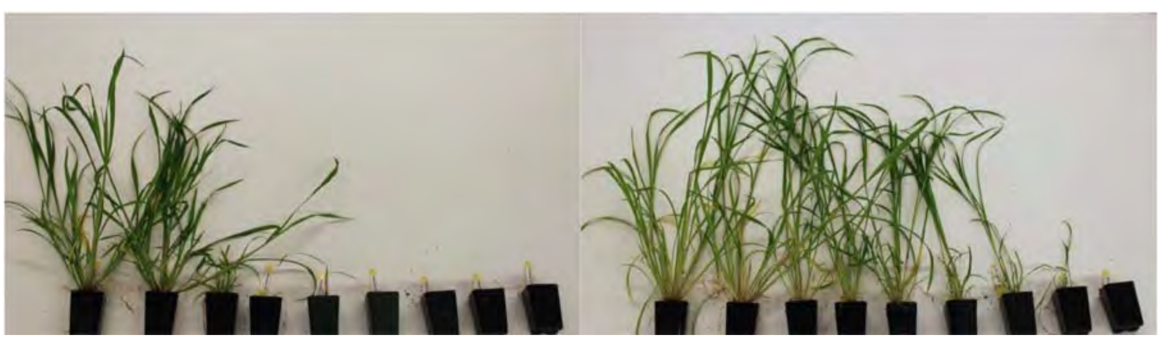
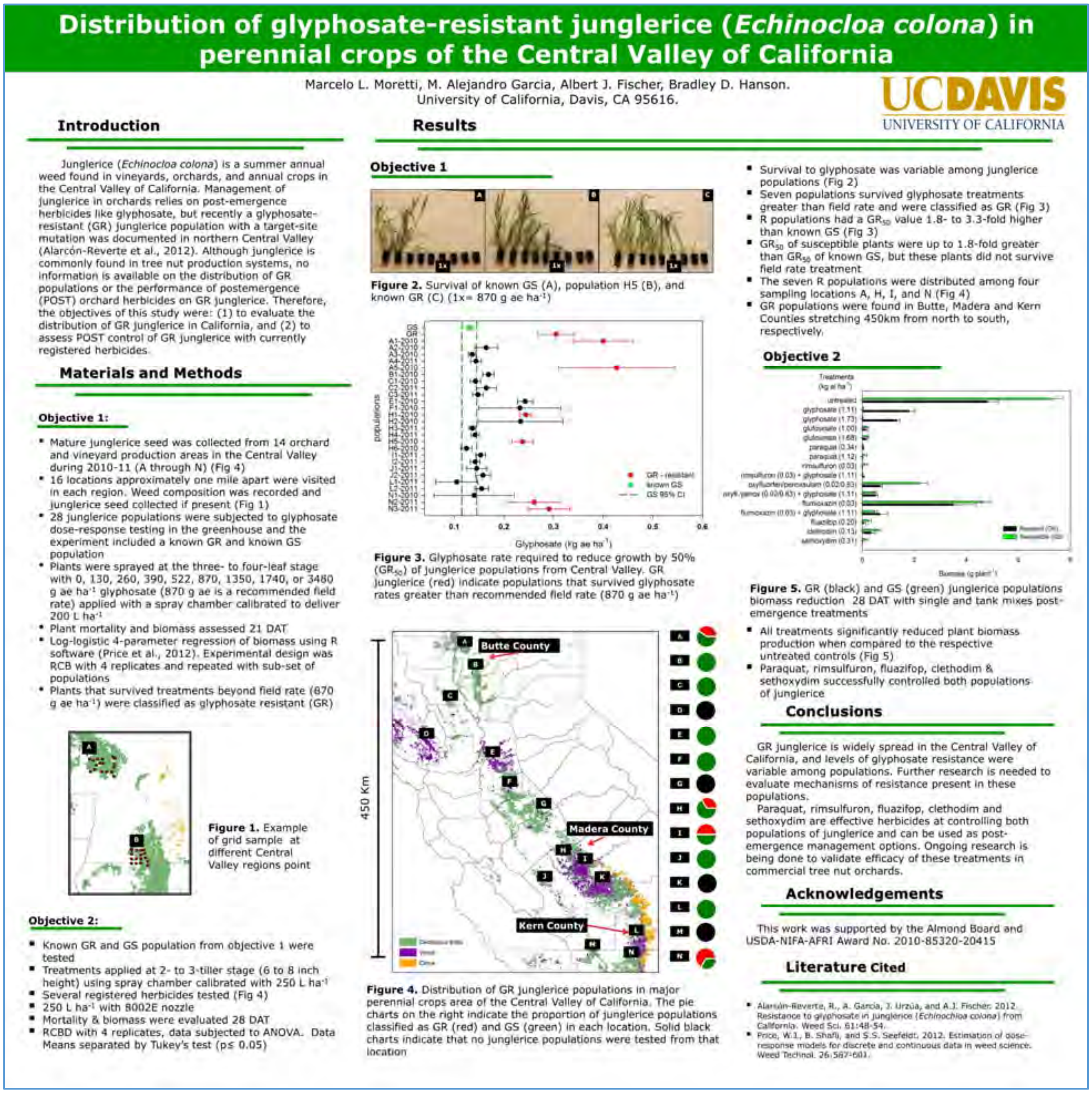


Figure 2.2. *Example response to increasing glyphosate doses of a susceptible (S) and resistant (R) population of junglerice collected from the Central Valley of California. Populations were sprayed in dose response experiments using a range of glyphosate rates from 0 to 3480 g ae.ha^{-1}. (Morran, Moretti, Fischer, and Hanson)*

Attachment 1



Distribution of glyphosate-resistant junglerice (*Echinocloa colona*) in perennial crops of the Central Valley of California

Marcelo L. Moretti, M. Alejandro Garcia, Albert J. Fischer, Bradley D. Hanson.
University of California, Davis, CA 95616.

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Introduction

Junglerice (*Echinocloa colona*) is a summer annual weed found in vineyards, orchards, and annual crops in the Central Valley of California. Management of junglerice in orchards relies on post-emergence herbicides like glyphosate, but recently a glyphosate-resistant (GR) junglerice population with a target-site mutation was documented in northern Central Valley (Alarcón-Reverte et al., 2012). Although junglerice is commonly found in tree nut production systems, no information is available on the distribution of GR populations or the performance of postemergence (POST) orchard herbicides on GR junglerice. Therefore, the objectives of this study were: (1) to evaluate the distribution of GR junglerice in California, and (2) to assess POST control of GR junglerice with currently registered herbicides.

Materials and Methods

Objective 1:

- Mature junglerice seed was collected from 14 orchard and vineyard production areas in the Central Valley during 2010-11 (A through N) (Fig 4)
- 16 locations approximately one mile apart were visited in each region. Weed composition was recorded and junglerice seed collected if present (Fig 1)
- 28 junglerice populations were subjected to glyphosate dose-response testing in the greenhouse and the experiment included a known GR and known GS population
- Plants were sprayed at the three- to four-leaf stage with 0, 130, 260, 390, 522, 870, 1350, 1740, or 3480 g ae ha^{-1} glyphosate (870 g ae is a recommended field rate) applied with a spray chamber calibrated to deliver 200 L ha^{-1}
- Plant mortality and biomass assessed 21 DAT
- Log-logistic 4-parameter regression of biomass using R software (Price et al., 2012). Experimental design was RCB with 4 replicates and repeated with sub-set of populations
- Plants that survived treatments beyond field rate (870 g ae ha^{-1}) were classified as glyphosate resistant (GR)

Figure 1. Example of grid sample at different Central Valley regions point

Objective 2:

- Known GR and GS population from objective 1 were tested
- Treatments applied at 2- to 3-tiller stage (6 to 8 inch height) using spray chamber calibrated with 250 L ha^{-1}
- Several registered herbicides tested (Fig 4)
- 250 L ha^{-1} with 8002E nozzle
- Mortality & biomass were evaluated 28 DAT
- RCBD with 4 replicates, data subjected to ANOVA. Data Means separated by Tukey's test ($p \leq 0.05$)

Results

Objective 1

Figure 2. Survival of known GS (A), population H5 (B), and known GR (C) (1x= 870 g ae ha^{-1})

Figure 3. Glyphosate rate required to reduce growth by 50% (GR_{50}) of junglerice populations from Central Valley. GR junglerice (red) indicate populations that survived glyphosate rates greater than recommended field rate (870 g ae ha^{-1})

Figure 4. Distribution of GR junglerice populations in major perennial crops area of the Central Valley of California. The pie charts on the right indicate the proportion of junglerice populations classified as GR (red) and GS (green) in each location. Solid black charts indicate that no junglerice populations were tested from that location

- Survival to glyphosate was variable among junglerice populations (Fig 2)
- Seven populations survived glyphosate treatments greater than field rate and were classified as GR (Fig 3)
- R populations had a GR_{50} value 1.8- to 3.3-fold higher than known GS (Fig 3)
- GR_{50} of susceptible plants were up to 1.8-fold greater than GR_{50} of known GS, but these plants did not survive field rate treatment
- The seven R populations were distributed among four sampling locations A, H, I, and N (Fig 4)
- GR populations were found in Butte, Madera and Kern Counties stretching 450km from north to south, respectively.

Objective 2

Figure 5. GR (black) and GS (green) junglerice populations biomass reduction 28 DAT with single and tank mixes post-emergence treatments

- All treatments significantly reduced plant biomass production when compared to the respective untreated controls (Fig 5)
- Paraquat, rimsulfuron, fluazifop, clethodim & sethoxydim successfully controlled both populations of junglerice

Conclusions

GR junglerice is widely spread in the Central Valley of California, and levels of glyphosate resistance were variable among populations. Further research is needed to evaluate mechanisms of resistance present in these populations.

Paraquat, rimsulfuron, fluazifop, clethodim and sethoxydim are effective herbicides at controlling both populations of junglerice and can be used as post-emergence management options. Ongoing research is being done to validate efficacy of these treatments in commercial tree nut orchards.

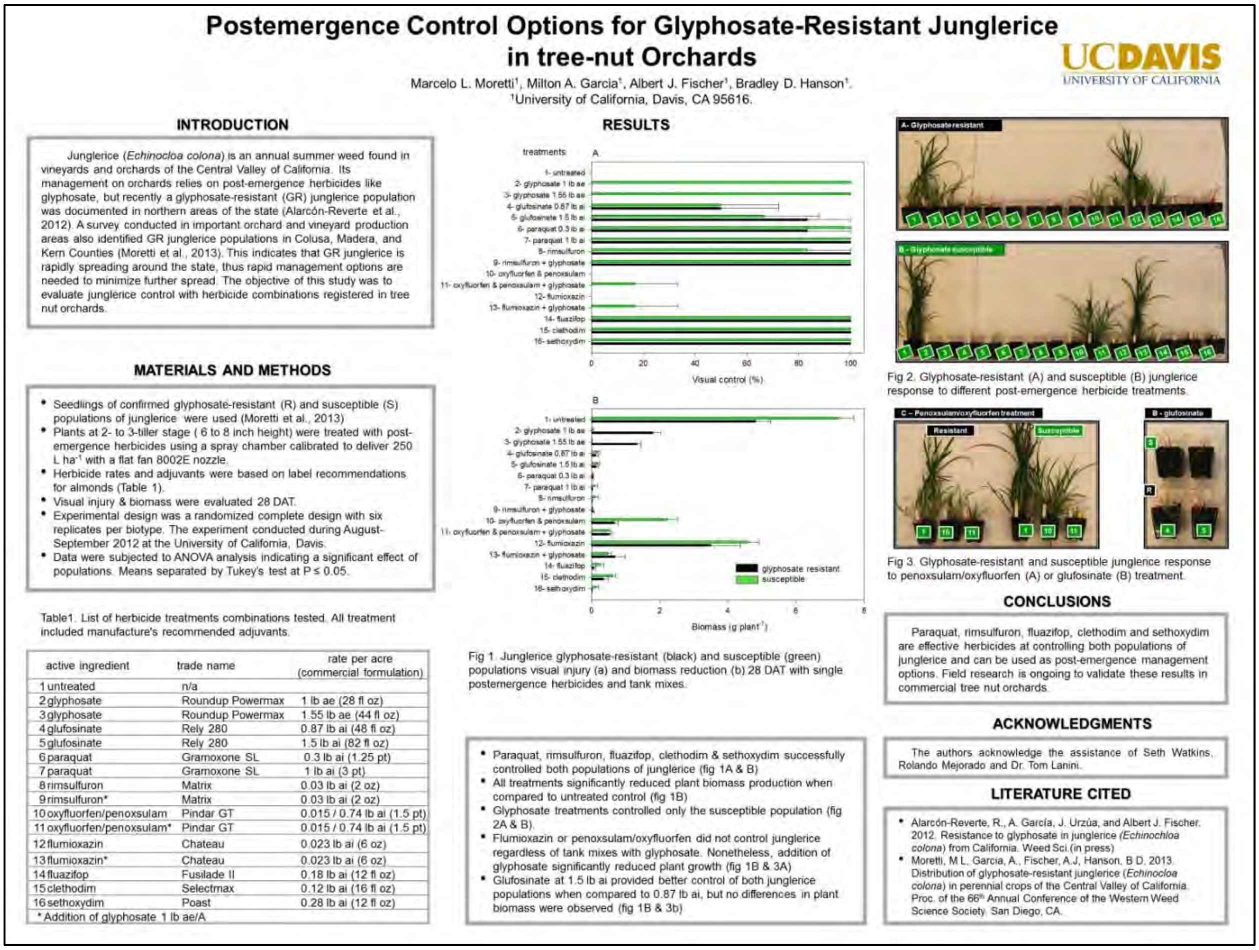
Acknowledgements

This work was supported by the Almond Board and USDA-NIFA-AFRI Award No. 2010-85320-20415

Literature Cited

- Alarcón-Reverte, R., A. García, J. Urzúa, and A.J. Fischer. 2012. Resistance to glyphosate in junglerice (*Echinochloa colona*) from California. Weed Sci. 61:48-54.
- Price, W.J., B. Shafii, and S.S. Seefeldt. 2012. Estimation of dose-response models for discrete and continuous data in weed science. Weed Technol. 26:587-601.

Figure 2.3. *Poster presentation of orchard sampling to determine the distribution of glyphosate resistant junglerice in California orchards and vineyards. Poster was presented to around 300 scientists and pest control industry researchers at the 2013 Western Society of Weed Science annual meeting (Moretti, Garcia, Fischer, and Hanson)*



Postemergence Control Options for Glyphosate-Resistant Junglerice in tree-nut Orchards

Marcelo L. Moretti[1], Milton A. Garcia[1], Albert J. Fischer[1], Bradley D. Hanson[1].
[1]University of California, Davis, CA 95616.

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INTRODUCTION

Junglerice (*Echinocloa colona*) is an annual summer weed found in vineyards and orchards of the Central Valley of California. Its management on orchards relies on post-emergence herbicides like glyphosate, but recently a glyphosate-resistant (GR) junglerice population was documented in northern areas of the state (Alarcón-Reverte et al., 2012). A survey conducted in important orchard and vineyard production areas also identified GR junglerice populations in Colusa, Madera, and Kern Counties (Moretti et al., 2013). This indicates that GR junglerice is rapidly spreading around the state, thus rapid management options are needed to minimize further spread. The objective of this study was to evaluate junglerice control with herbicide combinations registered in tree nut orchards.

MATERIALS AND METHODS

- Seedlings of confirmed glyphosate-resistant (R) and susceptible (S) populations of junglerice were used (Moretti et al., 2013)
- Plants at 2- to 3-tiller stage (6 to 8 inch height) were treated with post-emergence herbicides using a spray chamber calibrated to deliver 250 L ha^{-1} with a flat fan 8002E nozzle.
- Herbicide rates and adjuvants were based on label recommendations for almonds (Table 1).
- Visual injury & biomass were evaluated 28 DAT.
- Experimental design was a randomized complete design with six replicates per biotype. The experiment conducted during August-September 2012 at the University of California, Davis.
- Data were subjected to ANOVA analysis indicating a significant effect of populations. Means separated by Tukey's test at $P \leq 0.05$.

Table1. List of herbicide treatments combinations tested. All treatment included manufacture's recommended adjuvants.

active ingredient	trade name	rate per acre (commercial formulation)
1 untreated	n/a	
2 glyphosate	Roundup Powermax	1 lb ae (28 fl oz)
3 glyphosate	Roundup Powermax	1.55 lb ae (44 fl oz)
4 glufosinate	Rely 280	0.87 lb ai (48 fl oz)
5 glufosinate	Rely 280	1.5 lb ai (82 fl oz)
6 paraquat	Gramoxone SL	0.3 lb ai (1.25 pt)
7 paraquat	Gramoxone SL	1 lb ai (3 pt)
8 rimsulfuron	Matrix	0.03 lb ai (2 oz)
9 rimsulfuron*	Matrix	0.03 lb ai (2 oz)
10 oxyfluorfen/penoxsulam	Pindar GT	0.015 / 0.74 lb ai (1.5 pt)
11 oxyfluorfen/penoxsulam*	Pindar GT	0.015 / 0.74 lb ai (1.5 pt)
12 flumioxazin	Chateau	0.023 lb ai (6 oz)
13 flumioxazin*	Chateau	0.023 lb ai (6 oz)
14 fluazifop	Fusilade II	0.18 lb ai (12 fl oz)
15 clethodim	Selectmax	0.12 lb ai (16 fl oz)
16 sethoxydim	Poast	0.28 lb ai (12 fl oz)

* Addition of glyphosate 1 lb ae/A

RESULTS

Fig 1. Junglerice glyphosate-resistant (black) and susceptible (green) populations visual injury (a) and biomass reduction (b) 28 DAT with single postemergence herbicides and tank mixes.

- Paraquat, rimsulfuron, fluazifop, clethodim & sethoxydim successfully controlled both populations of junglerice (fig 1A & B)
- All treatments significantly reduced plant biomass production when compared to untreated control (fig 1B)
- Glyphosate treatments controlled only the susceptible population (fig 2A & B).
- Flumioxazin or penoxsulam/oxyfluorfen did not control junglerice regardless of tank mixes with glyphosate. Nonetheless, addition of glyphosate significantly reduced plant growth (fig 1B & 3A)
- Glufosinate at 1.5 lb ai provided better control of both junglerice populations when compared to 0.87 lb ai, but no differences in plant biomass were observed (fig 1B & 3b)

Fig 2. Glyphosate-resistant (A) and susceptible (B) junglerice response to different post-emergence herbicide treatments.

Fig 3. Glyphosate-resistant and susceptible junglerice response to penoxsulam/oxyfluorfen (A) or glufosinate (B) treatment.

CONCLUSIONS

Paraquat, rimsulfuron, fluazifop, clethodim and sethoxydim are effective herbicides at controlling both populations of junglerice and can be used as post-emergence management options. Field research is ongoing to validate these results in commercial tree nut orchards.

ACKNOWLEDGMENTS

The authors acknowledge the assistance of Seth Watkins, Rolando Mejorado and Dr. Tom Lanini.

LITERATURE CITED

- Alarcón-Reverte, R., A. García, J. Urzúa, and Albert J. Fischer. 2012. Resistance to glyphosate in junglerice (*Echinochloa colona*) from California. Weed Sci.(in press)
- Moretti, M.L. Garcia, A., Fischer, A.J, Hanson, B.D. 2013. Distribution of glyphosate-resistant junglerice (*Echinocloa colona*) in perennial crops of the Central Valley of California. Proc. of the 66th Annual Conference of the Western Weed Science Society. San Diego, CA.

Figure 2.4. *Poster presentation of initial cross-resistance screening of glyphosate resistant junglerice to other herbicide modes of action. Poster was presented to over 500 growers and pest control advisors at the 2013 California Weed Science Society annual meeting. (Moretti, Garcia, Fischer, and Hanson)*

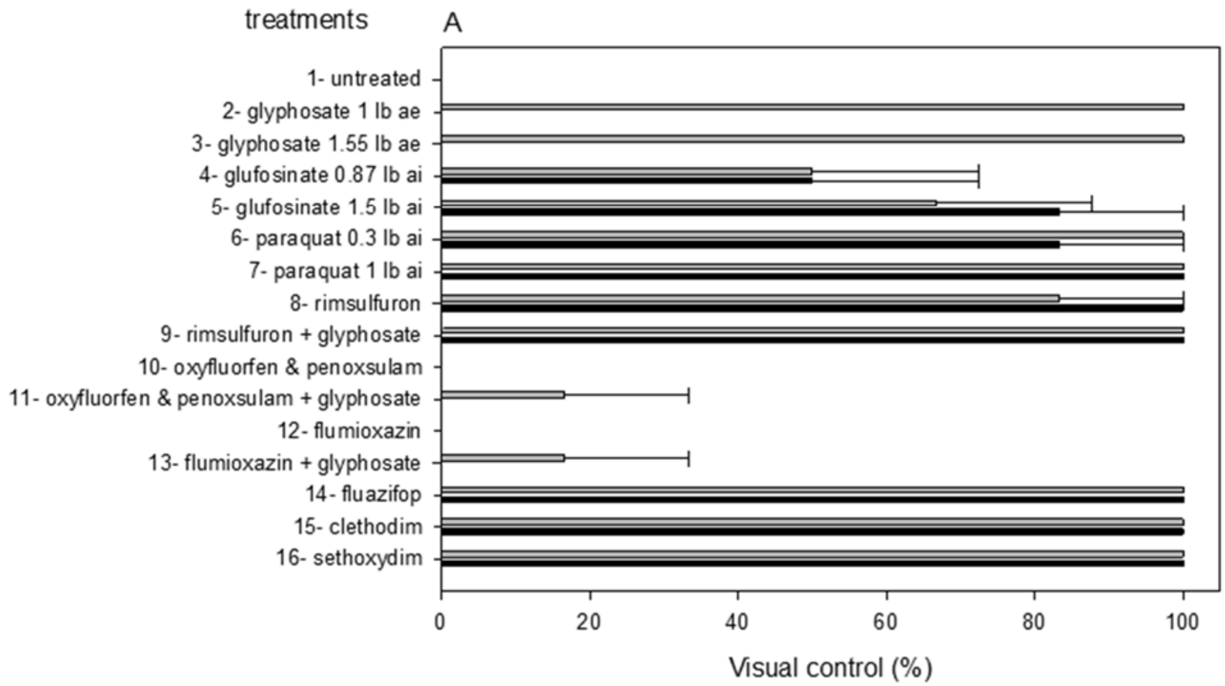


Figure 2.5. *Postemergence control of glyphosate-resistant junglerice in a 2012-13 greenhouse experiment. Light colored bars were glyphosate-susceptible biotypes and the dark colored bars were glyphosate-resistant. (Moretti and Hanson)*

Attachment 1

Section 3. Genetic and enzyme assays on GR and GS jungerice (UC Davis).

E.colona location data for populations used in UC Davis genetics and physiology experiments.

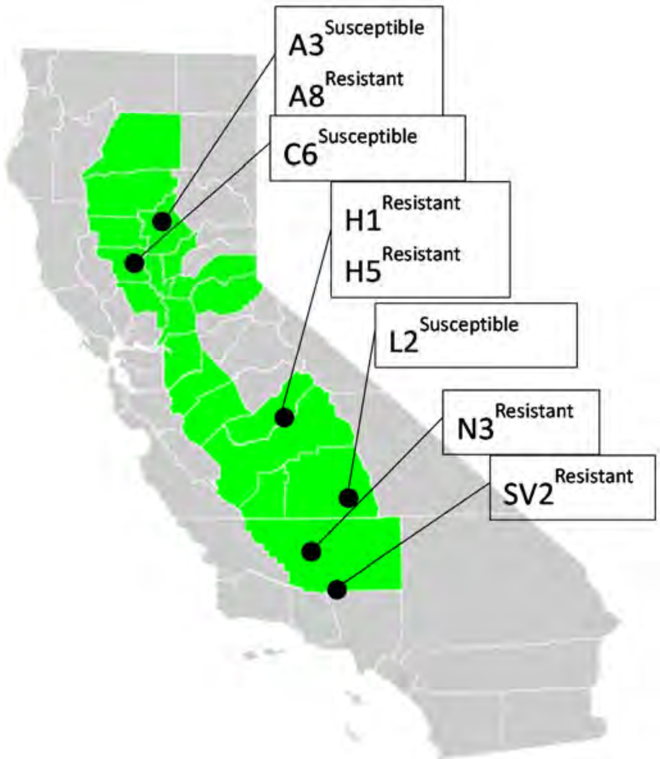


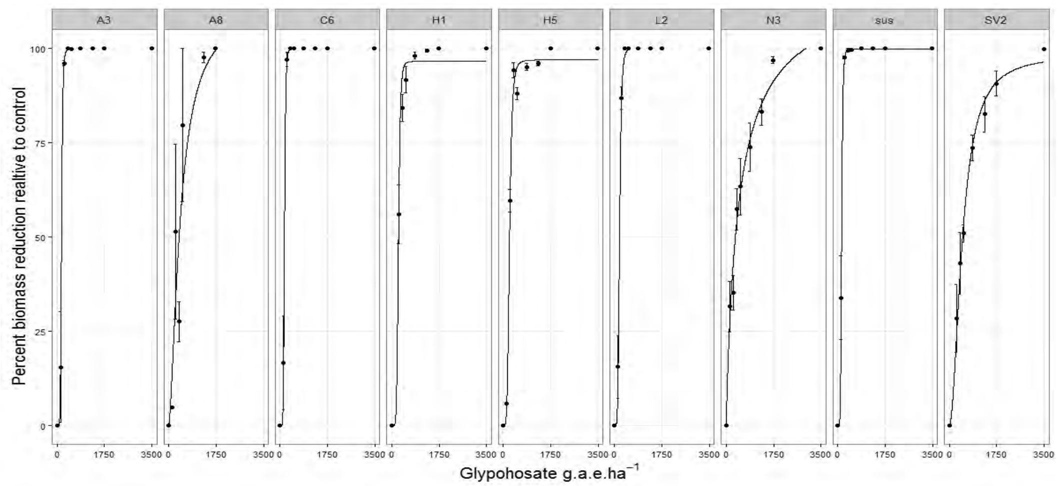
Figure 3.1. *Location of E.colona populations in the California Central Valley from which inbred lines were developed and resistance studies were carried out*

Table 3.1*. List of E.colona populations, location and cropping environment.*

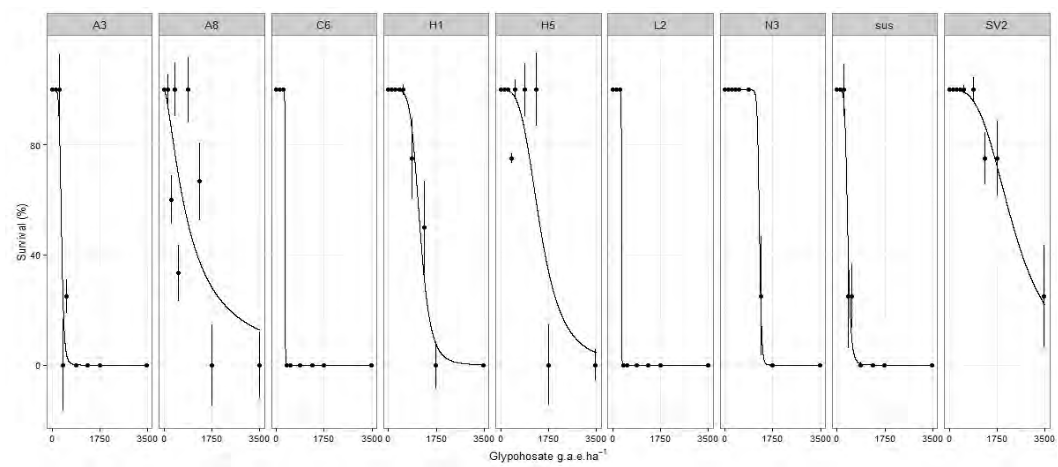
Population	Crop	County	GPS coordinates	
A3	Almond/Citrus	Butte	39°35'44.435"N	121°48'03.439"W
A8	Almond	Butte	39°37'33.005"N	121°48'04.831"W
C6	Almond	Colusa	38°58'56.673"N	122°04'45.299"W
H1	Almond	Madera	37°01'33.077"N	120°15'23.982"W
H5	Almond	Madera	37°00'39.734"N	120°13'15.823"W
L2	Vineyard	Tulare	35°53'30.845"N	119°13'56.584"W
N3	Orchard	Kern	35°41'19.084"N	119°23'18.426"W
Sus	Commercial seed	n/a	n/a	n/a
SV2	Almond	Kern	35º32.630"N	119º14.510"W

Dose response on field populations

Methods: To determine the presence of glyphosate resistant *E.colona* in specialty cropping systems, populations were collected from various sites across the central valley. These populations were subjected to glyphosate dose response assays. Plants at the three-to four- leaf stage were sprayed with 0, 130, 260, 390, 522, 870, 1350, 1740 and 3480 g.a.e. ha^{-1} (870 g.a.e ha^{-1} is the label field rate for control of *E.colona* in orchard and vineyard cropping systems). Plants were treated in a cabinet sprayer calibrated to 200 L ha^{-1}. Plant survival and dry above ground biomass was assessed at 21 days after treatment. Data were analyzed using a three-parameter log-logistic model (biomass) or a two-parameter-log-logistic binomial model (survival) fitted using the statistical program R version 3.2.3 with the package 'drc'.

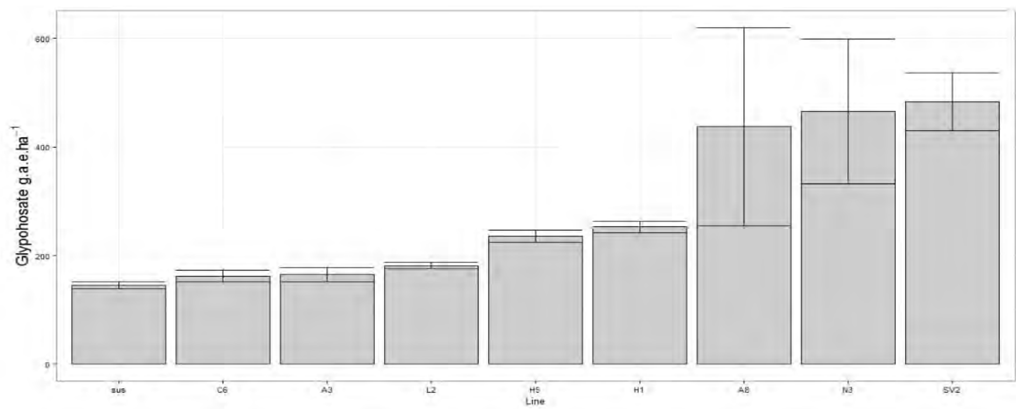


A.

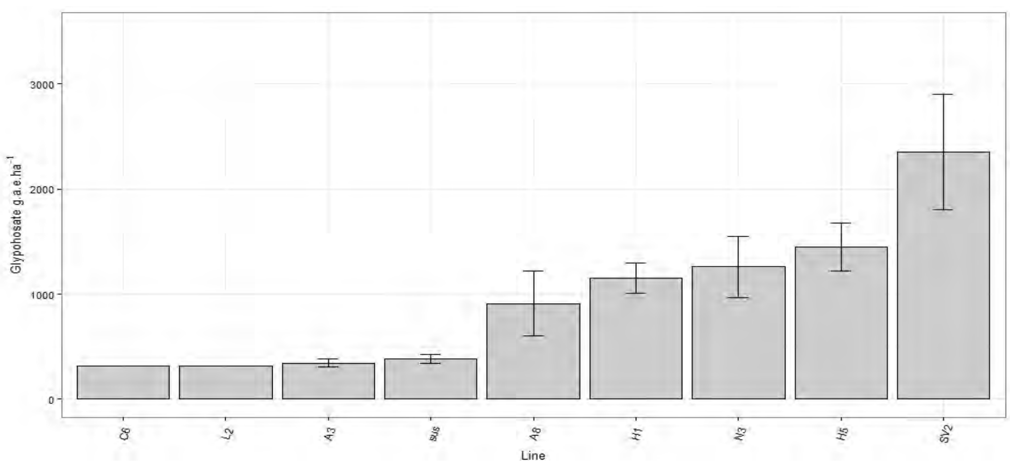


B.

Figure 3.2. *Dose response experiment on field populations of E.colona treated with a range of glyphosate rates.* ***A****. Growth reduction (GR) of E.colona lines, expressed as percent reduction compared to the untreated control.* ***B****. Survival expressed as percent of untreated control. Lines represent predicted survival from Log-logistic fitted curves. Data points represent the mean biomass/survival. Error bars represent SE of the mean.*



A.



B.

Figure 3.3. *Estimated doses causing 50% in field populations of E.colona treated with a range of glyphosate rates. Glyphosate rates causing a 50% reduction in **A**. dry above ground biomass (GR_{50}) or **B**. survival (LD_{50}). GR_{50}/LD_{50} values predicted from log-logistic fitted curves on the data. Error bars represent the SE.*

Attachment 1

Table 3.2. *Glyphosate rates causing a 50% reduction in dry above ground biomass (GR_{50}) or survival (LD_{50}) in field populations of E.colona. Resistance indices (RIs) represent the ratio of GR_{50} or LD_{50} of resistant to susceptible plants.*

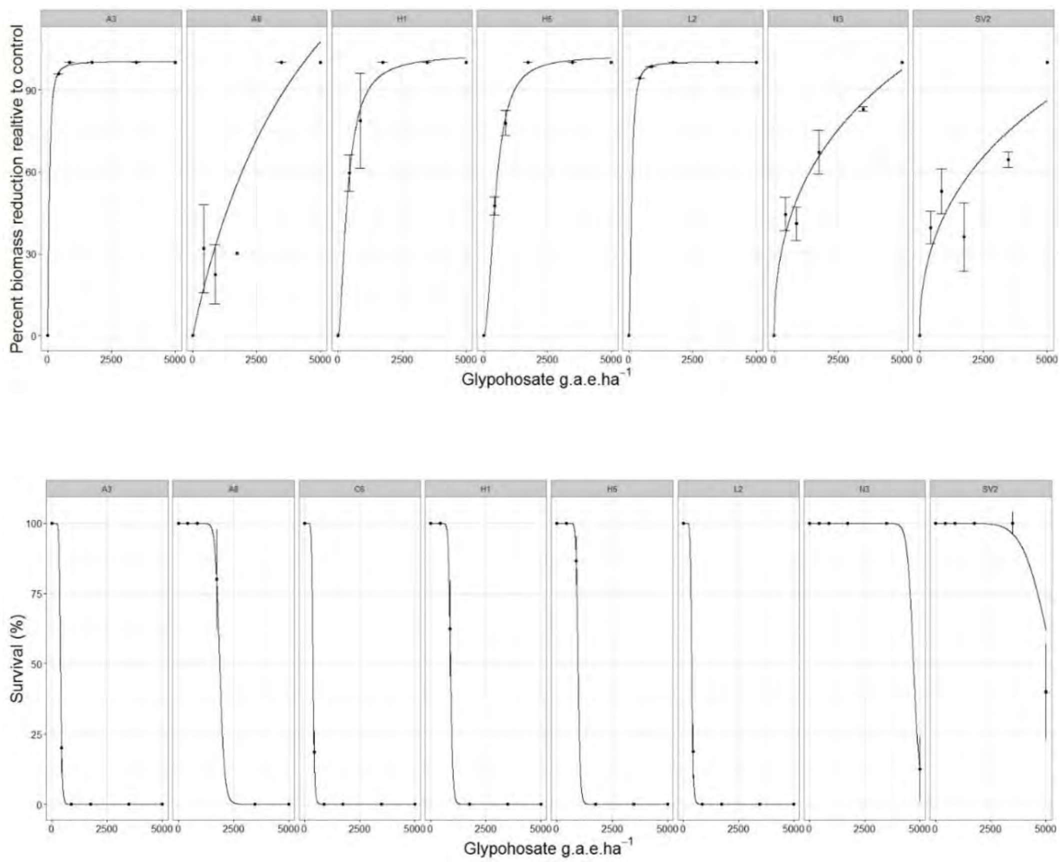
	Above-ground biomass (g)		Survival (%)	
Line	GR_{50} (g.a.e.ha^{-1}) (95%CI)	RI	LD50 (g.a.e.ha-1)(95%CI)	RI
A3	165.6 (138-192)	1	344 (273-415)	1
A8	437 (57-816)	2.6	910 (301-1518)	2.6
C6	162 (139-184)	0.9	319 (-988-1627)	0.9
H1	252 (230-275)	1.5	1151 (868-1433)	3.3
H5	235 (211-259)	1.4	1449 (998-1900)	4.2
L2	181 (169-192)	1.09	319 (-988-1627)	0.9
N3	465 (194-736)	2.8	1260 (688-1831)	3.6
Sus	144 (132-157)	0.8	384 (299-469)	1.11
SV2	483 (374-592)	2.9	2350 (1279-3422)	6.8

Results: Resistance to glyphosate was detected in multiple field populations of *E.colona* across the central valley. Resistant populations originated from multiple sampling locations cropping environments indicating it is widespread in the central valley (Table i.). There was a range of responses and resistance levels to glyphosate across the populations, ranging from 1.4 to 2.8-fold increase in resistance (growth reduction) and 2.6 to 6.8-fold resistance (survival) compared to the susceptible. Of the populations tested, A3, C6, L2 and the commercially sourced Sus populations were classified as susceptible to glyphosate. A8, H1, H5, N3 and SV2 were considered resistant compared to these susceptible populations.

Attachment 1

<u>Dose response on F_2 generation single seed lines</u>

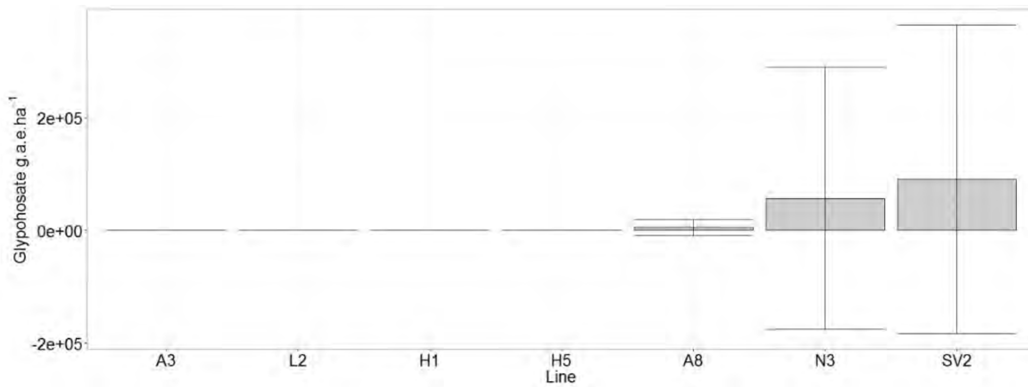
Methods: Second generation (F_2) single seed lines were developed from plants surviving the field rate or confirmed susceptible from previous dose response experiments. The aim of creating these lines is to reduce the segregation of resistance traits in the populations creating pools of seed with a more uniform genetic background. Plants were grown in greenhouse conditions and sprayed at the three- to four- leaf stage with 0, 435, 870, 1740,3480 and 5000 g.a.e. ha^{-1} glyphosate. Results were collected and analyzed as mentioned previously.



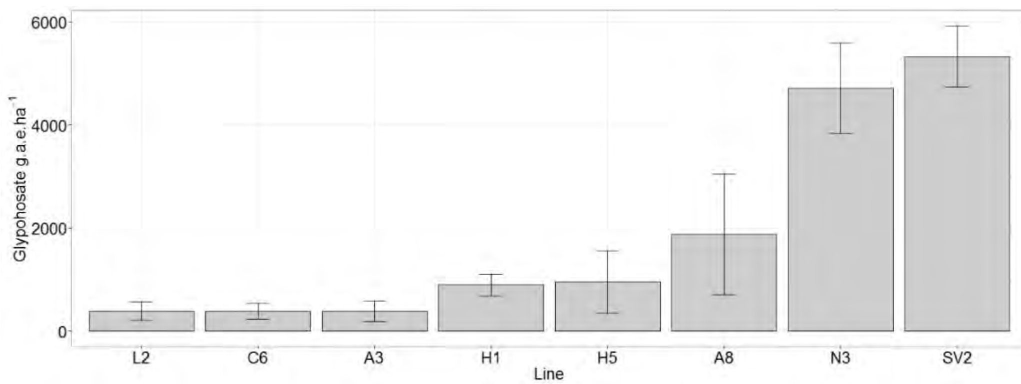
A.

B.

Figure 3.4. *Dose response experiment on F_2 single seed E.colona lines treated with glyphosate.* ***A****. Growth reduction (GR) of junglerice lines, expressed as percent reduction compared to the untreated control.* ***B****. Survival as percent of untreated control. Lines represent predicted survival from Log-logistic fitted curves. Data points represent the mean biomass/survival. Error bars represent SE of the mean.*



A.



B.

Figure 3.5. *Estimated doses causing 50% in F_2 single seed lines of E.colona treated with a range of glyphosate rates. Glyphosate rates causing a 50% reduction in **A**. dry above ground biomass (GR_{50}) or **B**. survival (LD_{50}). GR_{50}/LD_{50} values predicted from Log-logistic fitted curves on the data. Error bars represent the SE.*

Table 3.3. *Glyphosate rates causing a 50% reduction in dry above ground biomass (GR_{50}) or survival (LD_{50}). Resistance indices (RIs) represent the ratio of GR_{50} or LD_{50} of resistant to susceptible plants.*

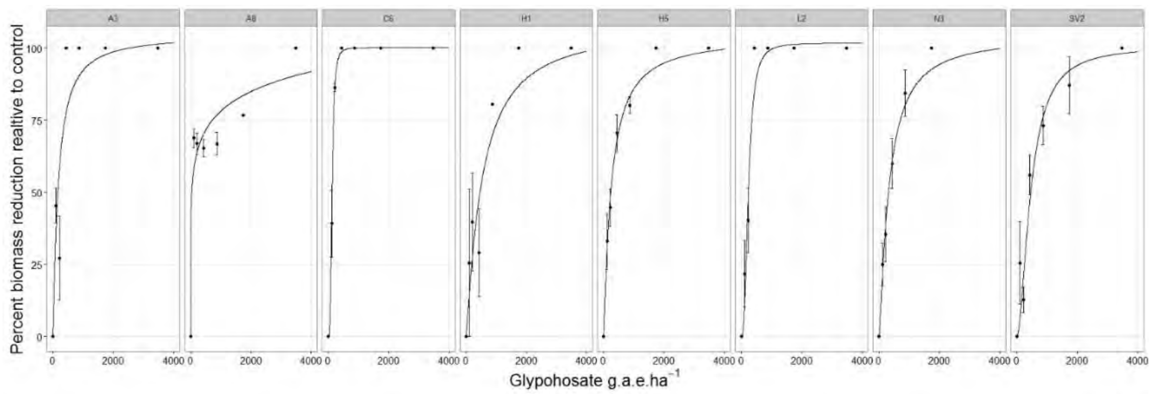
	Above-ground biomass (g)		Survival (%)	
Line	GR_{50} (g.a.e.ha^{-1}) (95%CI)	RI	LD50 (g.a.e.ha-1)(95%CI)	RI
A3	60.3 (8 – 112.3)	1	385.6 (-6.3-777)	1
A8	1659 (335.1 – 2983)	27.4	1878.7 (-422 – 4180)	4.8
C6	n/a	n/a	382.8 (78.4 – 687)	0.9
H1	351.4 (249.9-452)	5.8	895.2 (479-1310)	2.3
H5	472.1 (429.2-514.9)	7.8	956.2 (-231 – 2144)	2.4
L2	105.3 (90.8-119.8)	1.7	382.4 (33.5-731.2)	0.9
N3	22092 (-134759-178943)	365.8	4711.8 (2994-6429)	12.2
SV2	108206(-543112-759523)	1792	5331.2 (4169-6493)	13.8

Results: The response of F_2 generation lines to glyphosate was similar to that seen in the field populations. A3, C6 and L2 displayed high mortality at low rates of glyphosate and were again classified as susceptible. A8, H1, H5, N3 and SV2 showed varying levels of resistance to glyphosate. Interestingly the reduction of biomass in these populations had a higher variability than seen at the population level as well as higher resistance indices. This may be in part a result of natural segregation in the plants selected for each single seed line. *E.colona* is a hexaploid and thus resistance traits may segregate for multiple generations before homozygosity is achieved within or amongst loci.

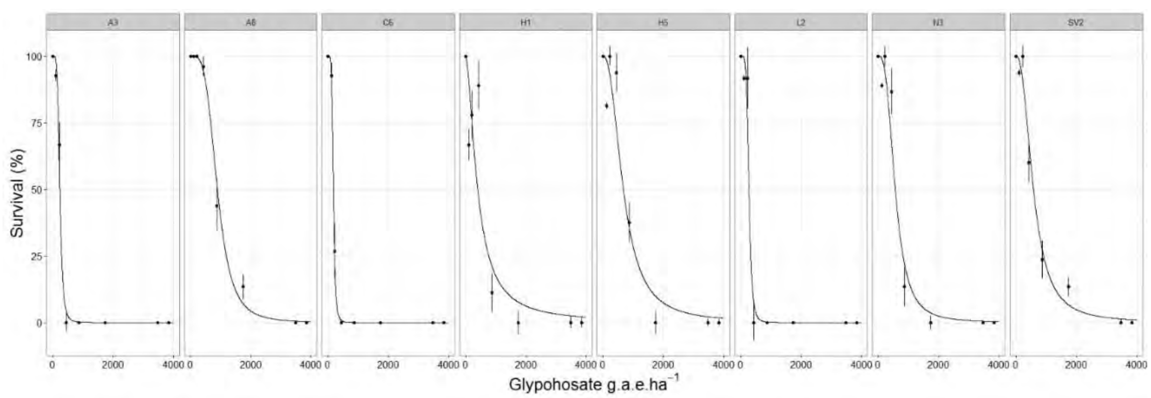
Attachment 1

Dose response on F_3 lines in a 30-degree Celsius controlled environment

Methods: Third generation (F_3) self-pollinated, single seed lines were developed from F_2 plants surviving the field rate or confirmed susceptible. *E.colona* is a hexaploid species and multiple generations of self-pollinating and selecting of single seed plants is required to reduce segregation in the lines. This provides the opportunity to assess resistance traits and mechanisms with less variability due to segregation. Plants were grown in a controlled environment growth chamber held at 30°C/25°C day/night temperatures. These conditions were chosen to mitigate the effect of variable light intensity and temperature present when plants are grown in greenhouse conditions.

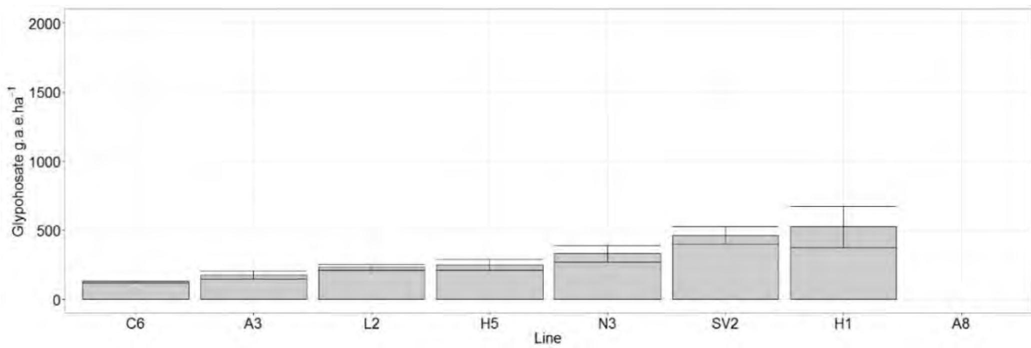


A.

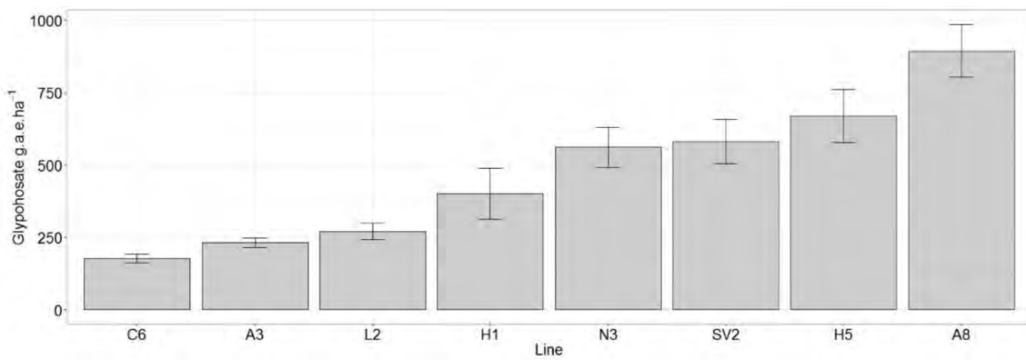


B.

Figure 3.6. *Dose response experiment on F_3 E.colona lines grown at 30°C treated with glyphosate.* ***A****. Growth reduction (GR) of junglerice lines treated with glyphosate, expressed as percent reduction compared to the untreated control.* ***B****. Survival as percent of untreated control. Lines represent predicted survival from Log-logistic fitted curves. Data points represent the mean survival. Error bars represent SE of the mean.*



A.



B.

Figure 3.7. *Estimated doses causing 50% in F3 single seed lines of E.colona grown at 30°C treated with a range of glyphosate rates. Glyphosate rates causing a 50% reduction in **A**. dry above ground biomass (GR_{50}) or **B**. survival (LD_{50}). GR_{50}/LD_{50} values predicted from Log-logistic fitted curves on the data. Error bars represent the SE.*

Table 3.4. *Glyphosate rates causing a 50% reduction in dry above ground biomass (GR_{50}) or survival (LD_{50}). Resistance indices (RIs) represent the ratio of GR_{50} or LD_{50} of resistant to susceptible plants.*

	Above-ground biomass (g)		Survival (%)	
Line	GR_{50} (g.a.e.ha^{-1}) (95%CI)	RI	LD50 (g.a.e.ha-1)(95%CI)	RI
A3	180.5 (109.3-251.7)	1	231.2 (198.5-263.8)	1
A8	8828.7 (42204.2-92834.1)	69.7	893.5(714.5-1072.4)	3.8
C6	124.2 (107.1-141.2)	0.7	176.9(146.7-207.1)	0.7
H1	524.0 (218 – 830)	2.9	400.8(227.3-574.4)	1.7
H5	249.2 (168.8-329.7)	1.4	668.4(488.8-847.9)	2.9
L2	233 (189.5-276.6)	1.3	271(214.2-327.8)	1.17
N3	329.7 (211.6-447.8)	1.8	560.8(423.5-698.2)	2.4
SV2	464.8 (340.9-588.7)	2.6	580.6(429.9-731.2)	2.5

Results

Resistance to glyphosate in all lines was reduced in this dose response experiment compared to previous experiments. A8, H1, H5, N3 and SV2 still showed higher resistance to glyphosate than the previously characterized susceptible lines A3, C6 and L2, but all GR_{50} and LD_{50} values were reduced. This variation in resistance may be a result of an effect of temperature or light availability as a result of lines being grown in a controlled growth chamber, it may also be a result of the plant producing the single seed line. The individual selected to generate the F_3 seed may have been less resistant than the average of the previous population. Variability within each line was reduced suggesting segregation for the resistant trait is reducing in the lines.

Attachment 1

Dose response on F_3 single seed lines at high rates of glyphosate

Methods: Resistance to glyphosate in summer weed species can range from 1 fold to 20 fold that of the susceptible. The control achieved by higher rates of glyphosate on the resistant *E.colona* lines were determined in a dose response experiment. The most resistant lines as determined from previous dose response studies (A8, N3 and SV2) were selected along with two susceptible lines (A3 and C6) for further study. The dose response experiment was carried out as previously described, here plants were grown in greenhouse conditions and sprayed with 0, 108.8, 217.5, 435,870, 1740, 3480, 5220, 6960, 8700 and 10000 g.a.e. ha^{-1} glyphosate.

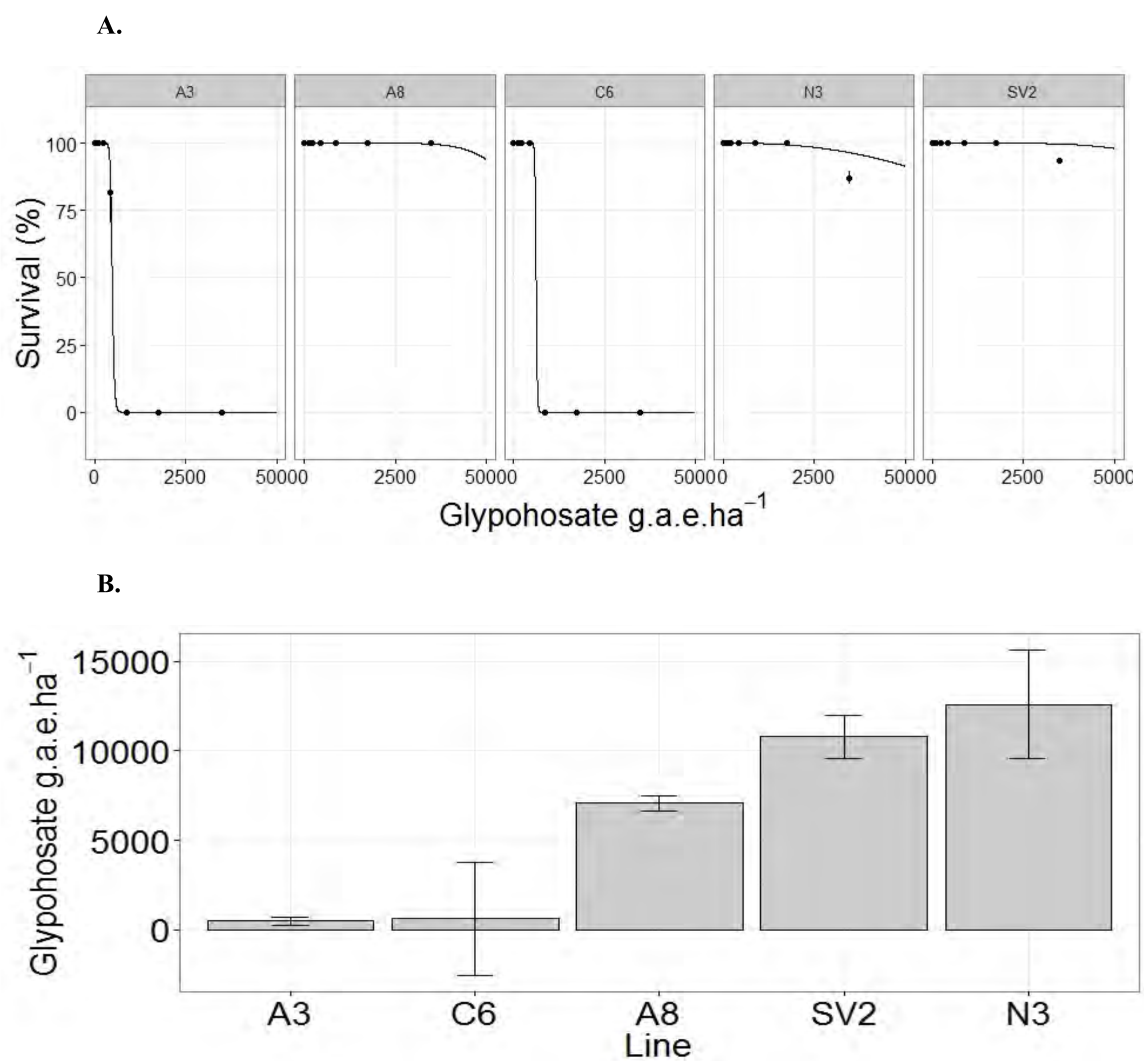


Figure 3.8. *Dose response experiment on F_3 E.colona lines treated with high rates of glyphosate.* ***A****. Survival as percent of untreated control.* ***B****. Glyphosate rates causing a 50% reduction in survival (LD_{50}). Lines represent predicted survival from Log-logistic fitted curves. Data points represent the mean survival. Error bars represent SE of the mean.*

Table 3.5. *Glyphosate rates causing a 50% reduction in survival (LD_{50}). Resistance indices (RIs) represent the ratio of LD_{50} of resistant to susceptible plants.*

	Survival (%)	
Line	LD50 (g.a.e.ha-1)(95%CI)	RI
A3	385.6 (-6.3-777)	1
A8	1878.7 (-422 – 4180)	4.8
C6	382.8 (78.4 – 687)	0.9
N3	4711.8 (2994-6429)	12.2
SV2	5331.2 (4169-6493)	13.8

Results. The resistant lines tested showed very high resistance compared to susceptible lines at high rates of glyphosate. This may be a function of the environmental conditions at the time of treatment, or throughout the growing period of the plants. Results were consistent with previous dose response experiments showing A8, N3 and SV2 to be more resistant than A3 and C6.

Shikimate accumulation assay

Methods: The accumulation of shikimic acid in the chloroplasts of leaves is used to investigate the effect of glyphosate on its target enzyme EPSPS. Glyphosate inhibits the shikimic pathway causing an accumulation of the upstream substrate shikimic acid. Resistant *E.colona* possessing a target site mutation at Proline 106 of the EPSPS enzyme blocks the binding of glyphosate and therefore do not accumulate shikimate as susceptible plants do. Here the accumulation of shikimic acid in lines treated with two rates of glyphosate, half (435 g.a.e. ha-1) and full (870 g.a.e. ha-1) field rates over time was investigated. Plants were sprayed at the two-to three- leaf stage and the youngest fully expanded leaf was taken for analysis.

Attachment 1

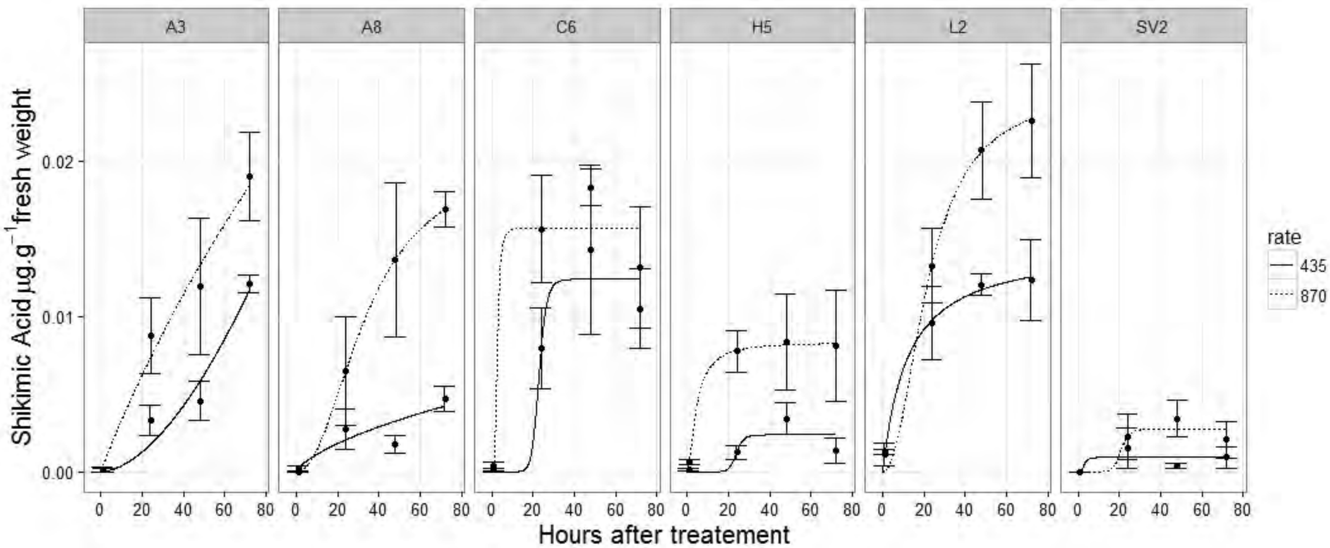


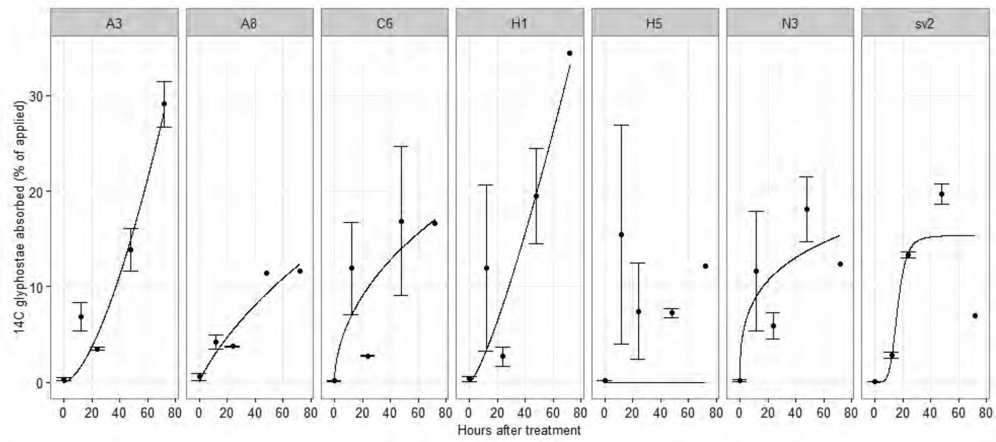
Figure 3.9. *Shikimate accumulation in E.colona lines treated with a 0.5 and 1 x rate of glyphosate. Lines represent predicted shikimate accumulation from Log-logistic 3 parameter fitted curves. Data points represent the mean shikimate. Error bars represent SE of the mean.*

Results: E.colona plants from confirmed susceptible (A3, C6, L2) lines showed an increase in shikimic acid accumulation when treated with glyphosate; results show that in these lines, glyphosate causes inhibition of the EPSPS enzyme within 24 hours of treatment. At 72 hours after treatment, GR junglerice (A8, H5, N3, SV2) lines had significantly less shikimic acid accumulation than the GS at the 0.5 times field rate. When treated with glyphosate at 1 times the field rate, results suggest some GR lines may have multiple resistance mechanisms involved in resistance. The GR line, A8, measured similar shikimic acid accumulation to GS lines when treated at 1 times field rate. This suggests that at the higher rate, the mutated EPSPS enzyme is unable to overcome the effect of glyphosate in the shikimate pathway. Confirming previous results, GR lines H5 and SV2 which contain the same target site mutation (TSM) in the EPSPS gene, showed significantly different shikimic acid accumulation at the 1 times rate. Line SV2 does not have an increase in shikimate when treated at the higher rate, whereas line H5 has a significantly higher accumulation. This suggests that the glyphosate resistance seen in population SV2 may involve more than one mechanism of resistance.

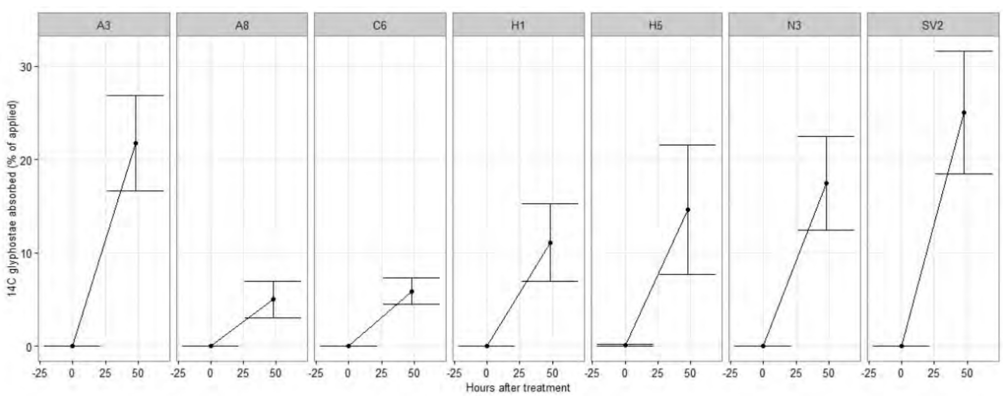
Attachment 1

<u>Absorption of radiolabeled glyphosate in *E.colona*</u>

Methods: The altered absorption and/or translocation of glyphosate away from growing regions of the plant is a common mechanism of resistance in weed species. Here *E.colona* plants were treated with 1µl droplets of glyphosate solution corresponding to 0.5 field rate and ^{14}C radiolabeled glyphosate equal to 560 Bq. µl^{-1}. Absorption of applied glyphosate was sampled at 0, 12,24,48 and 72 hours after treatment.



A.



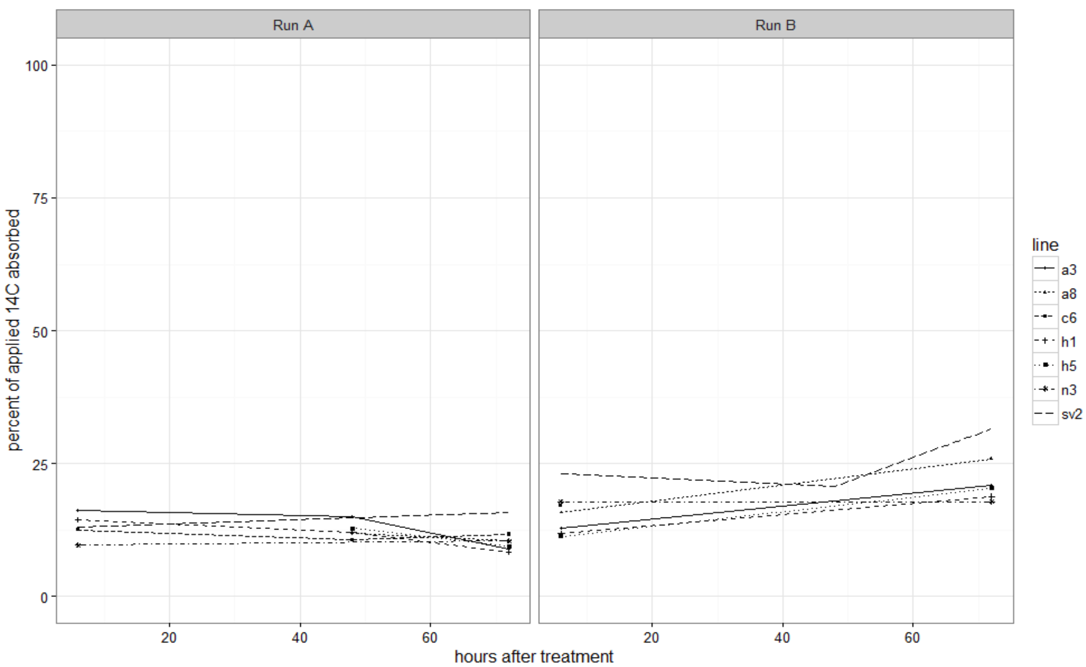
B.

Figure 3.10. *Amount of radiolabeled glyphosate absorbed by E.colona. Data is expressed as a percent of total applied radiolabeled glyphosate. **A**. Experimental run 1. **B**. Experimental run 2.*

Results: No differences were detected in the absorption of glyphosate between resistant and susceptible lines. Absorption of [^{14}C]-glyphosate increased over time, with highest absorption measured after 48 hours. In both experimental runs total absorption of applied [^{14}C]-glyphosate reached a maximum of ~ 30 percent. This result is relatively low compared to previous studies on glyphosate absorption in other weed species. Glyphosate absorption is measured in most studies at 75 % of applied by 24 hours after treatment. The low absorption observed in these studies may be a function of experimental conditions such as humidity, glyphosate rate, non-ionic surfactant concentration and light intensity. These factors will be further investigated.

Movement of radiolabeled glyphosate in *E.colona*

Methods: The altered absorption and/or translocation of glyphosate away from growing regions of the plant is a common mechanism of resistance in weed species. Here *E.colona* plants were treated with 1µl droplets of glyphosate solution corresponding to 0.5 field rate and ^{14}C radiolabeled glyphosate equal to 560 Bq. μl^{-1}. Absorption and movement of applied glyphosate was sampled at 6,24,48 and 72 hours after treatment in three plant sections; the treated leaf, the rest of the plant annotated as above ground, and the roots of the plant.



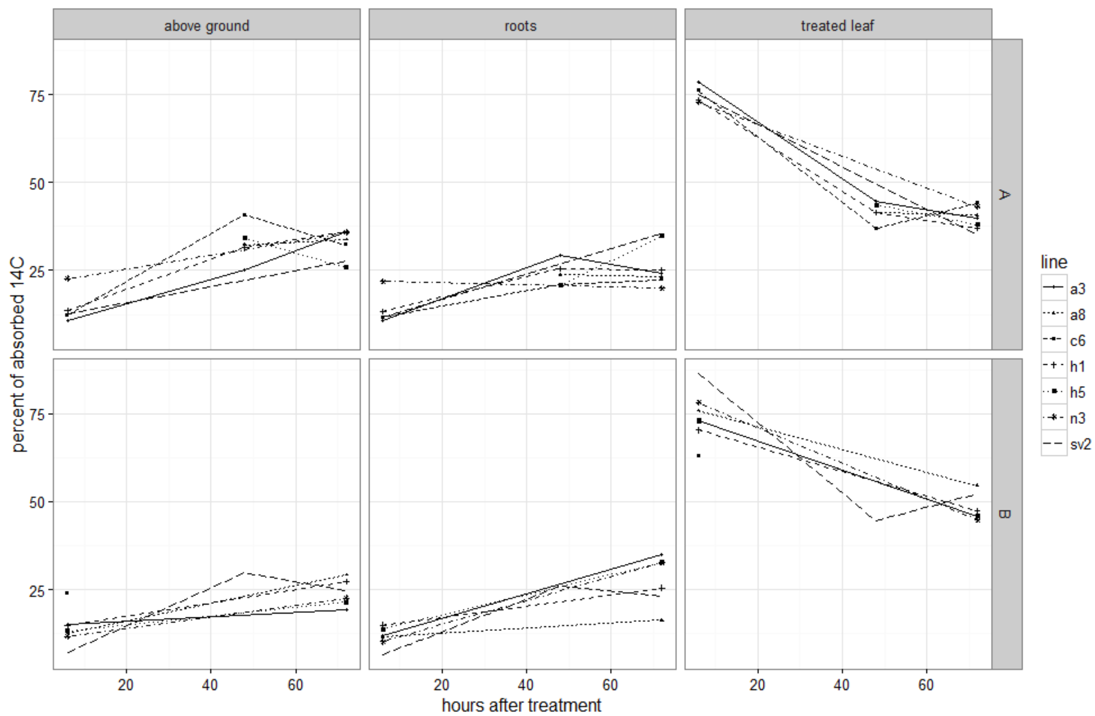


Figure 3.11. *Translocation of 14C-glyphosate in E.colona lines.* ***A****. percent of total 14C-glyphosate applied to leaves absorbed into the plant, across two experimental runs.* ***B****. percent of total absorbed 14C-glyphosate in sampled plant sections, across two experimental runs.*

Results:

There was no significant difference in the amount of applied 14C-glyphosate absorbed into the plant between resistant and susceptible *E.colona* lines. Both resistant and susceptible lines showed an absorption of 10-25% of the applied solution over 72 hours. Maximum absorption was reached after 24 hours in all of the lines in both experimental runs and did not increase significantly after this time point. Studies in other species have shown that a reduction in glyphosate uptake in leaves can lead to resistance, but this was not the case for these junglerice lines. Studies have also found that accumulation of absorbed glyphosate in the treated leaf, or site of application, can result in resistance. The reduced movement of glyphosate from the leaves to the active growing regions of the plant such as meristems, in turn reduces the effect of glyphosate on the plants as they are able to continue to grow. The resistant and susceptible junglerice lines here did not show significantly different movement out of the treated leaf up to 72 hours after treatment. This suggests that the resistance seen in these lines is not due to altered translocation of glyphosate.

<u>Altered metabolism of glyphosate in E.colona</u>

Methods: Resistant and susceptible lines of E.colona were analyzed for differential metabolism of glyphosate. *E.colona* plants were treated with 1µl droplets of glyphosate solution with ^{14}C radiolabeled glyphosate equal to 560 Bq. μl^{-1}. Plants were allowed to photosynthesize for 16h at which time they were analyzed for the presence of glyphosate and its primary metabolite aminomethylphosphonic acid (AMPA).

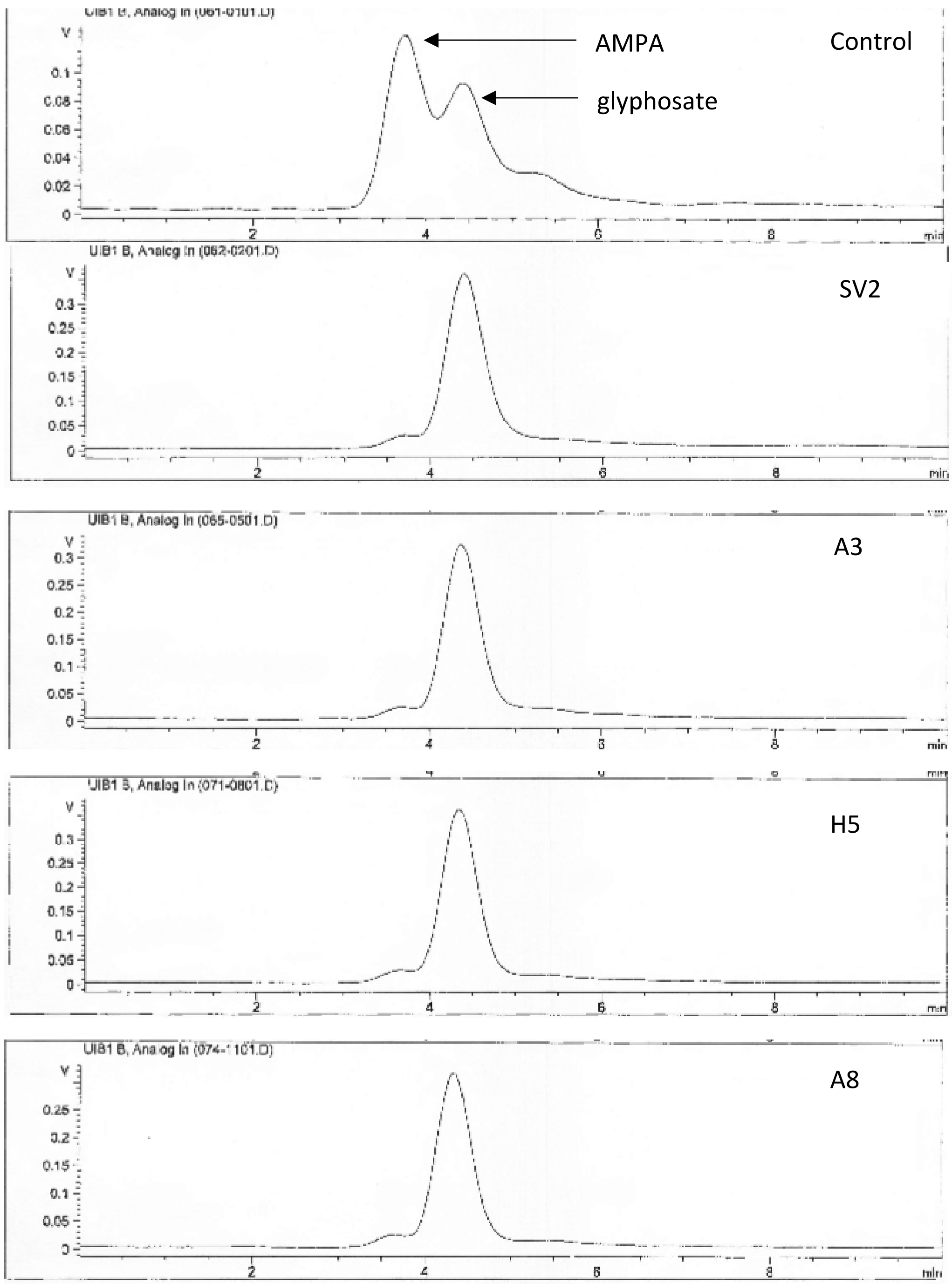


Figure 3.12. *Metabolism of glyphosate in E.colona lines. Each peak indicates the detection of 14C present in AMPA or glyphosate.*

Results:

The metabolism of glyphosate in plants as a mechanism of resistance has been observed in multiple weed species. Glyphosate is metabolized into the less toxic metabolite AMPA allowing the plant to reduce the impact of exposure to the herbicide. A protocol to detect 14C radiolabeled glyphosate and AMPA using high performance liquid chromatography (HPLC) technology was developed and validated as seen in the control sample, where both glyphosate and AMPA appear as two distinct peaks at 3.5 and 4.5 minutes respectively. Of the four *E.colona* lines tested, three were resistant (SV2, H5 and A8) and one susceptible (A3). The metabolism of glyphosate into AMPA was not detected in any of these lines. In all samples, a single peak representing glyphosate was observed at 4.5 minutes. These results indicate that metabolism is not a mechanisms of resistance in these lines.

<u>Detection of target site mutations in the EPSPS gene:</u>

Methods: A mutation at the Proline-106 position of the EPSPS gene of *E.colona* is a known mechanism of resistance to glyphosate. The mutation causes a conformational change in the active site of the enzyme, preventing glyphosate from binding and subsequently blocking the shikimic acid pathway in the chloroplast. Genomic DNA was extracted from colona individuals and a 1500bp region of the EPSPS gene amplified to obtain the sequence of this region in F_3 lines. These amplicons were cloned into bacteria and individual plasmids isolated to mitigate the effect of multiple alleles due to polyploidy on the sequence results.

Figure 3.11. *Diagrammatic representation of the EPSPS gene in the 5' to 3' direction. Top shows the full length gene. Bottom shows the region amplified for sequencing. Orange arrows represent exon regions; light blue lines represent introns. Proline 106 is indicated.*

Table 3.5. Mutations detected in the EPSPS gene of *E. colona* lines. Single nucleotide polymorphisms leading to non-synonymous amino acid changes at site 106 are known to confer resistance to glyphosate. Wild type genotype is CCA at 106 translating to Proline.

Line	106 Codon	Amino Acid
A3	CCA	Proline
C6	CCA	Proline
L2	CCA	Proline
H1	TCA	Serine

H5	CTA	Leucine
A8	ACA	Threonine
N3	CTC	Leucine
SV2	CTC	Leucine

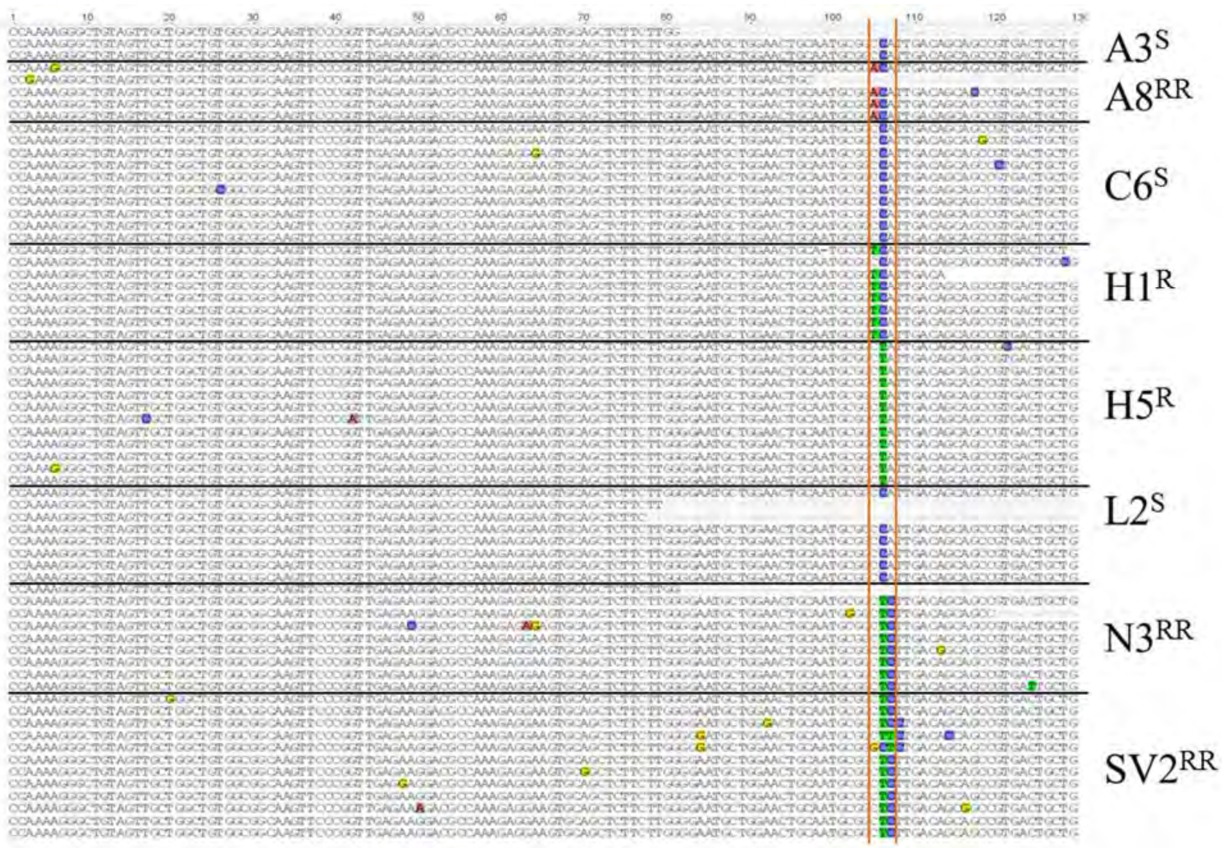


Figure 3.14*. Multiple sequence alignment of a 130bp region of genomic DNA from single plants. The codon for Pro106 is shown between orange bars. Dissimilar nucleotides are depicted in color. Sequences aligned using ClustalW in Geneious version 9.1.2.*

Results: The region encompassing Proline 106 of the EPSPS gene was successfully sequenced in F_3 representatives of all *E.colona* lines. Single nucleotide polymorphisms (SNPs) were identified in the resistant lines with resistance alleles showing high sequence similarity to the EPSPS *gene 1* in *E. colona*. identified in other studies. The wild type Proline codon was present at this position in all susceptible populations sequenced. Three different single nucleotide changes at Proline 106; Proline to Leucine, Proline to Threonine and Proline to Serine were identified amongst the resistant lines. Three resistant populations originating from geographically distant locations (Madera and Kern counties) contained the same Pro106Leu substitution, whereas geographically close populations (H1 & H5, Madera county) contained two different mutations, Pro106Ser and Pro106Leu respectively. These results suggest that target site resistance is evolving independently in multiple locations, rather than a single even spreading to nearby areas. This is further supported by comparison of the intron sequence of the E. colona lines. Introns are regions of DNA that are not translated into proteins and possess a higher incidence of SNPs compared to the highly conserved coding regions. This allows for the identification of divergent EPSPS alleles between populations. Here we found multiple different SNPs in the intron region sequenced and thus multiple different EPSPS alleles in the different populations. This suggests independent evolution as a main generator of the target site resistance in these lines. Interestingly, lines containing the same PRO106Leu substitution in the EPSPS enzyme showed different glyphosate response profiles which strongly suggests the possible interaction of multiple mechanisms contributing to resistance in these lines.

Section 4. Junglerice phenology and productivity in response to shade in common garden experiments (UC Davis and CSU Frenso).

Seeds of five (A3, A8, C6, H5, SV2) were scarified, planted into seedling trays, and placed into a greenhouse that was held at 30 C. When the seedlings had produced a minimum of three basal stems, two to three plants of each biotype were transplanted (in a completely randomized design and at a minimum of 0.5 m between plants) into field plots (field plots were 1 m wide by 15 m long) that were exposed to either full sunlight (0% shade) or 30% and 60% shade environments. The shade treatments were established by covering the entire plots with black, woven, plastic fabric of differing mesh size on PVC frames. Each shade environment was replicated three times and the entire study was conducted at two locations: UC Davis and CSU Fresno. Plants were watered once to twice daily to ensure that soil moisture was not limiting. Plant growth and development was monitored for four weeks after which each specimen was destructively harvested. The aboveground biomass was separated into three distinct tissue types (stems, leaves, and panicles), characterized and weighed.

Table 4.1. *Total number of stems, axillary stems, leaves, panicles and vegetative and reproductive fresh weights for five biotypes of junglerice grown under three different shade environments.*

Biotype	Shade (%)	# Stems	# Axillary Stems	# Leaves	Vegetative FW (g)		# Panicles	Panicle FW (g)
A3	0	107.5	128.6	546.6	456.7		240.9	83.2
	30	84.8	104.0	448.3	413.8		146.2	66.5
	60	49.6	58.7	265.8	257.5		72.3	28.8
A8	0	133.7	237.1	1033.3	515.4		450.1	141.0
	30	85.2	91.0	455.2	256.0		115.8	43.0
	60	57.7	74.9	312.7	216.1		93.9	24.9
C6	0	78.7	149.8	552.2	388.4		218.1	93.5
	30	62.4	90.1	416.3	320.6		131.1	56.5
	60	33.1	51.2	186.6	170.0		52.4	18.7
H5	0	82.0	107.1	429.0	318.0		204.0	84.6
	30	64.7	63.4	318.3	221.0		102.4	43.0
	60	51.6	56.3	219.6	229.2		62.2	30.0
SV2	0	116.0	106.3	540.3	464.3		185.1	90.5
	30	76.6	93.0	505.8	425.8		128.4	62.2
	60	60.6	52.2	309.3	257.7		56.3	23.9

With few exceptions, junglerice plants were largest when gown in full sunlight (0% shade) as compared to the 30 and 60% shade environments (Table A). The mean number of basal stems/plant at 0% shade ranged from 79 (C6) to 134 (A8). At 30% shade, the number of stems produced per plant ranged from 62 (C6) to 85 (A8); at 60% shade, stem production ranged from 33 stems/plant (C6) to 61 stems/plant (SV2). With respect to axillary stems (i.e. 'branches'), the plants grown in full sunlight produced more (106-237 axillary stems/plant) than did the plants grown at 30% shade (63-104 axillary stems/plant) and 60% shade (51-75 axillary stems/plant).

Similar observations were made for both leaf and panicle production. As might be expected, vegetative and reproductive fresh weights (g) reflected the trends observed for stem, leaf, and panicle numbers. No advantage (or penalty) was observed to be associated with the GR trait with respect to plant growth and development.

Differential growth and development of junglerice under varying environmental conditions, such as shade, can have significant management consequences. For example, junglerice plants growing under full sun conditions (such as a field edge) may become too large to control, more quickly, as compared to plants growing under reduced light (such as an orchard interior). Weed control with postemergence herbicides is most readily achieved while plants are still young and small. Many weedy species become more tolerant of herbicide products as they age due to physiological and physical changes that affect uptake, absorption, and translocation. Additionally, the architecture of junglerice has been shown to change depending on the shade environment; junglerice plants grown in 0% shade tend to be more prostrate to vase-shaped whereas plants grown under 60% shade were more likely to be upright. These alterations in habit may also affect weed control. Erect plants may be less able to retain spray droplets, thus reducing their ability to be controlled with herbicides as compared to prostrate specimens. Conversely, upright plants may be more sensitive to physical management strategies such as mowing.

Attachment 1

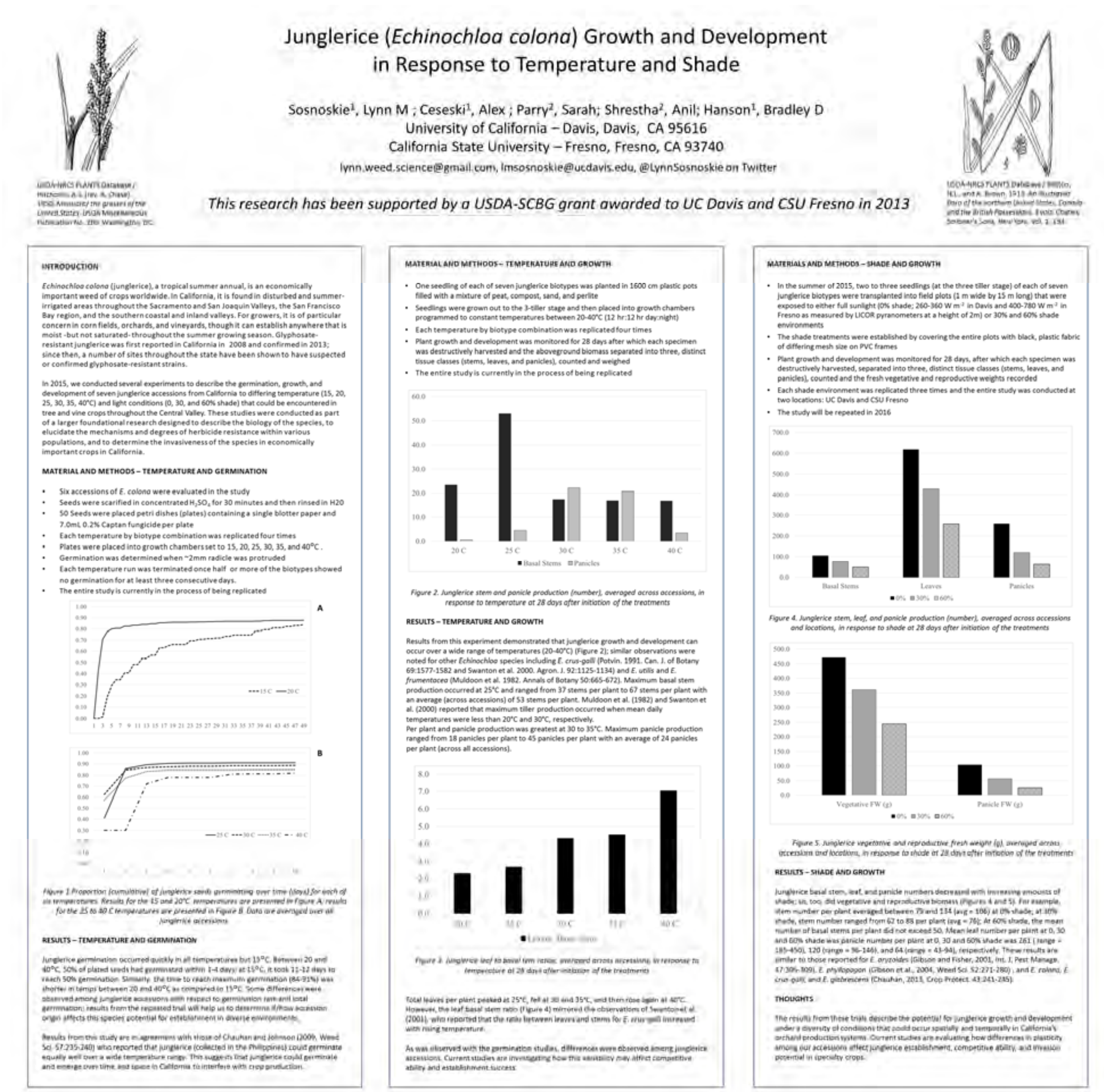


Figure 4.1. *Poster presentation of junglerice response to shade and temperature. Poster was presented to around 300 scientists and pest control industry researchers at the 2016 Weed Science Society of America annual meeting (Sosnoskie, Ceseski, Parry, Shrestha, and Hanson)*

Section 5. Junglerice germination and growth in response to temperature (UC Davis).

Effects of temperature on germination success and plant growth and development under laboratory or growth chamber conditions at UC Davis.

Weed management is critical during the establishment phase of new orchards and vineyards in order to promote the growth of young transplants, which can affect the long-term productivity of the ecosystem. In bearing crops, weeds that escape control can reduce irrigation efficiency and interfere with harvest operations. Furthermore, there is some concern among growers that non-managed weeds may support populations of insect, vertebrate, and pathogenic pests that can significantly affect tree health. Because of the permanent nature of trees and vines, some integrated weed control strategies are difficult, if not impossible (i.e. crop rotation), to implement.

Commonly used mechanical weed control practices, such as disking and mowing, can effectively remove unwanted vegetation, although care must be taken to minimize the potential for damage to the irrigation infrastructure, as well as the trees themselves (i.e. root-pruning or debarking). Although permanent cover crops and sod strips can be used in orchards and vineyards to improve access, reduce dust and prevent the establishment of some weedy species, they must be extensively managed to prevent competition and excessive water use. Preemergence herbicides applied during the dormant season, when activating rains occur most frequently, are often ineffective at controlling late spring- and summer-emerging annuals. As a consequence, many California tree and vine growers have relied, heavily, on the use of glyphosate (a post-emergence, foliar-applied herbicide) for weed control.

Glyphosate, the most widely used non-selective herbicide (because of its broad spectrum of efficacy, economical pricing, and favorable environmental profile), worldwide, blocks 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase, a strategic enzyme in the shikimate pathway. Inhibition of this pathway by glyphosate allows for the buildup of shikimic acid, a reduction in carbon fixation, a decline in photosynthesis, and a depletion of products involved in the synthesis of aromatic amino acids, leading to plant death. In 1996, more than 20 years after the introduction and widespread adoption of glyphosate, the first instance of glyphosate resistance was recorded in rigid ryegrass (*Lolium rigidum* Gaudin) in Australia. Since then, resistance to glyphosate has evolved in a total of 35 weed species in more than 25 countries.

In California, seven weed species, all of them common to perennial cropping systems, have confirmed glyphosate resistance, including junglerice (*Echinochloa colona* (L.) Link), an annual, C4 grass native to Asia and the Indian sub-continent. Reduced sensitivity to glyphosate in junglerice was first demonstrated in offspring derived from a population collected from a field of glyphosate resistant corn in Northern California. Additional characterization studies conducted on junglerice collected from orchard and vineyard production areas throughout the Central Valley between (2010-2013) identified multiple populations with at least two- to four-fold levels of glyphosate resistance relative to the susceptible check.

Although an overreliance on glyphosate has clearly imposed a strong selection pressure and has contributed to the development of glyphosate resistant (GR) junglerice in California, it is unknown how other morphological, phenological, physiological characteristics are contributing to the spread of junglerice infestations in perennial systems. Furthermore, it is unknown if elevated tolerances to abiotic stresses or differential responses to environmental cues could help to advance glyphosate resistant junglerice in the Central Valley. Between 2013 and 2016, laboratory, greenhouse, and field experiments were undertaken to, firstly, evaluate the specific effects of environmental stresses (i.e. temperature, shading, salt, moisture) on junglerice growth and development and, secondly, to determine if the subsequent responses are either correlated with or independent of the GR phenotype.

Temperature:

Seed from five junglerice accessions (A3, Butte County, glyphosate susceptible (GS); A8 Butte County, GR; C6, Colusa County, GS; H5, Madera County, GR; SV2, Kern County, GR) were scarified in concentrated sulfuric acid for 30 minutes to break seed dormancy. Fifty seeds of each biotype were placed in individual plastic Petri dishes and on blue blotter paper that were moistened with 7 ml of 0.2% Captan fungicide solution. Petri dishes were then placed in growth chambers set to constant temperatures of 15, 20, 25, 30, 35, and 40 C for 10 days. Temperatures were randomly assigned to the growth chambers for each run of the study to minimize the potential for confounding. Seed germination was monitored, daily. A seed was considered germinated when the protruded radicle was as long as the length of the seed coat. Dishes were checked for desiccation and refilled, as needed with distilled water. Each temperature by biotype combination was replicated four times and the entire study was conducted twice.

Four germination indices were used to describe junglerice responses to temperature and included: 1) time, in days, to the observance of the first germinated seed; 2) time, in days, to 50% germination; 3) mean daily germination; and 4) cumulative germination on day 10. To calculate time to 50% germination for each temperature, cumulative germination was regressed against time, in days, using a three parameter sigmoid model (*G = Gmax/{1 + e[-T-T50/Grate]}* where *G* is the proportion of seed germinated at time *T*, *Gmax* is the maximum estimated germination, *T50* is the estimated time to 50% of maximum germination, and *Grate* is the slope); each species by temperature combination was analyzed separately. Mean daily germination is calculated that the total number of seeds germinated per temperature divided by the total number of days (10 days) in the experiment; mean daily germination for each species by temperature combination was determined separately.

Results from temperature germination studies indicated that junglerice accessions from California were able to germinate over a wide range of temperatures (Figures A to D), although differences in germination rates and total germination were observed among temperature treatments. Temperatures of 15 and 20 C delayed the observance of initial seed germination for all accessions (Figure A). For 15 C, the time to first germination ranged from 2.5 days after the start of the experiment (accession A8) to 3.4 days (accession SV2). At 20 C, time to the start of germination ranged from 2 (A3, C6, H5, SV2) to 2.5 (A8) days. Seed from each accession began germinating on the first day of the study when temperatures exceeded 20 C.

With respect to the time to 50% germination (Figure B), the lowest (15 C) and highest (40 C) temperatures evaluated had the slowest rates. Time to 50% germination at 15 C ranged from 2.5 days (A8) to 8.7 days (H5). At 40 C, time to 50% germination ranged from 2.4 days (A8) to 2.6 days (SV2). At 20 C, time to 50% germination ranged from less than 1 day (A8 and C6) to 2.3 days (SV2). For treatments of 25, 30, and 35 C, it was estimated that 50% of junglerice seed across all accessions had germinated within two days of the start of the temperature study for all accessions.

Mean daily junglerice germination was lowest at 15 C and ranged from 1.9 seeds/day for C6 to 4.0 seeds/day for SV2 (Figure C). The mean daily germination index did not vary, substantially, among temperatures ranging from 20 (4.0-4.8 seeds/day) to 40 C (3.4-4.5 seeds/day). Similarly, cumulative germination at 10 days after plating was lower at the 15 C treatment (0.36 for C6 to 0.79 for SV2) than all other temperatures (0.69 to 0.99) (Figure D).

In our studies, seeds of junglerice seed germinated over the entire temperature range between 15 and 40 C. This suggests that germination can occur throughout the Central Valley of California. With the exception of 15 C, and sometimes 20 and 40 C, germination did not appear to vary much among temperature treatments, suggesting that the optimal range for germination is not particularly narrow. Furthermore, there did not appear to be any indication that the GR and GS biotypes responded differently to temperature with respect to germination. This would suggest that the resistance trait may not be linked to any advantage (or, conversely, disadvantage) regarding this initial phase of weed growth and development.

In a second set of temperature-based studies, newly germinated seedlings of each of the five biotypes (A3, A8, C6, H5, SV2) were planted in 1600 cm plastic pots filled with a mixture of peat, compost, sand, and perlite; grown out to the 3-leaf stage; and placed into walk-in growth chambers programmed to a set of constant temperature ranging between 20 and 40C with a day/night photoperiod of 12/12 hours. The 15 C temperature treatment could not be included in this study because a sufficient large growth chamber with adequate cooling capabilities could not be obtained. Each biotype by temperature interaction was replicated four to five times and the entire study was conducted twice in time. Temperatures were randomly assigned to the growth chambers for each run of the study to minimize the potential for confounding. All plants were watered and fertilized as needed to support vigorous growth. Plants were spaced within each of the growth chambers to allow for maximum light penetration throughout the individual canopies.

Seven weeks after seedlings were transferred into the growth chambers, junglerice plants were destructively harvested and the aboveground biomass characterized and weighed. Measurements were made to describe the number of basal stems produced/plant, the number of leaves produced/plant, and the number of panicles observed.

All of the junglerice biotypes produced between 11 (C6, H5, and SV2) and 12 (A3 and A8) basal stems/plant at 20 C, 10 (C6) to 16 (A8) stems/plant at 25 C, and 15 (SV2) to 18 (A3 and A8) stems/plant at 30 C (Figure E). The lowest number of basal stems were produced at 40 C (3 stems/plant [H5] to 6 stems/plant [A8] stems/plant) and 35 C (5 stems/plant [C6] to 8 stems/plant [A3 and SV2] stems/plant).

The numbers of leaves (Figure F) produced by junglerice plants followed a pattern similar to that observed for tillering. The number of leaves/plant at 20 C ranged from 40 (H5) to 57 (SV2). At 25 C, the number of leaves per plant ranged from 54 (H5) to 63 (A3 and A8). Maximum leaf production (131 leaves/plant (H5) to 161 leaves/plant (A8) leaves/plant) occurred at 30 C. As was noted with basal stem production, the numbers of leaves produced per plant declined at both 35 C (62 leaves/plant [C6] to 79 leaves/plant [SV2]) and 40 C (43 leaves/plant [H5] to 60 leaves/plant [A8]). With the exception of accession C6, panicle production per plant was greatest at 25 C (8 panicles/plant [H5] to 13 panicles/plant[A8]) (Figure G). At 30 C, inflorescence production ranged from 7 panicles/plant (H5 and SV2) to 11 panicles/plant (A8); C6 produced 18 panicles/plant. Inflorescence production was lowest at the temperature extremes (15, 35, and 40 C). The greatest amount of aboveground biomass (stems, leaves, and panicles) produced per plant occurred at 30 C; biomass amounts ranged from 98 g/plant (SV2) to 113 g/plant (C6) (Figure H). The next greatest amount of biomass produced occurred at 35 C (68 g/plant for C6 to 88 g/plant for H5) followed by 25 C and 40 C. The least amount of biomass was produced at the 20 C temperature treatment for all accessions.

Junglerice growth and development occurred over a wide range of constant temperatures, although maximum output appeared to occur at 30 C. Although some differences were observed among the junglerice accessions, with respect to plant size and mass, it did not appear as though the GR trait provided junglerice with any discernable advantage, relative to the GS plants, in the absence of glyphosate. Knowledge about how junglerice germinates, grows, and develops under different temperatures can help us to improve the timing of management practices and may help us to understand why control failures occur. The potential for rapid germination, emergence, and growth of junglerice under warmer conditions can reduce the success of weed control programs if junglerice is not properly treated at a susceptible growth stage. Our ability to anticipate germination events can facilitate the timely application of both preemergent and postemergent chemical applications to maximize herbicide efficacy and prevent escapes that can repopulate the soil seedbank. The potential for rapid germination, emergence, and growth of junglerice under warmer conditions can reduce the success of weed control programs if junglerice is not properly treated at a susceptible growth stage. Improved timing of weed management options will help to improve the environmental sustainability of perennial cropping seasons by preventing the unnecessary herbicide applications.

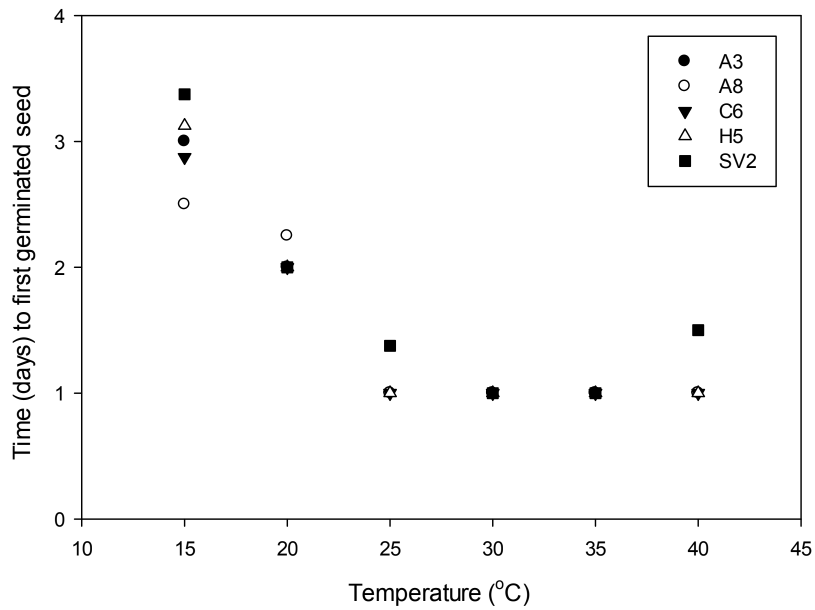


Figure 5.1. *Time (days) to the observance of the first germinated seed for five junglerice accessions from the Central Valley of California in response to temperature.*

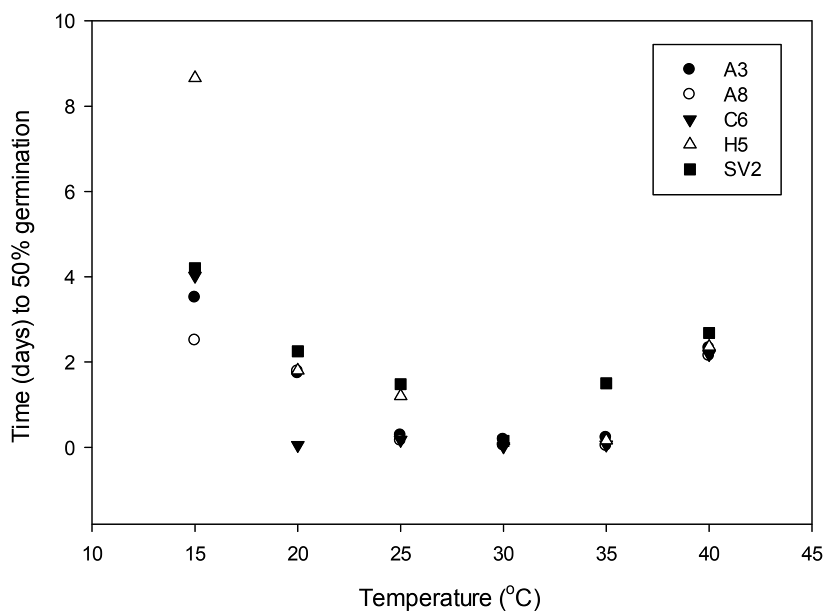


Figure 5.2. *Time (days) to 50% germination for five junglerice accessions from the Central Valley of California in response to temperature.*

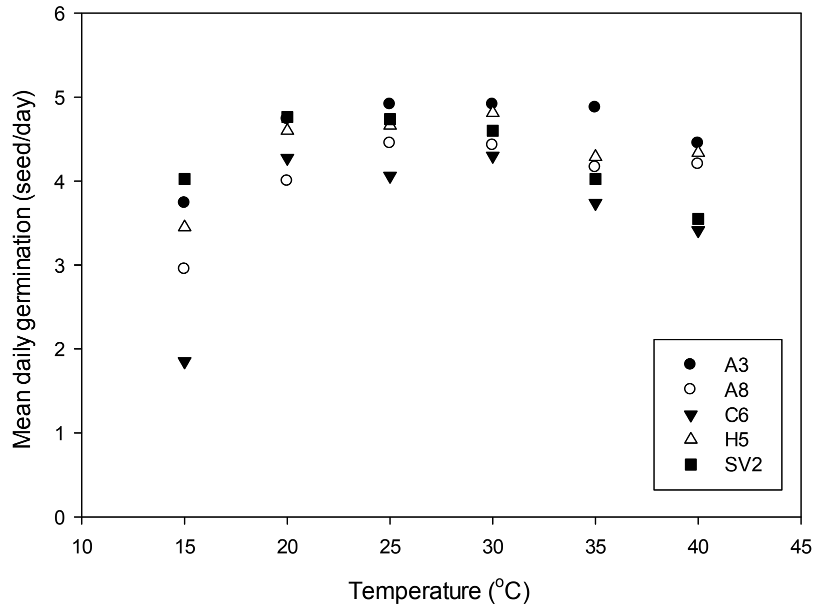


Figure 5.3. *Mean daily germination (seeds/day) for five junglerice accessions from the Central Valley of California in response to temperature.*

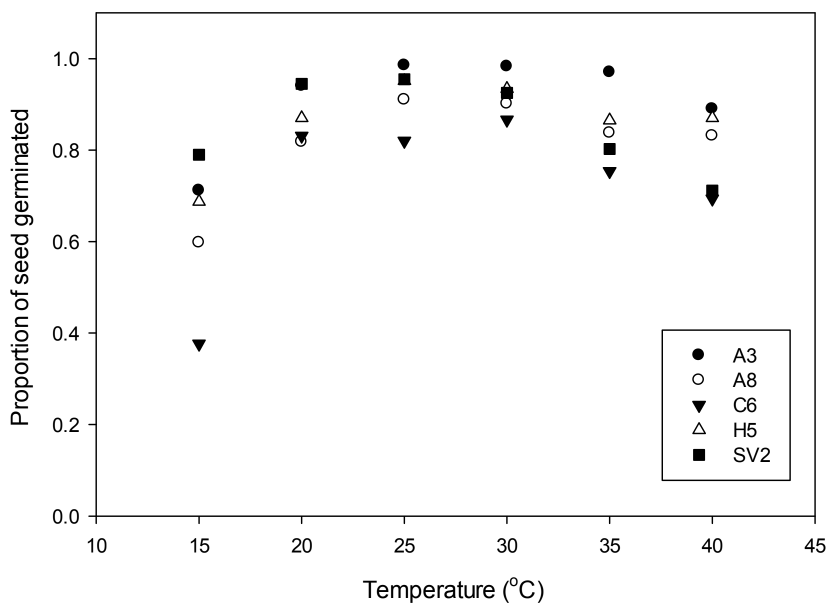


Figure 5.4. *Proportion of seed germinated for five junglerice accessions from the Central Valley of California in response to temperature.*

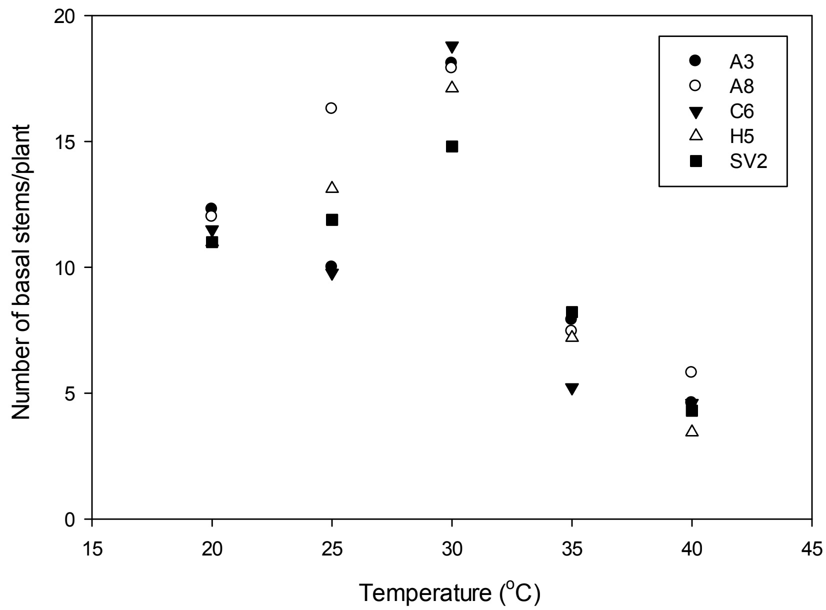


Figure 5.5. *Number of basal stems produced per plant for five junglerice accessions from the Central Valley of California in response to temperature.*

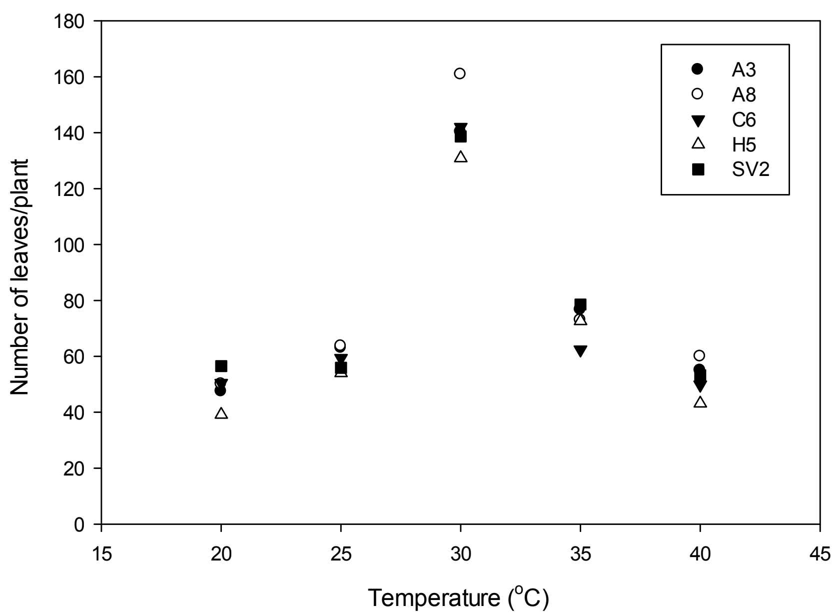


Figure 5.6. *Number of leaves produced per plant for five junglerice accessions from the Central Valley of California in response to temperature.*

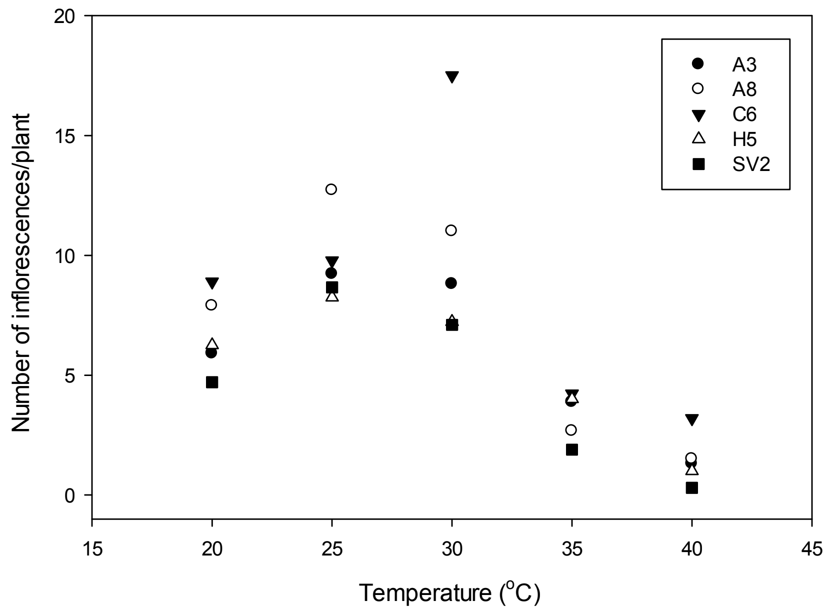


Figure 5.7. *Number of panicles produced per plant for five junglerice accessions from the Central Valley of California in response to temperature.*

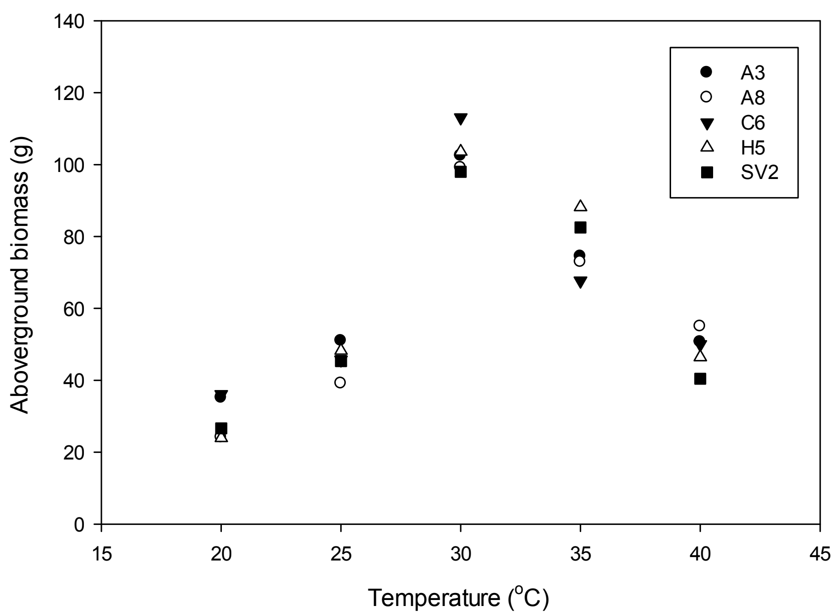


Figure 5.8. *Aboveground fresh weight (g/plant) for five junglerice accessions from the Central Valley of California in response to temperature.*

Section 6. Comparisons of GR and GS junglerice response to temperature, salinity, nitrogen uptake, and osmotic stress (CSU Fresno).

Objective 1: To determine the effect of salinity and moisture stress on seed germination of a glyphosate-susceptible and a glyphosate-resistant biotype of junglerice.

A growth chamber study was conducted to assess the effect of moisture or salinity stress on the germination of a glyphosate-resistant (GR) and a glyphosate-susceptible (GS) biotype of junglerice. Polyethylene glycol was used to create solutions of different water potential (0, -0.149, -0.51, -1.09, -1.88, -2.89, -4.12, and -5.56 MPa) and sodium chloride (NaCl) was used to create a range of salinity solutions (equivalent to electrical conductivity of 0, 5, 10, 15, 20, 25 dS m^{-1}). Experimental units consisted of 20 junglerice seeds in a petri dish with a Whatman No. 2 filter paper and 10 mL of a treatment solution (Figure 6.1). Dishes were sealed with parafilm, and placed in a growth chamber programmed for a day/night temperature of 30/25°C with 12 h daylight. Germination was monitored up to 21 days and data were expressed as a percentage of the distilled water control.

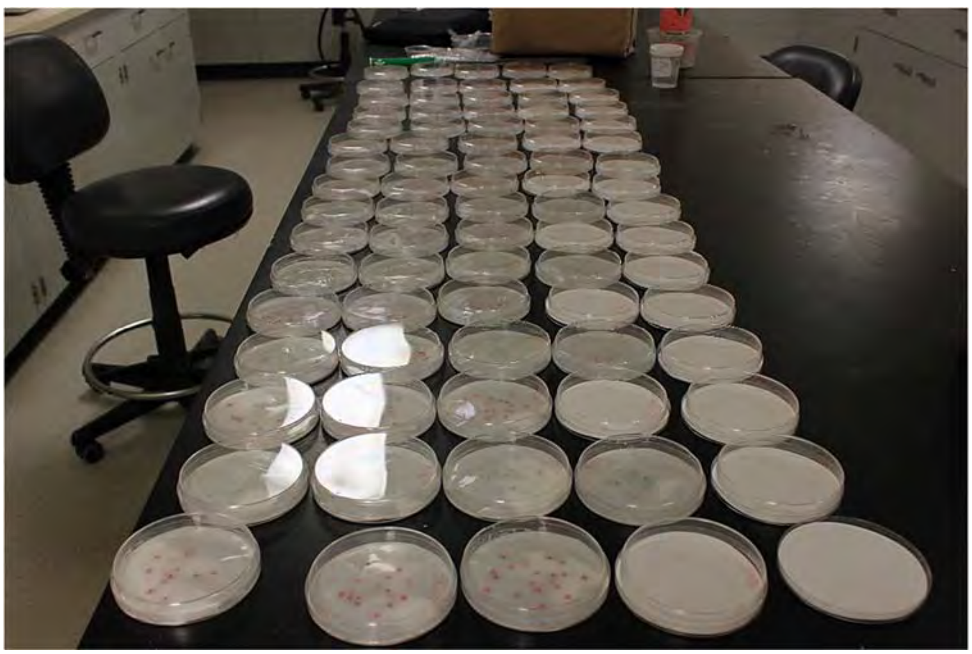


Figure 6.1. *Seeds of junglerice placed in petri dishes for germination study.*

Results: Germination of the GS and GR types was reduced by 50% at 1.45 and 2.4 MPa, respectively. Similarly, germination of the GS and GR types was reduced by 50% at 99 and 124 mM of NaCl, respectively (Figure 6.2).

Figure 6.2 suggests that the GR biotype of junglerice has the potential for greater germination than the GS biotype at various soil moisture levels. The GR seeds showed more than 10% germination even in the highest soil moisture stress level tested whereas, the GS seeds did not germinate at all at this stress level. However, the results also showed that both GR and GS types of junglerice has the potential to germinate even under considerable dry conditions.

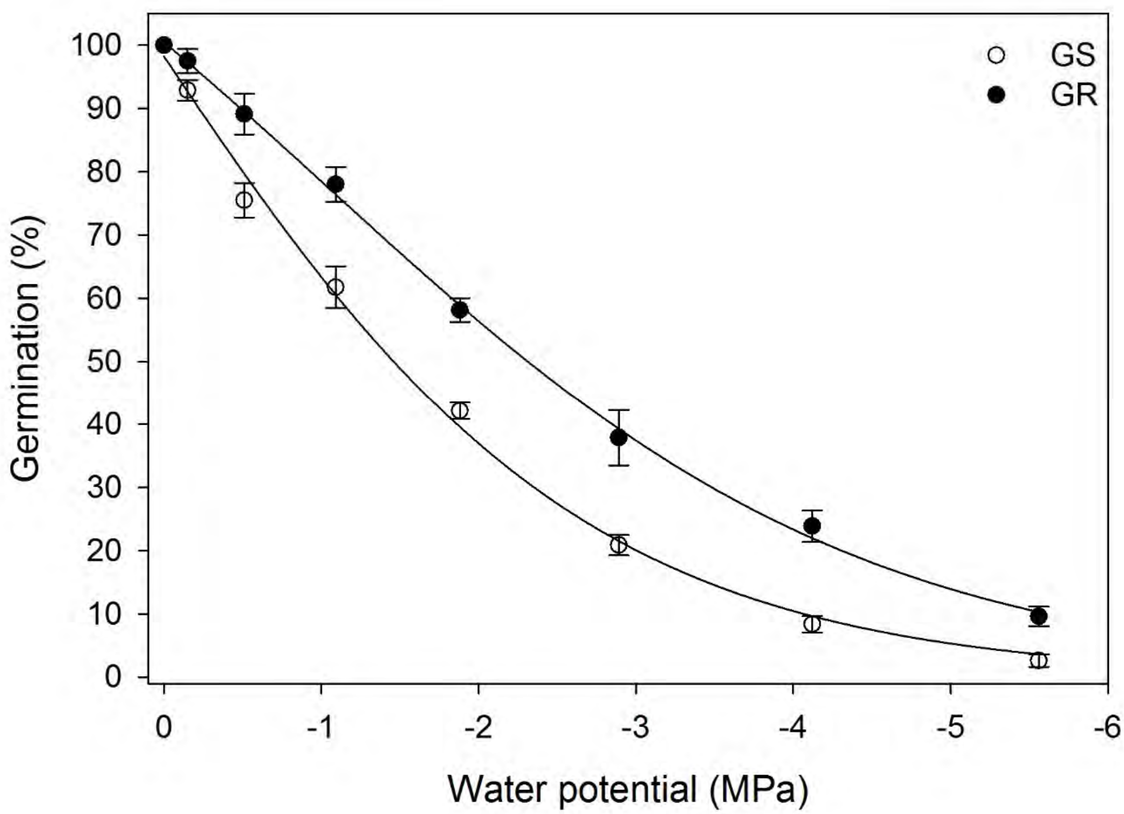


Figure 6.2. *Percent seed germination of a glyphosate-resistant (GR) and a glyphosate-susceptible (GS) biotype of junglerice from the Central Valley at various water potential levels.*

Similar to the water potential (moisture stress) study, germination of the GS and GR types was reduced by 50% at electrical conductivities of 8.5 and 12 dS m^{-1}, respectively. Therefore, the GR type was more tolerant than the GS type to salinity stress during germination (Figure 6.3).

These experiments showed that the GR junglerice was more tolerant to moisture and salt stress than the GS type. However, this cannot be generalized for all GR types of junglerice. Additional research is needed to ascertain if the stress tolerance characteristics of this GR junglerice types are linked to herbicide resistance. Nevertheless, the study showed that junglerice, specifically the GR type had the potential to invade and establish the dry and saline soils that exist in the western part of the San Joaquin Valley (SJV).

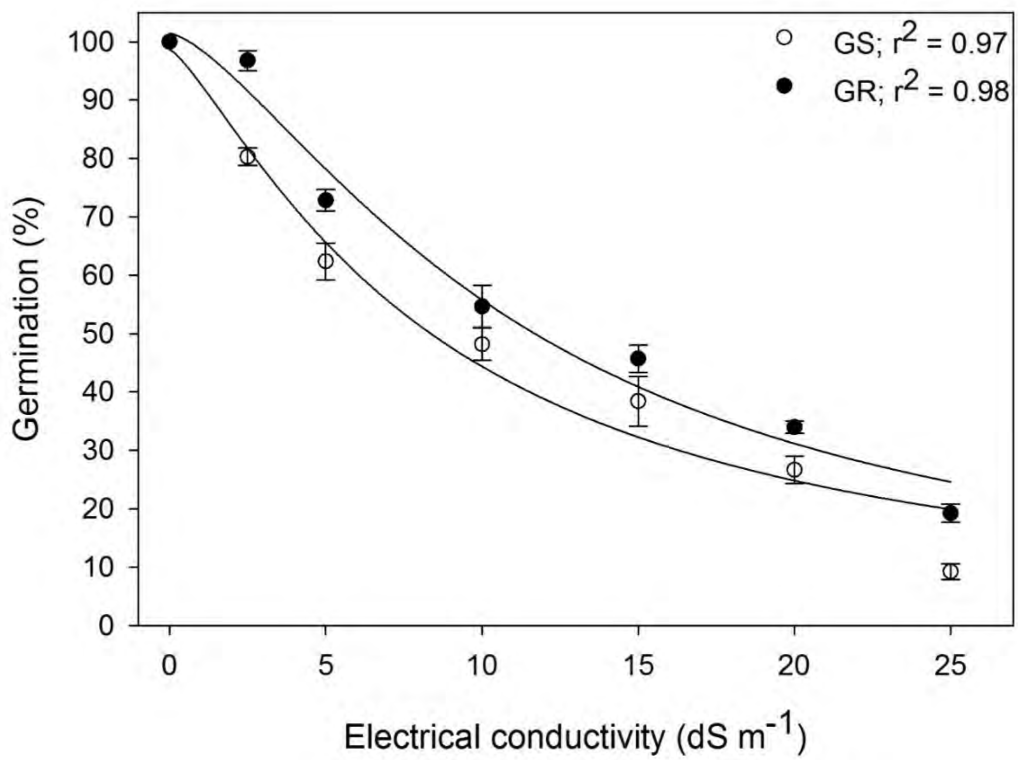


Figure 6.3. *Percent seed germination of a glyphosate-resistant (GR) and a glyphosate-susceptible (GS) biotype of junglerice from the Central Valley at various salinity (electrical conductivity) levels.*

<u>Objective 2</u>: To determine the effect of soil salinity on growth of a glyphosate-susceptible and a glyphosate-resistant biotype of junglerice.

A greenhouse study was conducted to assess the effect of soil salinity stress on the growth of a glyphosate-resistant (GR) and a glyphosate-susceptible (GS) biotype of junglerice. Sodium chloride solutions of difference concentrations was used to simulate soil salinity conditions in potted plants (Figure 6.4). These concentrations include 0, 5, 10, 15, and 20 dS m^{-1}. The plants were grown in these salinity conditions for 6 weeks and their growth was monitored. The plants were then harvested and their dry weights were recorded. The experiment was conducted twice.

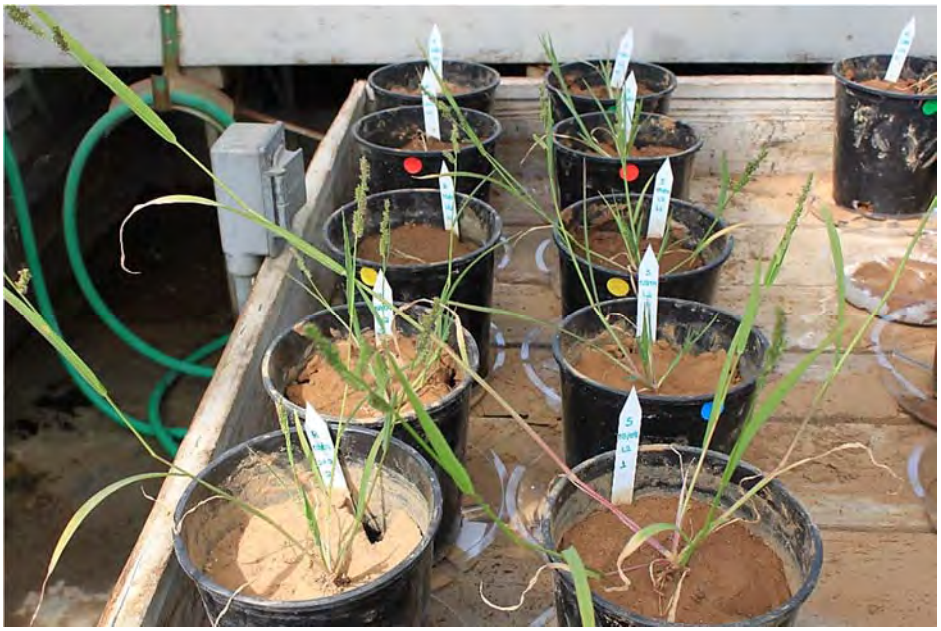


Figure 6.4. *Potted glyphosate-resistant and –susceptible plants growing under various soil salinity conditions.*

Results: The biotypes differed in their tolerance to soil salinity. Although the height and biomass of the plants were reduced as soil salinity levels increased, the GR biotype grew taller (Figure 6.5) and produced more biomass (Figure 6.4) than the GS biotype at all soil salinity conditions. The difference in plant height between the GR and GS junglerice type was more evident in the non-saline (0 dS m^{-1}) treatment than in the saline treatments. Under non-saline (0 dS m^{-1}) conditions the total aboveground biomass of the GR plants was approximately 1.5 times more than the GS plants. Although this difference in biomass grew smaller at higher soil salinity levels, the GR plants accumulated more biomass than the GS plants at all levels of salinity tested. Thus indicating that the GR plants may be more competitive than the GS plants.

Furthermore, both junglerice types were able to complete their life cycle and produce seeds even under the highest level of soil salinity tested (Figure 6.7). When the experiment was conducted in the earlier part of the summer, the plants in general produced more seeds than when they were grown in the later part of the summer. Again, it was observed that the GR plants produced more seeds than the GS plants at almost all of the salinity levels tested. It was interesting to note that both the GR and GS plants were able to produce 100 – 200 seeds even at the highest level of salinity tested.

Therefore, this part of the study showed that both junglerice types had the ability to survive, complete its life cycle, and produce seeds even under extreme salinity conditions. However, the viability of these seeds were not tested.

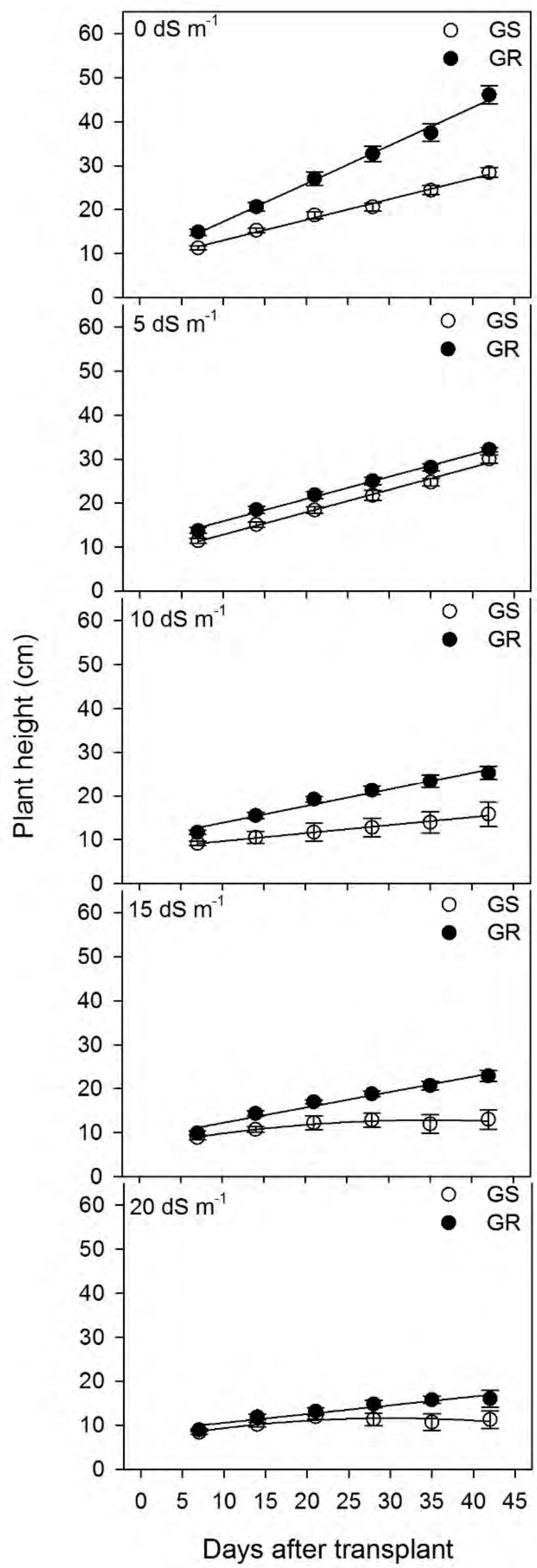


Figure 6.5. *Height of the glyphosate-resistant (GR) and a glyphosate-susceptible (GS) junglerice plants from the Central Valley at various salinity (electrical conductivity) levels.*

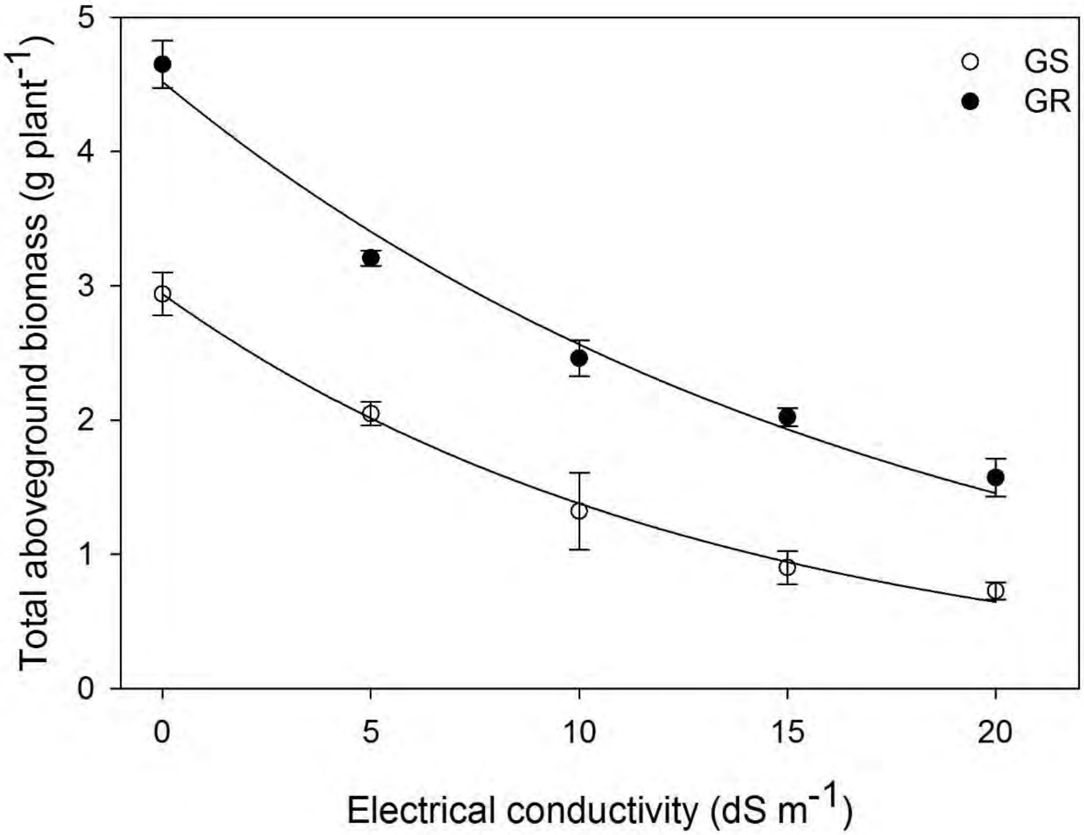


Figure 6.6. *Final aboveground biomass of the glyphosate-resistant (GR) and a glyphosate-susceptible (GS) junglerice plants from the Central Valley at various salinity (electrical conductivity) levels.*

Therefore, objectives 1 and 2 showed that the GR junglerice was more tolerant to moisture stress and soil salinity conditions than the GS type. However, this cannot be generalized for all GR types of junglerice. Additional research is needed to ascertain if the stress tolerance characteristics of this GR junglerice types are linked to herbicide resistance. Nevertheless, as discussed earlier, both junglerice types have the ability to invade and establish the dry and saline conditions that exist in the western SJV where many almond and pistachio orchards are situated.

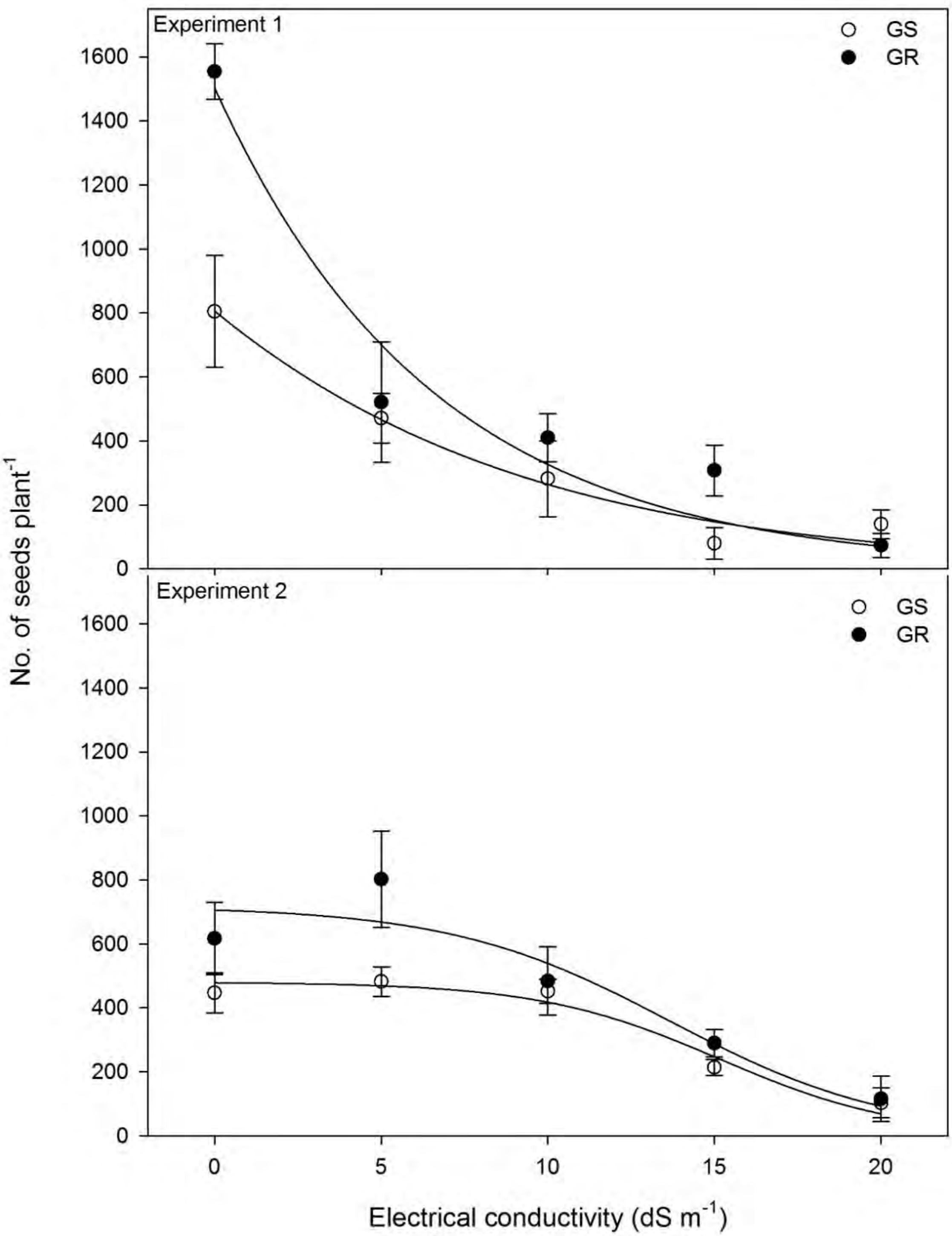


Figure 6.7. *Number of seeds produced per plant by the glyphosate-resistant (GR) and a glyphosate-susceptible (GS) junglerice plants from the Central Valley at various salinity (electrical conductivity) levels in experiment 1 (early summer) and experiment 2 (late summer).*

<u>Objective 3</u>: To determine intra-specific competitive ability between a glyphosate-resistant and a glyphosate–susceptible biotype of junglerice.

A pot-study was conducted in open-field conditions in summer 2015 to compare the competitive ability of a glyphosate-resistant (GR) and a glyphosate-susceptible (GS) biotype of junglerice. In each pot, the GR and GS plants were planted at different ratios (4:0, 3:1, 2:2, 1:3, and 0:4 of GR and GS plants) in a replacement series experiment style (Figure 6.8). The plants were grown for 6 weeks. At the early flowering stage, the plants were individually harvested and dry biomass was recorded. The study was conducted three times (twice in 2015 and once in 2016).

Figure 6.8. *Potted glyphosate-resistant and –susceptible plants growing under various density combinations.*

Results: The results for the first round of the 2015 study was different from the second round of 2015 and that of the 2016 study. However, results for the second round of 2015 and the 2016 study were very consistent. Therefore, results for the first round are presented separately and those for the second and third round were combined and analyzed.

Results from the first round showed that the total aboveground biomass was greater in the GS than in the GR type (Figure 6.9). However, the number of flower heads was greater in the GR than in the GS type. This indicated that the biomass allocation patterns to the reproductive structures and total seed production could be different in the GS and the GR junglerice. The GS junglerice was more competitive and produced more biomass than the GR plants at all densities indicating that this particular GS biotype was more competitive than the GR biotype. However, this finding, cannot be generalized as the results for the subsequent studied showed the opposite results.

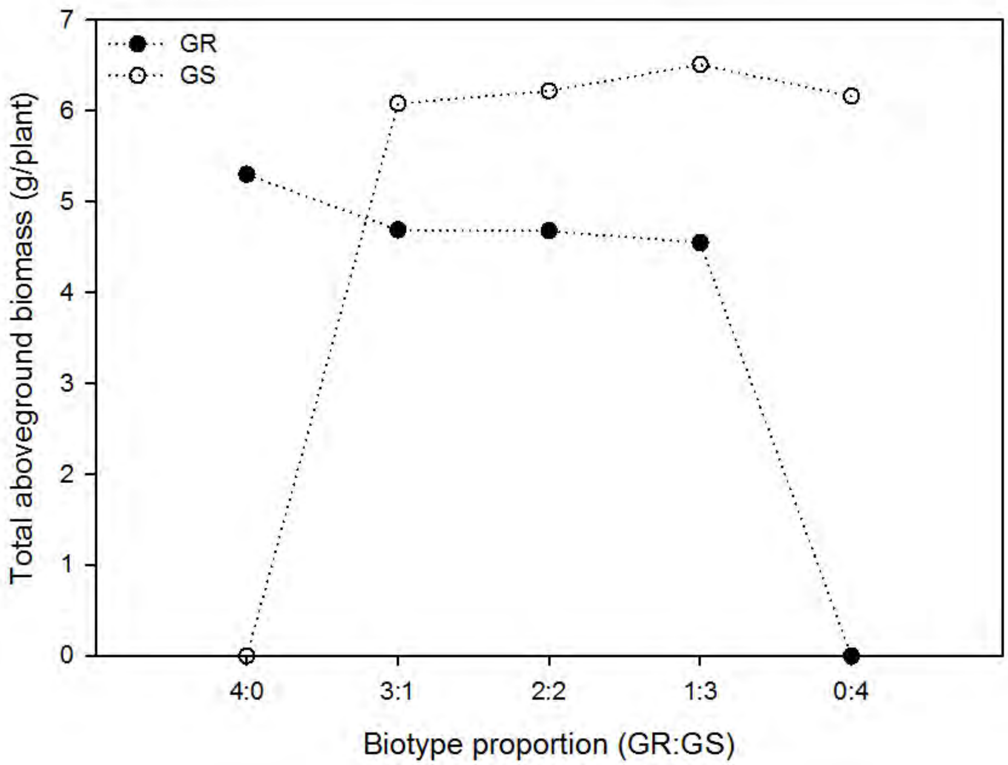


Figure 6.9. *Total aboveground biomass of glyphosate-resistant (GR) and glyphosate-susceptible (GS) biotypes of junglerice in the various competitive ratios in study conducted in early summer 2015.*

Contrary to the results from the first round, the second and third round showed that the total aboveground biomass was greater in the GR than in the GS type. Figure 6.11 shows that the GR plants were more competitive than the GS plants under all levels of competition. These results support the finding from the greenhouse salinity study in which the GR plants grew larger than the GS plants and produced more total aboveground biomass than the GS plants.

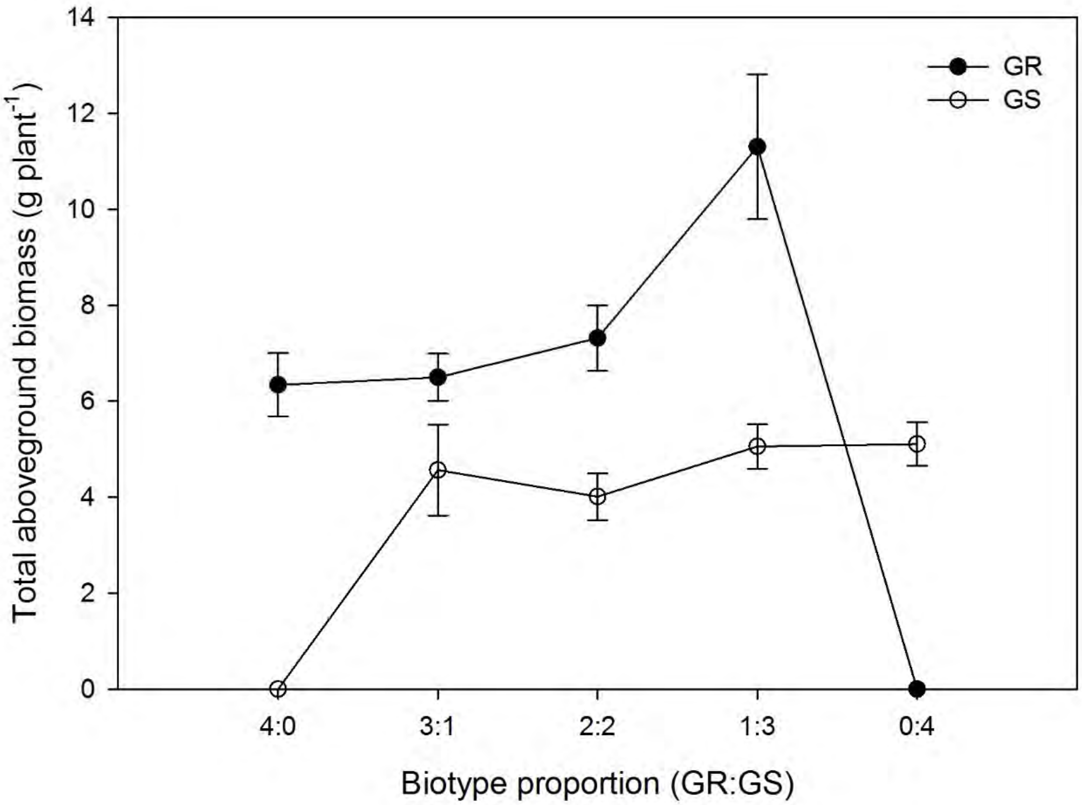


Figure 6.10. *Total aboveground biomass of glyphosate-resistant (GR) and glyphosate-susceptible (GS) biotypes of junglerice in the various competitive ratios in study conducted in late summer 2015 and late spring 2016.*

Attachment 1

Objective 4: To compare the nitrate (NO_3) uptake and accumulation pattern of a GR and GS biotype of junglerice.

Seeds of confirmed GR and GS biotypes of junglerice were used in the study. Before planting, the seeds were scarified by placing them in a small jar lined with sandpaper and shaking for 30 seconds. The seeds were then planted in separate 9-cell seedling packs containing a commercial potting media (Sunshine No. 1; Canadian sphagnum peat moss, coarse grade perlite, gypsum, dolomitic lime and Sun Gro's long-lasting wetting agent). The seeds were watered twice a week with enough water to saturate the potting media. The temperature in the greenhouse was set at 80º F and no supplemental lighting was provided. Six replicates of each biotype were used and the study was conducted twice. The plants were grown in the greenhouse for 30 days. The experiment was arranged as a completely randomized design.

Once the potted plants were 30 days old, each plant was removed from its respective pot carefully and rinsed with tap water to remove the soil from the pots without destroying the roots and root hairs. The soil-free plants were then transferred to 250mL beakers containing Hoagland solution (0.99mM CaSO4, 0.13mM Ca (H2PO4), 1.25mM K2SO4, 0.50mM MgSO4, 46µM H3BO3, 9µM MnCl2, 0.28µM ZnSO4, 0.32µM CuSO4, 0.10µM H2MoO4 AND 50µM Fe supplied as Sequestrene 138). The plants were arranged in a manner that only the roots were suspended in the Hoagland solution using organza linen cloth (Figure 6.11). The organza linen cloth was cut in the center allowing only the roots to pass through and be immersed in the Hoagland solution. Rubber bands were used to hold the cloth to the beaker. Every 24 hours, the Hoagland solution that each plant was suspended in was refreshed and a 50ml sample was taken. All samples were frozen for further analysis. The pH and temperature of each sample was also recorded using a Denver Instrument UB-5 pH meter. Samples were taken 5 times in 24 hour periods. The 50 ml samples that were taken were later thawed and analyzed using an Automated Discrete Analyzer (AQ2). The machine calibrates for low levels of NO3- in solution. Data were analyzed using repeated measures analysis in SAS at a significance level of 0.05. The means and standard errors of means were plotted.

Figure 6.11. *Immersion of the glyphosate-resistant and glyphosate-susceptible plant roots in Hoagland's solution*

Results: The pH readings revealed that there was a significant difference in pH between GR and GS biotypes on days 1 and 5, but not on days 2, 3, and 4 (Figure 6.12). On days 1 and 5, the solution in which the GS biotype was growing had a higher pH than that of the GR biotype. The general curve formed by the pH readings was a "U" shaped curve, with day 1 and 5 having the highest pH readings.

The results showed that there was a significant difference in NO_3 levels on days 2 and 5 (Figure 6.13). On day 2, the solution from the GR biotypes contained more NO_3, and the opposite was true for day 5. The general curve formed by the NO_3 data was an inverted "U" shape, with days 1 and 5 having the lowest NO_3 levels.

Overall, there was no significant difference in the total amount of NO_3 taken up by the different biotypes. However, there was a difference in the amount of NO_3 taken up on certain days. According to the NO_3 and pH results, there were two spikes in NO_3 uptake. These spikes occurred on days 1 and 5. On day 1, the GS biotype took up more NO_3 than the GR biotype. On day 5, the opposite happened and the GR biotype took up more NO_3. In conclusion, the total amount of NO_3 taken up was similar between the two biotypes, but there were significant differences between the biotypes in uptake based on timing.

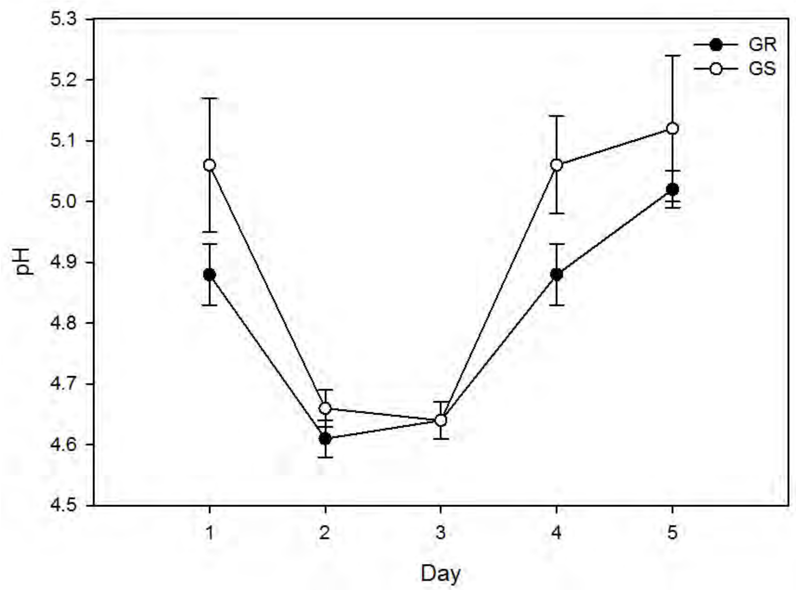


Figure 6.12. *The pH of the solution on various days in which the glyphosate-resistant (GR) and glyphosate-susceptible (GS) biotypes of junglerice were grown.*

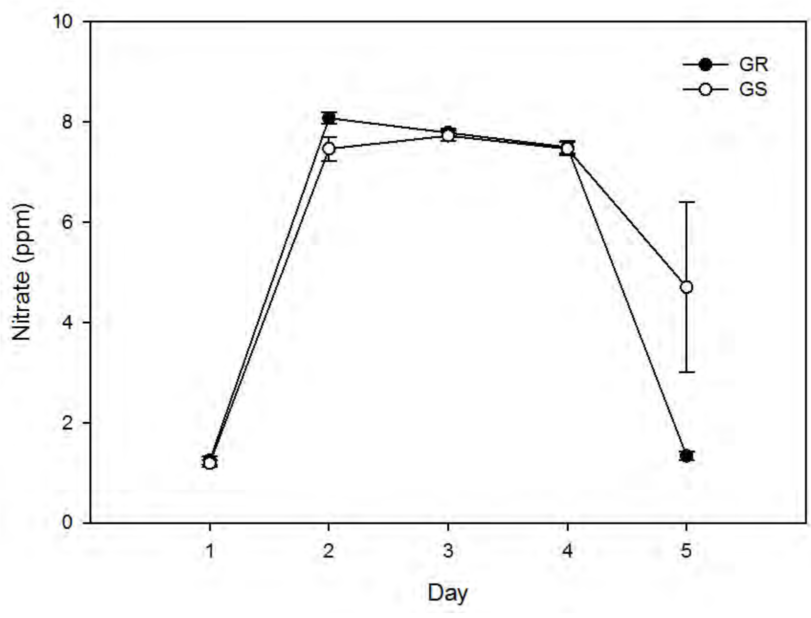


Figure 6.13. *The nitrate concentration of the solution on various days in which the glyphosate-resistant (GR) and glyphosate-susceptible (GS) biotypes of junglerice were grown.*

Section 7. Effects of shade or moisture conditions on herbicide on junglerice (CSU Fresno).

Objective: To determine the effect of shade and soil moisture on the efficacy of postemergence herbicides on junglerice.

A study was conducted in 2015 to evaluate the effect of light intensity and soil moisture levels on the efficacy of sethoxydim, glufosinate, and glyphosate on junglerice plants grown in pots containing field soil. Three levels of shade (70%, 50%, and 0%, i.e. no shade) and three soil moisture regimes (100%, 50%, and 25% of field capacity) were imposed (Figure 7.1). The plants were treated with label rates of the selected herbicides and an untreated control was also included. Mortality of these plants were evaluated every 7 days after treatment and aboveground biomass was recorded at 28 days after treatment.

Figure 7.1. Potted junglerice plants grown under various levels of shade and soil moisture.

Results: Results indicated that plant mortality was affected differentially by light intensity, moisture level, and herbicide type (Figure 7.2). There was a significant interaction between light intensity and soil moisture level. Interactions occurred between moisture level and herbicide type under shade but not under full sun. Among the herbicides compared, glufosinate was the best treatment under all levels of shade and moisture conditions. Control of junglerice with sethoxydim was lower under shaded and low moisture conditions, whereas control with glyphosate was better under shaded conditions at 100% and 75% FC moisture conditions. Therefore, both shade and soil moisture conditions should be taken into consideration when selecting postemergence herbicides for control of junglerice as these conditions can vary especially in orchards and vineyards. The study is being currently repeated in 2016.

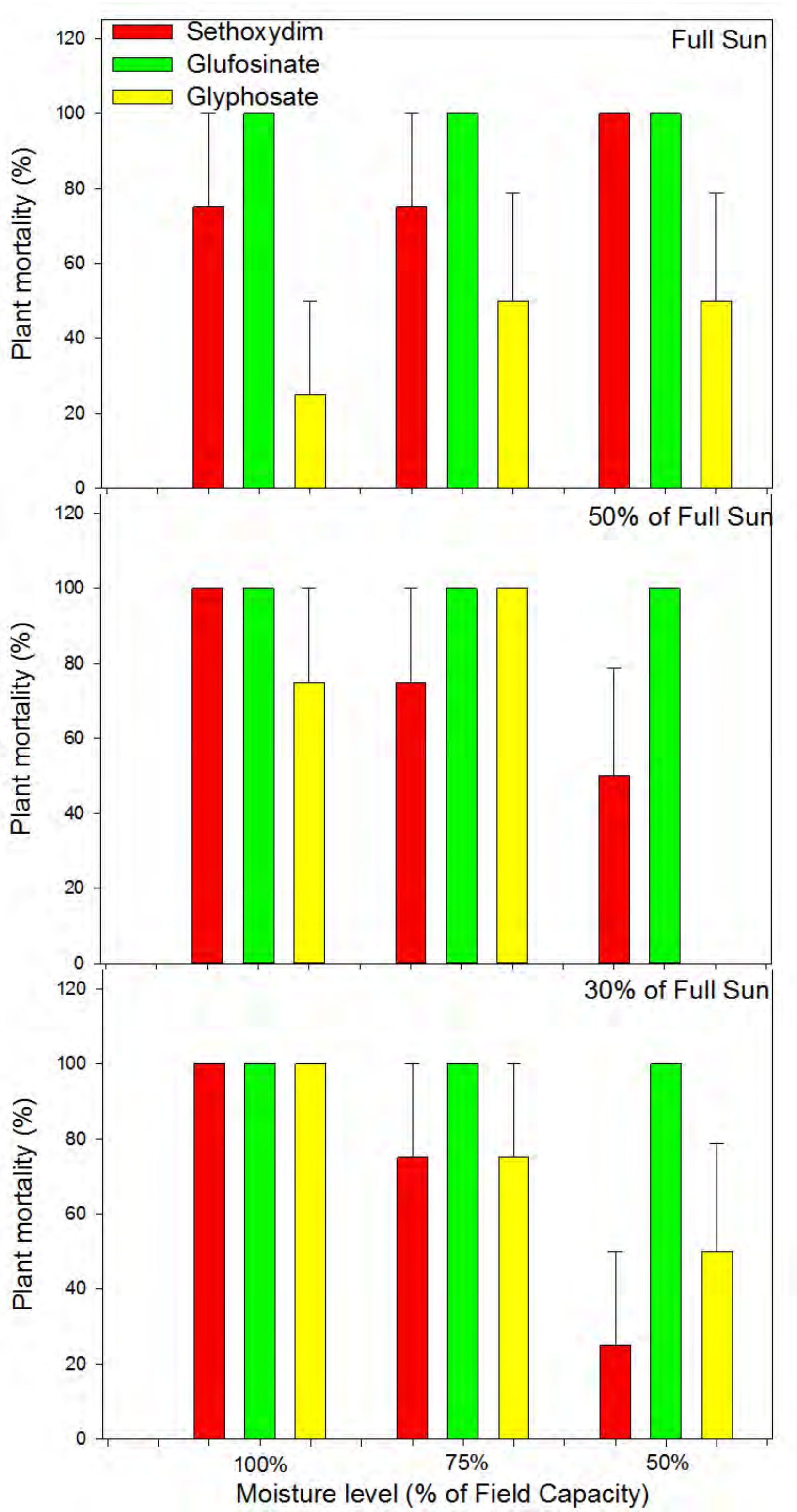


Figure 7.2. *Mortality of junglerice plants grown under various levels of shade and soil moisture to different herbicides.*

Attachment 1

Objective: To determine the phenological development of a glyphosate-susceptible and a glyphosate-resistant biotype of junglerice when planted two weeks apart in spring.

The study is ongoing and results have not been compiled yet.

***Figure** 7.3. Field layout of glyphosate-resistant and glyphosate-susceptible junglerice plants transplanted at 2 week intervals (3 transplanting dates) starting late March.*

Objective: To determine the effect of temperature on the growth and susceptibility of a glyphosate-susceptible and a glyphosate-resistant biotype of junglerice to label rate of glyphosate.

Seedlings of GR and GS biotype of junglerice were grown in a greenhouse set at 25°C. Once the plants reached the 3-4 leaf stage, they were placed in either of three temperature regimes (15/10° C, 25/20° C, 35/30° C) in growth chambers for three days. In each chamber, there were 6 plants of GR type and 6 plants of GS type. On the fourth day, 3 GR and GS plants were treated with 22 fl oz/ac of glyphosate and the other 3 were left untreated. The plants were put back into their respective chambers for another 7 days. On the eighth day, the plants were removed from the chambers and brought back to the greenhouse set at 25°C and grown for three weeks. They were then evaluated for mortality, harvested, and the dry weights of the aboveground biomass were recorded after drying them in a forced-air oven set at 60°C for 72 hours. The study was conducted four times and each run of the experiment was considered as a replication.

Results: Results showed that the GS plants were susceptible to glyphosate under all the temperature treatments. However, it was very interesting to note that the GR plants did not survive glyphosate applications when they were grown under a temperature regime of 15/10° C but they were resistant when grown under the higher temperatures (Figure 7.4). The results were consistent in all four runs of the experiment. The data compilation and analysis has not been completed yet but will be done soon. This finding warrants further investigation to determine the physiological and/or genetic reason for the susceptibility of the GR plants at lower temperatures.

Figure 7.4. *Mortality of the GR (back row) and GS (front row) junglerice plants grown under various temperature regimes and treated with glyphosate.*

<u>Section 8. Herbicide performance evaluations and demonstration in commercial orchards and vineyards (UC Davis and UCCE).</u>

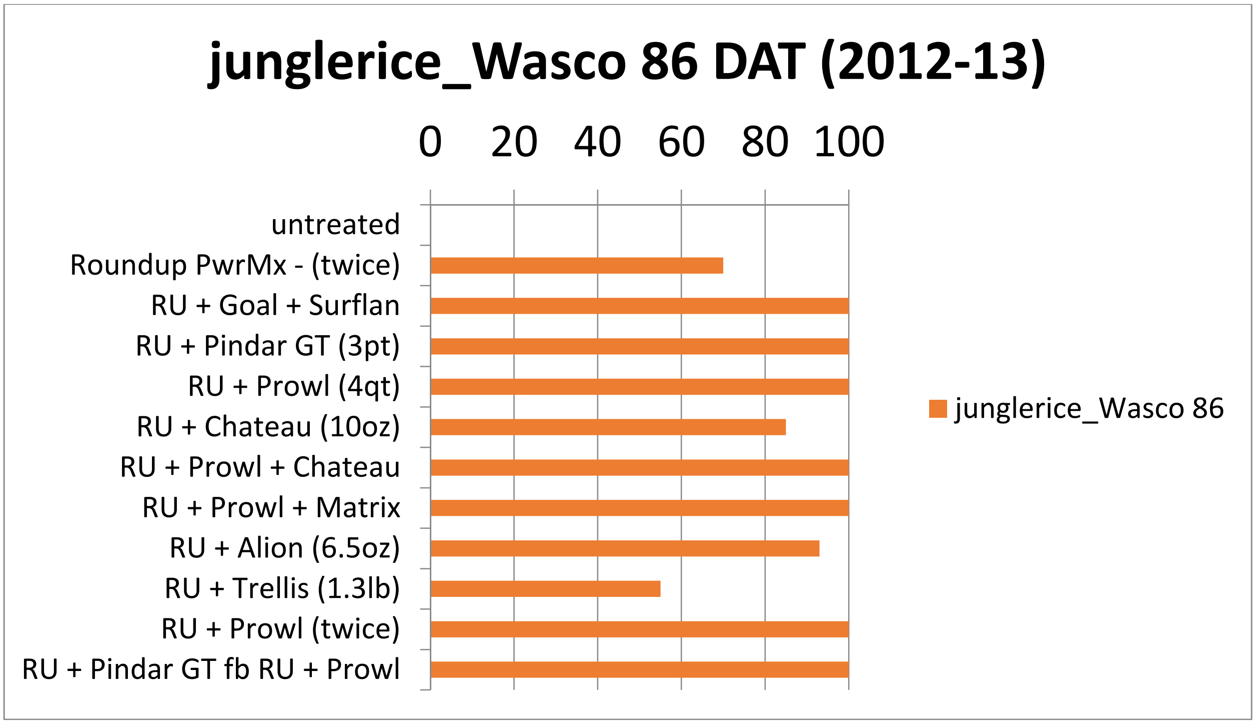


Figure 8.1. *Control of glyphosate resistant junglerice 86 days after treatment with various preemergence herbicide programs in an almond orchard near Wasco, CA in a 2013 field trial (Moretti and Hanson)*

Table 8.1. *Effects of Alion and Matrix tank mix and sequential combinations on broadleaf weed control in an almond orchard trial near Wasco, CA in a 2012-13. (Watkins and Hanson)*

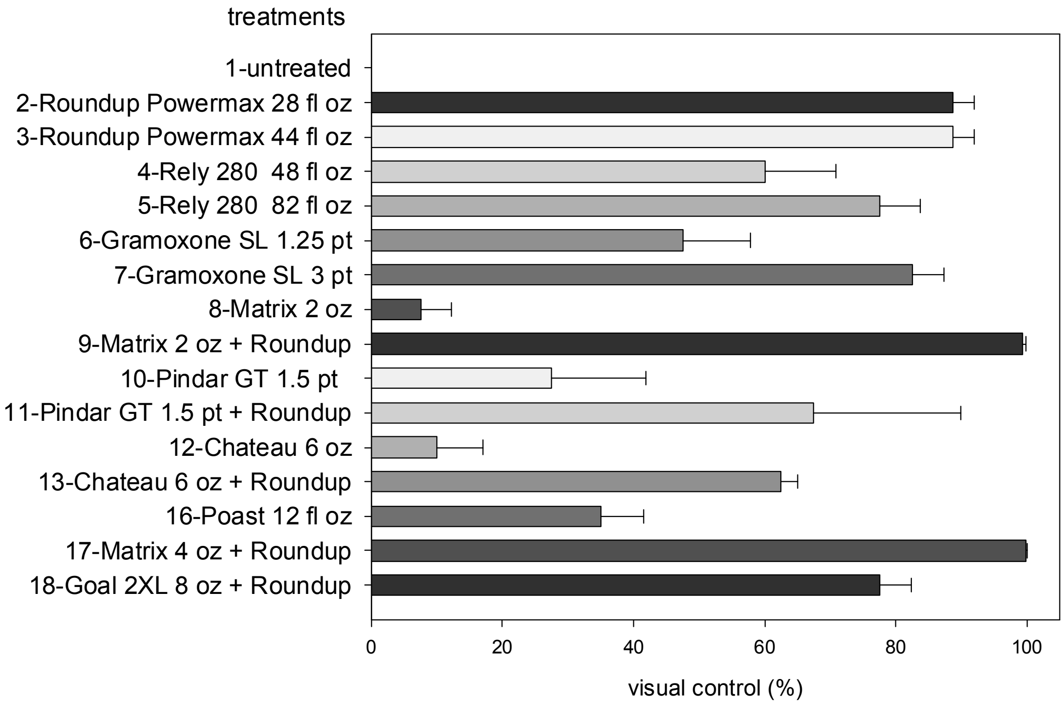
Trt	Treatment	Rate		Appl	Annual bluegrass 86 DAT	Common chickweed 86 DAT	Hairy fleabane 86 DAT	Junglerice 86 DAT	Prostrate knotweed 114 DAT	Junglerice 114 DAT
					% control					
1	untreated control				0	0	0	0	0	0
2	rimsulfuron (Matrix)	4	oz wt/a	A	100	100	100	57.5	100	47.5
3	indaziflam (Alion)	5	fl oz/a	A	100	100	100	85	100	77.5
4	rimsulfuron (Matrix)	4	oz wt/a	A	100	100	100	92.5	100	84.3
	indaziflam (Alion)	5	fl oz/a	A						
5	rimsulfuron (Matrix)	4	oz wt/a	A	100	100	99.7	87.5	100	67.5
	indaziflam (Alion)	2.5	fl oz/a	A						
6	rimsulfuron (Matrix)	2	oz wt/a	A	93.8	100	99.7	92.5	100	81.3
	indaziflam (Alion)	5	fl oz/a	A						
7	rimsulfuron (Matrix)	4	oz wt/a	A	100	100	99.7	100	100	93.8
	indaziflam (Alion)	5	fl oz/a	B						
8	indaziflam (Alion)	5	fl oz/a	A	100	100	100	92.5	100	72
	rimsulfuron (Matrix)	4	oz wt/a	B						
9	penox/oxyfluor (PindarGT)	2.5	pt/a	A	85	100	100	85	100	63.8
10	penox/oxyfluor (PindarGT)	3	pt/a	A	77.5	98.8	100	100	100	100
	Fishers LSD (0.05)				4.2	1.2	0.1	2.5	0	30.4

The A timing was applied on February 1, 2013 and B timing on March 25, 2013. All treatments included 1.0 lb ae/A glyphosate in the tank mix. Site was dominated by glyphosate-resistant junglerice.

Table 8.2. *Selected weed control evaluations from 2012-13 statewide large plot demonstrations of orchard residual herbicides. This protocol was conducted as large plot experiments at 5 tree nut sites (Arbuckle, Wheatland, Davis, Delhi, Lost Hills) and small plot experiments at 3 sites (Davis, Sanger, Wasco). (Watkins and Hanson)*

					UC Davis almond	**Davis ------------- walnut------------ -**			**Wasco almond**	**Delhi ------------ almond ------------**		
					Overall control	Rye grass	Common lambs quarters	Hairy fleabane	Jungle rice	Hairy fleabane	Cutleaf evening primrose	Overall control
	Treatment	Rate			120 DAT	122 DAT	122 DAT	122 DAT	86 DAT	95 DAT	95 DAT	95 DAT
					%	%	%	%	%	%	%	%
1	Untreated check				0 c	0 d	--	--	0 d	0 b	--	--
2	Roundup PowerMax	1	lb ae/a	A	91 a	100 a	13 b	67 ab	70 bc	99 ab	100 a	89 a
	AMS	2	qt/100 gal	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	10	lb/100 gal	B								
3	Roundup PowerMax	1	lb ae/a	A	98 a	70 a	58 ab	50 ab	100 a	67 bcde	50 bc	60 ab
	AMS	2	qt/100 gal	A								
	Goal 2XL	5	pt/a	A								
	Surflan	4	qt/a	A								
4	Roundup PowerMax	1	lb ae/a	A	99 a	60 a	100 a	67 ab	100 a	65 bcde	47 bc	60 ab
	AMS	2	qt/100 gal	A								
	Pindar GT	3	pt/a	A								
5	Roundup PowerMax	1	lb ae/a	A	77 b	90 a	80 ab	53 ab	100 a	62 cde	40 bc	40 b
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
6	Roundup PowerMax	1	lb ae/a	A	99 a	77 a	13 b	53 ab	85 ab	53 de	64 bc	67 ab
	AMS	2	qt/100 gal	A								
	Chateau	10	oz/a	A								
7	Roundup PowerMax	1	lb ae/a	A	99 a	87 a	40 ab	40 b	100 a	41 e	50 bc	57 ab
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
	Chateau	10	oz/a	A								
8	Roundup PowerMax	1	lb ae/a	A	98 a	83 a	100 a	80 ab	100 a	94 a-d	86 ab	73 ab
	AMS	2	qt/100 gal	A								
	Prowl H20	4	qt/a	A								
	Matrix SG	4	oz/a	A								
9	Roundup PowerMax	1	lb ae/a	A	96 a	97 a	40 ab	70 ab	93 a	46 de	25 c	50 ab
	AMS	2	qt/100 gal	A								
	Alion	6.5	oz/a	A								
10	Roundup PowerMax	1	lb ae/a	A	96 a	87 a	60 ab	50 ab	55 c	47 de	13 c	37 b
	AMS	2	qt/100 gal	A								
	Trellis	1.3	lb/a	A								
11	Roundup PowerMax	1	lb ae/a	A	100 a	73 a	90 a	60 ab	100 a	96 abc	98 a	77 ab
	AMS	2	qt/100 gal	A								
	Prowl H20	3	qt/a	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	2	qt/100 gal	B								
	Prowl H20	2	qt/a	B								
12	Roundup PowerMax	1	lb ae/a	A	100 a	83 a	100 a	90 a	100 a	100 a	100 a	92 a
	AMS	2	qt/100 gal	A								
	Pindar GT	3	pt/a	A								
	Roundup PowerMax	1	lb ae/a	B								
	AMS	2	qt/100 gal	B								
	Prowl H20	2	qt/a	B								

“A” timings were applied on December 13, 2012 at UC Davis, December 28, 2013 at Davis, January 14, 2013 at Delhi, February 6, 2013 at Wasco. “B” timings were made in mid-March 2013. Note: the large-plot trials did not include an untreated control and, thus, had only 11 treatments.



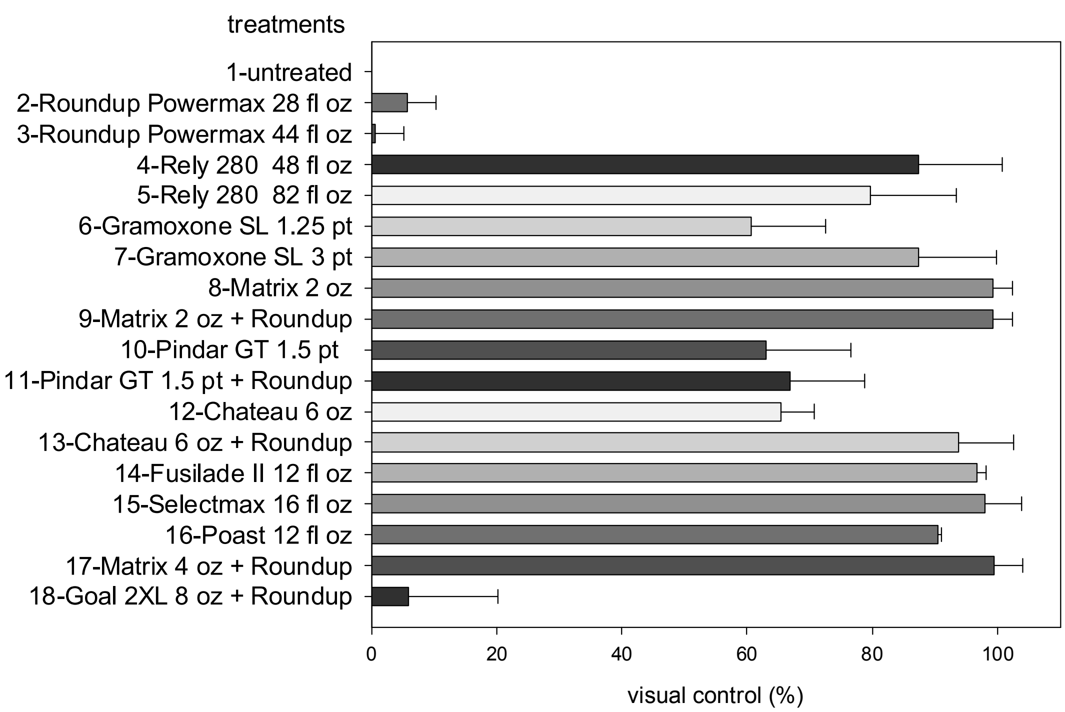


Figure 8.2. *Visual control of suspected glyphosate-resistant junglerice in two almond orchard trials conducted in 2013. The top figure is from an orchard near Discovery Bay, CA with glyphosate-suscepible junglerice and the lower figure is from an orchard near Bakersfield, CA with glyphosate-resistant population. In both orchards, treatmetns were applied durign May 2013 and visual evlauations made 28 days later. (Moretti and Hanson)*

Table 8.3. *Selected weed control evaluations from 2013-14 large plot demonstration conducted in an almond orchard near Wasco, CA. (Watkins, Moretti, and Hanson)*

					---------- 61 DAT-A ----------			------------ 125 DAT-A -----------			
					Annual bluegrass	Chick-weed	Hairy fleabane	Annual bluegrass	Jungle-rice	Hairy fleabane	Overal l
	Treatment	Rate			------------------------------------ % control ------------------------------------						
1	Untreated check				-	-	-	-	-	-	-
2	Roundup PowerMax	1	lb ae/a	A	49	80	55	97	72	99	72
	AMS	2	qt/100 gal	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	10	lb/100 gal	B							
3	Roundup PowerMax	1	lb ae/a	A	100	100	83	100	95	79	91
	AMS	2	qt/100 gal	A							
	Goal 2XL	5	pt/a	A							
	Surflan	4	qt/a	A							
4	Roundup PowerMax	1	lb ae/a	A	98	96	90	92	71	80	80
	AMS	2	qt/100 gal	A							
	Pindar GT	3	pt/a	A							
5	Roundup PowerMax	1	lb ae/a	A	90	100	60	100	98	53	80
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
6	Roundup PowerMax	1	lb ae/a	A	100	100	70	97	89	65	78
	AMS	2	qt/100 gal	A							
	Chateau	10	oz/a	A							
7	Roundup PowerMax	1	lb ae/a	A	100	100	80	100	99	86	92
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
	Chateau	10	oz/a	A							
8	Roundup PowerMax	1	lb ae/a	A	95	100	98	99	95	90	93
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
	Matrix SG	4	oz/a	A							
9	Roundup PowerMax	1	lb ae/a	A	100	100	72	100	99	86	96
	AMS	2	qt/100 gal	A							
	Alion	6.5	oz/a	A							
10	Roundup PowerMax	1	lb ae/a	A	53	100	85	60	60	63	66
	AMS	2	qt/100 gal	A							
	Trellis	1.3	lb/a	A							
11	Roundup PowerMax	1	lb ae/a	A	96	100	38	100	100	100	98
	AMS	2	qt/100 gal	A							
	Prowl H20	3	qt/a	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	2	qt/100 gal	B							
	Prowl H20	2	qt/a	B							
12	Roundup PowerMax	1	lb ae/a	A	68	95	75	100	100	100	99
	AMS	2	qt/100 gal	A							
	Pindar GT	3	pt/a	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	2	qt/100 gal	B							
	Prowl H20	2	qt/a	B							
	LSD (0.05)				***20***	***15***	***40***	***16***	***25***	***27***	***21***

*“A” timing was applied on January 16, 2014 and the “B” timing on March 18, 2014.
Note: the large-plot trials did not include an untreated control and, thus, had only 11 treatments.

Table 8.4. *Selected weed control evaluations from 2013-14 comparison of Alion and other preemergence tankmix partners in an almond orchard near Wasco, CA. All treatments included a high rate of Rely 280 and Roundup Powermax to ensure good control of existing weeds. (Watkins, Moretti, and Hanson)*

				---------------- 61 DAT-A ------------------				-------------- 125 DAT-A -------------		
				Annual bluegrass	Shepherds-purse	Hairy fleabane	Overall	Junglerice	Hairy flea bane	Overall
	Treatment	Rate		------------------------------------- % control ------------------------------------						
1	Untreated Check			0	0	0	0	0	0	0
2	Alion	2.5	oz/a	100	100	88	97	97	97	97
3	Alion	3.5	oz/a	100	100	88	97	98	92	92
4	Alion	5	oz/a	100	100	40	85	99	69	76
5	Chateau	10	oz wt/a	100	100	70	94	75	57	77
6	Matrix	4	oz wt/a	100	85	83	95	58	40	40
7	Pindar GT	2.5	pt/a	92	100	93	97	87	96	92
8	Goaltender	4	pt/a	99	100	100	100	98	98	97
9	Alion Chateau	5 6	oz/a oz wt/a	100	100	90	97	100	97	97
10	Alion Matrix	5 2	oz/a oz wt/a	100	100	93	98	100	100	100
11	Alion Pindar GT	5 1.5	oz/a pt/a	100	100	65	95	99	86	96
12	Alion Goaltender	5 2	oz/a pt/a	100	100	88	97	100	98	97
LSD (P=.05)				***6***	***7***	***31***	***9***	***24***	***34***	***25***

Treatments applied on January 16, 2014. All treatments included Roundup Powermax at 2 qt/A, Rely 280 at 2 qt/A, and AMS at 2 qt/100 gal spray solution.

***Table 8.5**. Selected weed control evaluations from 2013-14 comparison of Alion and other preemergence tankmix and sequential partners in a walnut orchard near Chico, CA. All treatments included a high rate of Rely 280 and Roundup Powermax to ensure good control of existing weeds. (Watkins, and Hanson)*

					Overall	Overall	Field bindweed	Junglerice	Hairy fleabane	Overall
					64 DAT-A	124 DAT-A	------------------	164 DAT-A	------------------	
	Treatment	Rate			-------------	-------------	-------------	% control	-------------	-------------
1	Untreated Check				0	0	0	0	0	0
2	Alion	2.5	oz/a	A	83	100	13	100	98	33
3	Alion	3.5	oz/a	A	88	100	5	100	100	30
4	Alion	5	oz/a	A	89	100	8	100	100	25
5	Chateau	10	oz wt/a	A	99	100	3	100	100	20
6	Matrix	4	oz wt/a	A	81	100	13	75	100	33
7	Pindar GT	2.5	pt/a	A	100	100	0	100	100	18
8	Goaltender	4	pt/a	A	100	100	10	100	98	25
9	Alion Chateau	5 6	oz/a oz wt/a	A	97	100	3	100	95	25
10	Alion Matrix	5 2	oz/a oz wt/a	A	88	98	0	100	98	28
11	Alion Pindar GT	5 1.5	oz/a pt/a	A	98	100	5	100	100	30
12	Alion Goaltender	5 2	oz/a pt/a	A	99	100	0	100	100	23
13	Chateau Alion	10 3.5	oz wt/a oz/a	A B	99	100	13	100	100	38
14	Chateau Alion	12 5	oz wt/a oz/a	A B	100	100	15	75	100	43
15	Matrix Alion	4 5	oz wt/a oz/a	A B	76	100	28	100	100	44
16	Alion Alion	5 5	oz/a oz/a	A B	89	100	25	100	100	45
17	Alion	3.5	oz/a	B	68	100	0	100	100	18
18	Alion	5	oz/a	B	74	100	13	100	95	30
LSD (P=.05)					***9***	***2***	***23***	***24***	***5***	***20***

The 'A' timing was applied December 18, 2013 and the 'B' timing on March 20, 2014. All treatments at both timings included Roundup Powermax plus Rely 280 and AMS for control of emerged weeds.

Table 8.6. *Preemergence weed control with Matrix and Alion combinations and sequential treatments in a walnut orchard trial conducted near Chico, CA in 2014. (Watkins and Hanson)*

				timing	Overall 64 DAT-A	Overall 124 DAT-A	Junglerice 160 DAT-A	Hairy fleabane 160 DAT-A	Overall 160 DAT-A
					%	%	%	%	%
1	Untreated Check				0	0	0	0	0
2	Matrix	4	oz wt/a	A	92	63	100	100	60
	Alion	5	fl oz/a	A					
3	Matrix	4	oz wt/a	AB	96	100	100	100	98
	Alion	2.5	fl oz/a	AB					
4	Matrix	4	oz wt/a	A	99	100	100	100	92
	Alion	2.5	fl oz/a	A					
	Matrix	2	oz wt/a	B					
	Treevix	1	oz wt/a	B					
5	Matrix	4	oz wt/a	A	96	97	95	100	76
	Alion	2.5	fl oz/a	A					
	Matrix	4	oz wt/a	B					
	Treevix	1	oz wt/a	B					
6	Matrix	4	oz wt/a	A	96	98	100	100	91
	Alion	2.5	fl oz/a	A					
	Matrix	2	oz wt/a	B					
	Prowl H2O	2	qt/a	B					
7	Matrix	4	oz wt/a	A	99	100	100	100	94
	Alion	2.5	fl oz/a	A					
	Matrix	4	oz wt/a	B					
	Prowl H2O	2	qt/a	B					
8	Matrix	4	oz wt/a	A	96	99	95	100	86
	Alion	2.5	fl oz/a	A					
	Matrix	2	oz wt/a	B					
	Alion	2.5	fl oz/a	B					
9	Matrix	4	oz wt/a	A	91	98	100	100	92
	Alion	2.5	fl oz/a	A					
	Matrix	4	oz wt/a	B					
	Alion	2.5	fl oz/a	B					
LSD (P=.05)					***8***	***19***	***6***	***0***	***18***

The ‘A’ timing was applied December 18, 2013 and the ‘B’ timing on March 20, 2014. The entire trial area was oversprayed with Roundup Powermax plus Rely 280 at the same time as the ‘A’ timing for control of emerged weeds.

Table 8.7. *Postemergence weed control in an almond orchard trial conducted near Wasco, CA in spring 2014. (Moretti, Watkins, and Hanson)*

				----- 15 DAT -----		---------- 28 DAT ----------			
				Annual bluegrass	*Hairy fleabane*	*Jungle-rice*	*Annual bluegrass*	*Hairy fleabane*	*Total biomass*
				------------	------------	%	------------	------------	*g/m sq*
1	untreated control			0	0	0	0	0	137.1
2	Roundup Powermax AMS NIS	1 2 0.25	lb ae/a pt/a % v/v	100	30	65	100	67	23.8
3	Roundup Powermax AMS NIS	44 2 0.25	fl oz/a pt/a % v/v	98	73	90	100	93	4.3
4	Rely 280 AMS	48 2	fl oz/a pt/a	100	100	87	98	100	1.4
5	Rely 280 AMS	82 2	fl oz/a pt/a	100	100	91	98	87	0.7
6	Gramoxone SL NIS	1.25 0.25	pt/a % v/v	100	0	92	100	50	52.5
7	Gramoxone SL NIS	4 0.25	pt/a % v/v	100	0	92	100	78	7.9
8	Matrix AMS NIS	2 2 0.25	oz/a pt/a % v/v	60	50	86	98	72	42.0
9	Roundup Powermax Matrix AMS NIS	1 2 2 0.25	lb ae/a oz/a pt/a % v/v	100	88	98	67	93	0.1
10	Roundup Powermax Pindar GT AMS NIS	1 1.5 2 0.25	lb ae/a pt/a pt/a % v/v	100	53	100	100	86	64.9
11	Chateau NIS Roundup Powermax AMS	6 0.25 1 2	oz/a % v/v lb ae/a pt/a	100	75	100	100	66	0.1
12	Poast COC	1.5 1	pt/a % v/v	0	0	0	33	27	217.8
13	Poast COC Roundup Powermax AMS	1.5 1 1 2	pt/a % v/v lb ae/a pt/a	100	40	98	67	95	74.7
14	Roundup Powermax Matrix Ammonium Sulfate NIS	1 4 2 0.25	lb ae/a oz/a pt/a % v/v	100	75	100	100	92	0.1
15	Roundup Powermax AMS NIS Goal 2XL	1 2 0.25 0.125	lb ae/a pt/a % v/v lb ai/a	100	34	97	100	98	12.6
LSD (P=.05)				***1***	***44***	***26***	***41***	***50***	***115.3***

** All treatments applied POST on April 23, 2014.*

Table 8.8. *Selected weed control evaluations from 2014-15 large plot demonstration conducted in an orchard near Escalon, CA; second year treatments. (Watkins and Hanson)*

					------------- 28 DAT-A --------------				------------------ 59 DAT-A ------------------		
					Annual bluegrass	Hairy fleabane	3 spike goose grass	Malva	Hairy fleabane	Filaree	Shep-herds purse
	Treatment	Rate									
					------------------------------------ % control				------------------------------------		
1	Untreated check				-	-	-		-	-	-
2	Roundup PowerMax	1	lb ae/a	A	100	95	90	93	100	100	100
	AMS	2	qt/100 gal	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	10	lb/100 gal	B							
3	Roundup PowerMax	1	lb ae/a	A	100	100	90	100	73	100	100
	AMS	2	qt/100 gal	A							
	Goal 2XL	5	pt/a	A							
	Surflan	4	qt/a	A							
4	Roundup PowerMax	1	lb ae/a	A	100	100	90	98	93	100	98
	AMS	2	qt/100 gal	A							
	Pindar GT	3	pt/a	A							
5	Roundup PowerMax	1	lb ae/a	A	100	87	90	93	63	100	73
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
6	Roundup PowerMax	1	lb ae/a	A	99	95	90	97	77	100	100
	AMS	2	qt/100 gal	A							
	Chateau	10	oz/a	A							
7	Roundup PowerMax	1	lb ae/a	A	98	98	90	97	77	100	100
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
	Chateau	10	oz/a	A							
8	Roundup PowerMax	1	lb ae/a	A	100	93	90	96	83	100	100
	AMS	2	qt/100 gal	A							
	Prowl H20	4	qt/a	A							
	Matrix SG	4	oz/a	A							
9	Roundup PowerMax	1	lb ae/a	A	100	93	90	77	73	100	100
	AMS	2	qt/100 gal	A							
	Alion	6.5	oz/a	A							
10	Roundup PowerMax	1	lb ae/a	A	98.3	93	87	50	67	100	98
	AMS	2	qt/100 gal	A							
	Trellis	1.3	lb/a	A							
11	Roundup PowerMax	1	lb ae/a	A	100	87	83	83	100	100	100
	AMS	2	qt/100 gal	A							
	Prowl H20	3	qt/a	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	2	qt/100 gal	B							
	Prowl H20	2	qt/a	B							
12	Roundup PowerMax	1	lb ae/a	A	99	90	87	100	100	100	100
	AMS	2	qt/100 gal	A							
	Pindar GT	3	pt/a	A							
	Roundup PowerMax	1	lb ae/a	B							
	AMS	2	qt/100 gal	B							
	Prowl H20	2	qt/a	B							
	LSD (0.05)				***6***	***13***	***7***	***18***	***14***	***0***	***8***

"A" timing was applied on January 21, 2015 and the "B" timing on March 5, 2015. The same treatments were applied to these plots in 2014/15.
Note: the large-plot trials did not include an untreated control and, thus, had only 11 treatments.

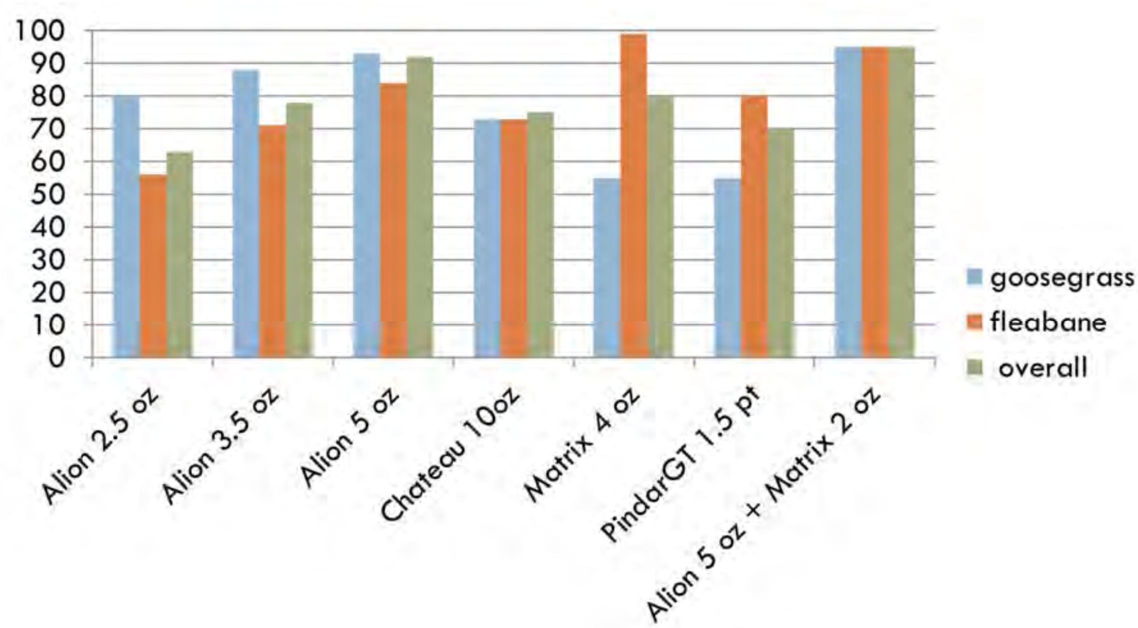


Figure 8.3 *Weed control evaluations in an almond orchard trial near Escalon, CA. Treatments were applied to the same plots in December 2013 and January 2015; data are from May 2015 (Watkins and Hanson).*

Figure 8.9. *Weed control evaluation in a vineyard trial near Esparto CA in 2015. Primary grass species was barnyardgrass at this site with some junglerice present.*

						overall	overall	grasses	horseweed	willowherb	Misc broad.
						4/25/2015	Rating 7/7/15 (rated on a 1-10 scale)				
1	UTC					2.5	2.8	6.0	5.8	6.3	5.8
2	ROUNDUP PM	1.5 qt		--		7.4	3.3	2.8	6.3	9.0	8.3
3	RELY 280	72 fl oz		--		7.3	3.8	4.0	6.5	9.3	8.0
4	MISSION	2.14 oz	+	ROUNDUP PM	1.5 qt	8.6	5.8	5.5	7.5	9.5	8.3
5	MATRIX	4 oz	+	ROUNDUP PM	1.5 qt	8.5	5.3	5.3	6.8	9.8	9.8
6	CHATEAU	12 oz	+	ROUNDUP PM	1.5 qt	9.0	6.5	7.0	8.5	9.5	9.3
7	TRELLIS SC	23 fl oz	+	RELY 280	72 fl oz	9.2	5.5	4.5	8.5	10.0	9.5
8	TRELLIS SC GOAL 2XL	23 fl oz 5 pt	+	ROUNDUP PM	1.5 qt	4.5	5.0	6.0	6.3	9.3	8.3
9	TRELLIS SC PROWL	23 fl oz 6 qt	+	RELY 280	72 fl oz	9.8	8.0	7.5	9.3	10.0	9.8
10	TRELLIS SC ALION	23 fl oz 2.5 fl oz	+	RELY 280	72 fl oz	9.5	5.3	5.0	8.5	10.0	9.8
11	TRELLIS SC CHATEAU	23 fl oz 6 oz	+	ROUNDUP PM	1.5 qt	8.5	4.0	3.5	8.3	9.0	9.8
12	TRELLIS SC MATRIX	23 fl oz 4 oz	+	ROUNDUP PM	1.5 qt	9.6	4.0	3.5	10.0	10.0	10.0
13	TRELLIS SC MISSION	23 fl oz 1.07 oz	+	ROUNDUP PM	1.5 qt	9.8	5.3	4.5	9.3	10.0	9.8
14	GOAL 2XL MATRIX	3 pt 4 oz	+	ROUNDUP PM	1.5 qt	9.8	5.6	4.5	9.8	10.0	10.0
15	CHATEAU MATRIX	6 oz 4 oz	+	ROUNDUP PM	1.5 qt	10.0	5.3	4.5	9.8	10.0	9.8

In the trial conducted in the Dunnigan Hills near Esparto, CA barnyardgrass was the dominant grass species with junglerice, and fall panicum also present. None of these grasses were emerged at the time of application. Several herbicides tested did not control summer grasses throughout the season. The only treatment that provided acceptable season-long grass control was pendimethalin.

Table 8.10. *Weed control evaluations at a winegrape vineyard herbicide research and demonstration trial conducted near Isleton CA in 2015.*

			under vine			Row Middles			
			Overall-All weeds			Grass	Filaree	Grass*	Broadleaf
	Treatment 1/29/2015	Rate	3/2/15	4/15/15	6/4/15	4/15/15		6/4/15	
		prod/A	All ratings on a 1-10 scale. 1= no control; 10 = complete control						
1	UTC		1.0	3.3	7.3	1.3	1.5	8.0	6.8
2	ROUNDUP WM	1 qt	5.6	4.8	7.0	9.9	2.3	9.8	6.5
3	RELY	48 oz	5.5	5.5	8.0	5.1	4.3	8.3	7.0
4	MISSION + RU WM	2.14 oz	8.6	9.4	9.3	10.0	8.3	10.0	8.0
5	MATRIX + RU WM	4 oz	6.8	7.5	9.5	10.0	3.0	10.0	7.3
6	CHATEAU + RU WM	12 oz	8.6	9.0	10.0	9.9	5.5	10.0	8.9
7	GOALTENDER + RU WM	2 qt	8.4	9.0	9.3	10.0	4.8	9.9	8.1
8	TRELLIS SC + Rely	23 fl. oz	8.0	7.5	8.8	4.0	6.5	8.3	8.3
9	ALION + Rely	3.5 fl. oz	9.3	8.7	9.0	3.0	9.0	7.9	8.0
10	ALION + Rely	5.0 fl. oz	9.6	9.0	9.9	3.0	9.0	9.5	8.6
11	TRELLIS + RU WM GOAL 2XL	23 fl. oz 5 pt	8.4	8.0	9.6	10.0	5.9	10.0	9.4
12	ALION + RU WM ZEUS	2.5 fl. oz 12 fl. oz	7.3	7.6	9.4	9.5	5.0	9.3	8.9
13	ALION + RU WM CHATEAU	3.5 fl. oz 4 oz	9.3	9.8	9.9	10.0	6.5	10.0	7.9
14	ALION + RU WM CHATEAU	5.0 fl. oz 6 oz	9.1	9.5	9.9	10.0	7.4	10.0	8.0
15	ALION + RU WM MATRIX	5.0 fl. oz 2 oz	7.7	8.8	9.9	10.0	5.4	10.0	9.0
16	ALION + RU WM MATRIX	2.5 fl. oz 4 oz	8.4	8.3	9.6	10.0	6.5	9.9	8.5
17	ALION + RU WM MISSION	5.0 fl. oz 2.14 oz	9.3	9.9	9.8	10.0	9.1	10.0	9.9
18	ALION + Rely TRELLIS SC	2.5 fl. oz 15.2 fl. oz	8.3	8.0	9.3	6.6	7.8	8.5	8.9
19	TRELLIS SC + Rely PROWL	23 fl. oz 6 qt	6.0	7.8	10.0	4.8	6.8	8.8	9.4
20	TRELLIS SC + Rely ALION	23 fl. oz 2.5 fl. oz	7.0	9.0	9.5	5.3	6.5	8.8	8.6
21	TRELLIS SC + RU WM CHATEAU	23 fl. oz 6 oz	8.7	9.0	9.3	10.0	5.5	10.0	8.4
22	TRELLIS SC + RU WM MATRIX	23 fl. oz 4 oz	7.5	6.9	8.5	10.0	4.3	10.0	8.4
23	TRELLIS SC + RU WM MISSION	23 fl. oz 1.07 oz	8.9	7.1	8.4	10.0	6.6	9.9	7.9
24	Untreated		1.0	2.3	7.5	1.8	1.3	8.3	9.0

In the Isleton trial much of the information was collected in the area between the row were foxtail barley (*Hordeum jubatum*), germinated before the herbicide applications were made. Treatments that included glufosinate instead of glyphosate did not control the small grasses that had germinated and resulted in unsatisfactory control at the early spring (April) rating. All treatments that contained glyphosate provided at least acceptable control of the foxtail.

Table 8.11. *Selected weed control evaluations from 2014-15 Broadworks and Alion tankmix trial near Arbuckle, CA (Brunharo and Hanson)*

				--------------- 56 DAT-A --------------				-------- 103 DAT-A ------		
				Filaree	Hairy fleabane	Chick weed	Rye grass	Hairy fleabane	Bind weed	Rye grass
	Treatment	Rate		------------------------------------- % control -------------------------------------						
1	Rely 280	2	qt/a	0	0	0	0	15	8	0
2	Alion	3.5	fl oz/a	93	88	96	88	81	99	98
	Rely 280	2	qt/a							
3	Alion	5	fl oz/a	99	99	99	40	83	47	98
	Rely 280	2	qt/a							
4	Matrix	4	oz/a	95	100	85	90	76	95	96
	Rely 280	2	qt/a							
5	Alion	3.5	fl oz/a	97	93	90	53	99	76	100
	Matrix	2	oz/a							
	Rely 280	2	qt/a							
6	Alion	3.5	fl oz/a	99	95	85	48	79	100	100
	Matrix	4	oz/a							
	Rely 280	2	qt/a							
7	Broadworks	6	fl oz/a	66	75	50	18	99	55	25
	Rely 280	2	qt/a							
8	Alion	3.5	fl oz/a	99	90	83	70	83	96	75
	Broadworks	6	fl oz/a							
	Rely 280	2	qt/a							
9	Alion	5	fl oz/a	98	98	97	96	92	87	100
	Broadworks	6	fl oz/a							
	Rely 280	2	qt/a							
10	Alion	5	fl oz/a	99	75	92	55	93	78	100
	Broadworks	3	fl oz/a							
	Rely 280	2	qt/a							
11	Broadworks	6	fl oz/a	72	95	95	30	99	98	53
	Prowl H2O	4	qt/a							
	Rely 280	2	qt/a							
12	Broadworks	6	fl oz/a	85	65	85	53	93	87	88
	Surflan	4	qt/a							
	Rely 280	2	qt/a							
13	Broadworks	6	fl oz/a	82	88	81	53	96	92	50
	GoalTender	3	pt/a							
	Rely 280	2	% v/v							
14	Broadworks	6	fl oz/a	87	93	74	55	96	92	74
	Matrix	2	oz/a							
	Rely 280	2	qt/a							
15	Broadworks	6	fl oz/a	94	100	91	64	99	78	95
	Matrix	4	oz/a							
	Rely 280	2	qt/a							
16	Pindar GT	2.5	pt/a	95	73	58	20	65	45	70
	Rely 280	2	qt/a							
	LSD (0.05)			***23***	***32***	***39***	***50***	***27***	***29***	***41***

*"A" timing was applied on January 16, 2014 and the "B" timing on March 18, 2014.
Note: the large-plot trials did not include an untreated control and, thus, had only 11 treatments.

Table 8.12. *Selected weed control evaluations from 2014-15 comparison of Alion and other preemergence tankmix and sequential partners in an orchard near Escalon, CA. All treatments included a high rate of Rely 280 and Roundup Powermax to ensure good control of existing weeds. (Watkins and Hanson)*

					Hairy fleabane	3 spike goose grass	Hairy fleabane	3 spike goose grass	Hairy fleabane	3 spike goose grass	Overall
					92 DAT		128 DAT		-------156 DAT --------		
	Treatment	Rate			------------------------------------ % control ------------------------------------						
1	Untreated Check				0	0	0	0	0	0	0
2	Alion	2.5	oz/a	A	55	75	58	80	53	83	58
3	Alion	3.5	oz/a	A	73	78	71	88	65	85	75
4	Alion	5	oz/a	A	85	93	84	93	85	90	91
5	Chateau	10	oz wt/a	A	78	65	73	73	68	70	68
6	Matrix	4	oz wt/a	A	98	63	99	55	95	20	58
7	Pindar GT	2.5	pt/a	A	85	60	80	55	70	60	48
8	Goaltender	4	pt/a	A	73	85	65	68	60	85	58
9	Alion Chateau	5 6	oz/a oz wt/a	A	97	98	93	93	90	90	93
10	Alion Matrix	5 2	oz/a oz wt/a	A	90	95	95	95	93	90	94
11	Alion Pindar GT	5 1.5	oz/a pt/a	A	100	96	99	91	100	93	95
12	Alion Goaltender	5 2	oz/a pt/a	A	93	98	90	96	90	98	94
13	Chateau Alion	10 3.5	oz wt/a oz/a	A B	92	98	90	100	85	98	92
14	Chateau Alion	12 5	oz wt/a oz/a	A B	97	99	96	100	94	96	96
15	Matrix Alion	4 5	oz wt/a oz/a	A B	100	100	97	99	100	100	99
16	Alion Alion	5 5	oz/a oz/a	A B	94	100	90	100	90	100	93
17	Alion	3.5	oz/a	B	85	98	65	95	43	95	75
18	Alion	5	oz/a	B	93	98	83	95	73	95	88
LSD (P=.05)					**10**	**13**	**11**	**14**	**16**	**12**	**10**

The "A" timing was applied on January 13, 2015 and the "B" timing on March 5, 2015. *All treatments at both timings included Roundup Powermax plus Rely 280 and AMS for control of emerged weeds.* The same treatments were applied to these plots in 2014/15.

Preemergent Control in Junglerice and Palmer Amaranth

UCCE – Tulare/Kings Co., Tulare – 2015
Steven Wright, Sarah Parry, Eddie Padilla and Isaac Giron

The objective of this study was to evaluate the control of preemergent herbicides at a 1X and 2X label rates (Table 8.13) in a field heavily populated with junglerice (*Echinochloa colona*) and Palmer Amaranth (*Amaranthus palmeri*). This study was conducted in Tipton, California, in June and July, 2015. Plots were 10 feet wide by 30 feet long; each treatment was replicated 4 times. Treatments were applied June 9, 2015. Air temperature was 82°F, wind speeds ranged from 6-8 mph, and relative humidity was 32%. Applications were sprayed at 15 GPA using a CO_2-pressured backpack sprayer with TeeJet 8002 flat fan nozzles at 30 psi. Weekly evaluations of weed emergence began 7 days after treatment (DAT).

The field was irrigated and disked 1 week before application. Post application, the field was disked with 2 passes at 3 inches deep within 2 hours after application to incorporate the herbicides. After the 42 DAT rating, there was very little emergence throughout the trial. The greatest reemergence were of junglerice (*Echinochloa colona*) in the untreated control and Roundup WeatherMax treated plots. Under the conditions of this study only a few plants emerged. The preemergent herbicides tested, however, showed complete control of junglerice and palmer amaranth at the 1X and 2X rates.

Table 8.13. *Junglerice and Palmer Amaranth Control Percent*

Trt #	Treatment	Product/Acre (pts)	Control (%)
1	Untreated Control	0	0
2	Prowl H_2O 1X	3	100
3	Prowl H_2O 2X	6	100
4	Treflan 4D 1X	3	100
5	Treflan 4D 2X	6	100
6	Dual II Magnum	1.5	100
7	Roundup WeatherMax + AMS	2	0

Attachment 1

Junglerice and Palmer Amaranth Control Using Postemergent Herbicides

UCCE- Tulare/Kings Co. Tulare – 2015

Steve Wright, Sarah Parry, Eddie Padilla, Isaac Giron

The objective of this study was to evaluate postemergent control for glyphosate resistant junglerice (*Echinochloa colona)* and Palmer amaranth *(Amaranthus palmeri)*. Other weeds present included Roundup Ready alfalfa, tumble pigweed (*Amaranthus albus)*, barnyardgrass (*Echinochloa crus-galli*), horse purslane (*Trianthema Portulacastrum*), and velvetleaf (*Abutilon theophrasti*). The study was conducted in Tipton, California in July, 2015. There were 6 postemergent herbicide treatments and an untreated control (UTC) (Table 8.14). Plots were 8 feet wide by 30 feet long, and treatments were replicated 4 times.

Each treatment was applied twice. The first application was July 6, 2015, and the second was on July 20, 2015. At the first application, air temperature was 76°F, wind speed ranged from 6-8 mph, and relative humidity was 53%. At the second application, air temperature was 90°F, wind speed ranged from 6-8 mph, and relative humidity was 44%. Applications were sprayed at 15 GPA using a CO_2-pressured backpack sprayer with TeeJet 8002 flat fan nozzles at 30 psi. Weekly evaluations of weed control were at 3 different timings from 7 days after treatment (DAT) through 21 DAT. Prior to 21 DAT, July 27, 2015, the study was mowed by the grower, so only junglerice ratings were taken (Table 2). Evaluations were taken for two timings depending on weed size (eg. Small <3” in diameter, <4” tall) vs (Large >3” diameter and >4’ tall).

Under the conditions of this study, most of the weeds observed were controlled by all of the treatments applied except broadleaves treated with Fusilade. Due to scattered populations of weeds in various plots, ratings are variable. Palmer amaranth was one of the most scattered weeds in the plots and sometimes was not present. This caused varied results and may need further observations. Junglerice was most controlled by all treatments at the small stage and moderately controlled at large stage. Lastly, Alfalfa injury levels were greatest when Rely 280 was applied. There was no injury observed when treated with Roundup.

Attachment 1

Table 8.14. *Postemergent Herbicide Control in Registered Cotton on Several Weeds Small and Large*

14DAT	Treatments	Rate	J. rice	Palmer	T. Pig.	B. Grass	H. Purs	Vel. Leaf	RR. Alfalfa
Small Weeds		Product/A							
1	UTC	0							
2	Roundup	32 oz	80	90	90	50	70	10	0
3	Rely280 + Roundup	29oz + 32oz	90	70	90	80	70	40	70
4	Rely280 + Fusilade	29oz + 1.5 pt	100	100	95	80	90	100	80
5	Rely280	29oz	100	90	80	70	90	70	80
6	Fusilade	1.5 pt	90	0	0	0	0	0	0
7	Roundup + Fusilade	32oz + 1.5pt	100	90	100	30	90	30	0
Large Weeds									
1	UTC								
2	Roundup	32 oz	30	30	80				
3	Rely280 + Roundup	29oz + 32oz	50	50	60				
4	Rely280 + Fusilade	29oz + 1.5 pt	90	50	70				
5	Rely280	29oz	70	90	40				
6	Fusilade	1.5 pt	50	0	0				
7	Roundup + Fusilade	32oz + 1.5pt	50		60				

Table 8.1. *Postemergent Herbicide on Junglerice at 21 DAT*

	Treatments	Rate	Junglerice
	Small Weeds	Product/A	
1	UTC	---	0
2	Roundup	32 oz	90
3	Rely280 + Roundup	29oz + 32oz	100
4	Rely280 + Fusilade	29oz + 1.5 pt	100
5	Rely280	29oz	100
6	Fusilade	1.5 pt	100
7	Roundup + Fusilade	32oz + 1.5pt	100

Attachment 1

Postemergent Weed Control in Walnuts at Different Weed Sizes
UCCE – Tulare/Kings Co. Tulare – 2015
Steven Wright, Sarah Parry, Eddie Padilla, Isaac Giron

The objective of this study was to evaluate 15 herbicides and tank mixes (plus an untreated control) (Table 8.16) on difficult-to-control weeds typical in tree crops using postemergent herbicides. Weeds present in this trial included: junglerice (*Echinochloa colona*), Palmer amaranth (*Amaranthus albus*), common lambsquarter (*Chenopodium album*), hairy fleabane (*Conyza bonariensis*), horseweed (*Conyza Canadensis*), little mallow (*Malva parviflora*), common purslane (*Portulaca oleracea*), puncturevine (*Tribulus terrestris*), and barnyardgrass (*Echinochloa crus-galli*). The study was conducted in Tulare, California in June 2015. Plots were 5 feet wide by 30 feet long, and treatments were replicated 4 times.

Treatments were applied on June 2, 2015. Air temperature was 75°F, wind speed ranged from 5-7 mph, and relative humidity was 54%. Applications were sprayed at 15 gpa using a CO_2-pressured quad sprayer with TeeJet 8002 flat fan nozzles at 30 psi. Weekly evaluations of weed control at different timings began 7 days after treatment (DAT) and continued up to 28 DAT. Evaluations were taken for two timings depending on weed size (eg. Small <3" diameter, <4"tall) vs (Large >3" diameter, >4" tall).

Under the conditions of this study, all of the treatments showed great control on Palmer amaranth, lambsquarter, malva, and fleabane(Tables 8.17-8.18) . Palmer amaranth was controlled completely by all treatments when sprayed at a small growth stage (<3" diameter, <4"tall) with the greatest control of large Palmer amaranth (>3" diameter, >4") with treatments NUP – 13028, Treevix, and Shark. There were similar results for small common lambsquarter with complete control by all treatments, except for Credit Extreme. However, large common lambsquarter was generally slightly controlled while only treatment Cheetah + Tuscany gave complete control. There was good control of barnyardgrass with all treatments. The best control observed was by Cheetah, NUP – 13028 + Credit Extreme at various rates and Rely 280 at various rates.

Due to the scattered variation in weeds throughout the study, some results were variable, such as for common purslane, puncturevine, junglerice, and horseweed. However, the treatments that were tested had excellent control.

***Table.** Composite List of Weeds*

Bayer Code:	Common Name:
AMAL	Palmer amaranth
ECHCG	Barnyardgrass
TRBTE	Puncturevine
ERIBO	Hairy fleabane
ERICA	Horseweed
CHEAL	Common Lambsquarter
POROL	Horse Purslane
MALPA	Little Mallow
ECHCO	Junglerice

***Table 8.16.** Weed Control Percentage 14 DAT 15-June 2015*

Treatments	Product Rates/ A	AMAL Small	AMAL Large	CHEAL Small	CHEAL Large	ECHEG	POROL	TRBTE	MALPA	ERIBO	ECHCO	ERICA
1. UTC		0	0	0	0	0	0	0	0	0	0	0
2. Cheetah	72 oz.	80	40	70	30	50	---	100	80	90	---	---
3. Credit Extreme	32 oz.	80	50	60	30	---	---	---	60	10	30	---
4. Cheetah + Credit Extreme	55 oz + 32 oz.	100	50	90	70	60	---	---	100	30	---	---
5. Cheetah + Tuscany	55 oz + 12 oz.	100	60	100	100	60	---	---	100	90	50	70
6.Cheetah + Tuscany	72 oz + 12 oz.	90	60	100	60	60	---	100	100	60	---	---
7.Cheetah + Tuscany + Credit Extreme	55 oz + 9 oz. + 32 oz.	90	70	100	70	60	100	---	100	80	90	---
8. NUP – 13028	55 oz.	100	70	100	80	60	100	100	100	90	---	---
9. NUP – 13028	72 oz.	100	70	100	80	---	100	---	100	90	---	---
10. NUP – 13028 + Credit Extreme	55 oz + 32 oz.	90	60	100	70	90	100	100	100	100	100	---
11. NUP – 13028 + Credit Extreme	72 oz + 32 oz.	100	60	100	60	60	---	100	100	100	---	70
12. Rely 280	3 pts.	100	60	100	70	60	100	100	100	90	---	---
13. Rely 280	3.5 pts.	100	60	80	60	80	---	---	100	90	30	---
14. Rely 280	5 pts.	100	70	100	80	80	100	100	100	90	---	60
15. Treevix	1 oz.	100	70	100	70	80	---	70	90	100	---	---
16.Shark	2 oz.	100	80	100	60	50	---	100	100	100	---	---

*Columns with (---): weeds were not present in any of the rep so treatments could not be tested.
Weed size (Small <3” diameter, <4”tall) vs. (Large >3” diameter, >4” tall).

Table 8.17. *Weed Control Percentage 21 DAT 22-June 2015*

Treatments	Product Rates/ A	AMA L Small	AMA L Large	CHEAL Small	CHEAL Large	ECHE G	POROL	TRBTE	MALP A	ERIB O	ECHC O	ERICA
1. UTC		0	0	0	0	0	0	0	0	0	0	0
2. Cheetah	72 oz.	80	50	100	30	100	---	100	100	100	---	---
3. Credit Extreme	32 oz.	90	50	80	30	---	---	---	100	10	30	---
4. Cheetah + Credit Extreme	55 oz + 32 oz.	100	50	100	60	70	---	---	100	70	---	---
5. Cheetah + Tuscany	55 oz + 12 oz.	100	80	100	100	60	---	---	100	100	100	90
6.Cheetah + Tuscany	72 oz + 12 oz.	100	80	100	50	60	---	100	100	60	---	---
7.Cheetah + Tuscany + Credit Extreme	55 oz + 9 oz. + 32 oz.	100	70	100	50	70	100	---	100	80	100	---
8. NUP – 13028	55 oz.	100	70	100	50	70	100	100	100	90	---	---
9. NUP – 13028	72 oz.	100	100	100	80	---	100	---	100	100	---	---
10. NUP – 13028 + Credit Extreme	55 oz + 32 oz.	100	70	100	70	90	100	100	100	100	100	---
11. NUP – 13028 + Credit Extreme	72 oz + 32 oz.	100	70	100	70	90	---	100	100	100	---	70
12. Rely 280	3 pts.	100	70	100	50	60	100	100	100	100	---	---
13. Rely 280	3.5 pts.	100	70	100	40	80	---	---	100	100	30	---
14. Rely 280	5 pts.	100	70	100	30	90	100	100	100	100	---	90
15. Treevix	1 oz.	100	90	100	30	80	---	100	100	100	---	---
16.Shark	2 oz.	100	80	100	40	50	---	100	100	100	---	---

*Columns with (---): weeds were not present in any of the rep so treatments could not be tested.
Weed size (Small <3” diameter, <4”tall) vs. (Large >3” diameter, >4” tall).

Table 8.18. *Weed Control Percentage 28 DAT 02- July 2015*

Treatments	Product Rates/ A	AMAL Small	AMAL Large	CHEAL Small	CHEAL Large	ECHEG	POROL	TRBTE	MALPA	ERIBO	ECHCO	ERICA
1. UTC		0	0	0	0	0	0	0	0	0	0	0
2. Cheetah	72 oz.	100	50	100	30	100	---	100	100	100	---	---
3. Credit Extreme	32 oz.	100	60	80	30	---	---	---	100	10	60	---
4. Cheetah + Credit Extreme	55 oz + 32 oz.	100	50	100	60	80	---	---	100	80	---	---
5. Cheetah + Tuscany	55 oz + 12 oz.	100	80	100	100	60	---	---	100	100	100	90
6.Cheetah + Tuscany	72 oz + 12 oz.	100	80	100	50	60	---	100	100	100	---	---
7.Cheetah + Tuscany + Credit Extreme	55 oz + 9 oz. + 32 oz.	100	70	100	50	80	100	---	100	90	100	---
8. NUP – 13028	55 oz.	100	70	100	50	80	100	100	100	90	---	---
9. NUP – 13028	72 oz.	100	100	100	80	---	100	---	100	100	---	---
10. NUP – 13028 + Credit Extreme	55 oz + 32 oz.	100	70	100	70	90	100	100	100	100	100	---
11. NUP – 13028 + Credit Extreme	72 oz + 32 oz.	100	70	100	70	90	---	100	100	100	---	90
12. Rely 280	3 pts.	100	70	100	50	90	100	100	100	100	---	---
13. Rely 280	3.5 pts.	100	70	100	40	90	---	---	100	100	30	---
14. Rely 280	5 pts.	100	70	100	30	90	100	100	100	100	---	100
15. Treevix	1 oz.	100	90	100	30	80	---	100	100	100	---	---
16.Shark	2 oz.	100	80	100	40	70	---	100	100	100	---	---

*Columns with (---): weeds were not present in any of the rep so treatments could not be tested. Weed size (Small <3” diameter, <4”tall) vs. (Large >3” diameter, >4” tall).

Attachment 1

Table 8.19. *Treatments for junglerice control in an almond orchard trial near Goshen, CA during 2016 (Wright, Shrestha, Perry, Smith, and Hanson)*

Treatments	Rate/A	March 2	March 29	April 6	May 5	June 9	June 23	July 3
		2 WAT	6	7	11	16	18	20
1. UTC	---	0	0	0	0	0	0	0
2. Broadworks + Prowl H2O	6 oz + 4 qts	100	100	100	100	100	100	0
3. Broadworks + Goal tender	6 oz + 3 pts	90	90	50	33	30	0	0
4. Broadworks + Alion	6 oz + 5 oz	90	90	80	60	40	0	0
5. NAI – 1360	5.7 oz	90	90	0	0	0	0	0
6. NAI – 1360	8.6 oz	90	85	60	36	0	0	0
7. Alion	3.5 oz	100	100	75	46	33	0	0
8. Matrix + Prowl H2O	4 oz + 4 qts	100	100	100	100	100	100	0
9. Alion	1.4 oz	90	95	60	32	0	0	0
10. Prowl H2O	4 qts	100	100	100	100	100	100	0
11. Pindar	2 pts	100	100	75	66	36	0	0
12. Alion + Rely 280 + Roundup	1.4 oz + 64 oz + 1 qt	N/A	85	89	96	90	0	0
13.Matrix + Alion + Rely 280 + Roundup WM	2 oz + 3.5 oz + 64 oz + 1 qt	N/A	100	55	30	0	0	0
14. Matrix + Alion + Rely + Roundup WM	2 oz +1.4 oz + 64 oz 1 qt	N/A	100	100	100	82	0	0

The objective of this study was to evaluate the efficacy of various preemergent herbicides and tank mixes in a nonbearing almond orchard with a known uniform population of junglerice (*Echinochloa colona*) and various other weeds.

Under the condition of this trial Prowl H20 (4 qts) and treatment combination of Prowl plus Matrix (4oz), Prowl plus Broadworks (6oz) gave excellent control of junglerice for 4 months. Both Alion (1.4oz), Pindar (2pts) and Alion plus Matrix (2oz) gave excellent junglerice control for 6 weeks with fair residual control remaining for 2 months. NAI-1360 (8.6 oz) and Broadworks plus Goal Tender (3pts) gave good control for 6 WAT (Table 8.19).

Tables 1–10

Table 1. Range of pathogen concentrations measured in irrigation water before and after treatment during the spring of 2014 strawberry trial. (Source water was pond-1.)

Date	Organism	Before Treatment	Treated Water		
			$Ca(ClO)_2$	PAA[2]	UV
		CFU 100 ml^{-1}	CFU 100 ml^{-1}		
8 May 2014	*E. coli*[1]	579.4	<1	<1	<1
	STEC	50	0	12	0
12 May 2014	*E. coli*	1553.1	<1	4.1	15.8
	STEC	100	0	5	2
13 May 2014	*E. coli*	866.4	<1	39.9	<1
	STEC	-	-	-	-
15 May 2014	*E. coli*	47.1	<1	488.4	7.4
	STEC	-	-	-	-
19 May 2014	*E. coli*	-	<1	<1	2
	STEC	150	0	0	11
23 May 2014	*E. coli*	93	<1	36.4	6.3
	STEC	-	-	-	-
27 May 2014	*E. coli*	325.5	<1	<1	3.1
	STEC	-	-	-	-
2 Jun 2014	*E. coli*	-	-	-	-
	STEC	42	0	72	34

[1]*E. coli* values are given as MPN 100 ml^{-1}
[2]PAA performance as a disinfectant is represented poorly by this table. The primary issue is that hydrogen peroxide gas evolves under vacuum and care must be taken to prevent an air-lock from developing during water treatment.

Table 2. Range of pathogen concentrations measured in irrigation water before and after treatment during the fall of 2014 tomato trial. (Source water was pond-2.)

Date	Organism	Before Treatment	Treated Water		
			$Ca(ClO)_2$	PAA[2]	UV
		CFU 100 ml^{-1}	CFU 100 ml^{-1}		
14 Aug 2014	*E. coli*[1]	2	<1	<1	<1
	STEC	96	0	0	0
21 Aug 2014	*E. coli*	<1	<1	<1	<1
	STEC	3	0	0	0
28 Aug 2014	*E. coli*	457	<1	<1	<1
	STEC	200	0	0	0
4 Sept 2014	*E. coli*	10	<1	<1	<1
	STEC	14	0	0	0
11 Sept 2014	*E. coli*	3	<1	3.1	<1
	STEC	82	0	26	0
18 Sept 2014	*E. coli*	301	<1	<1	<1
	STEC	20	0	0	0
25 Sept 2014	*E. coli*	2	<1	<1	<1
	STEC	1	0	0	0
2 Oct 2014	*E. coli*	25	<1	<1	<1
	STEC	11	0	0	0

[1] *E. coli* values are given as MPN 100 ml^{-1}
[2] PAA values on September 11, 2014 represent an injection pump failure.

Table 3. Range of *E. coli* and STEC concentrations measured in irrigation water before and after treatment during the spring of 2015 strawberry trial. (Source water was pond-2.)

Date	Organism	Before Treatment	Treated Water		
			PAA	ClO_2	UV
		CFU 100 ml^{-1}	CFU 100 ml^{-1}		
17 Apr 2015	*E. coli*[1]	172 – 344	<1 – 41	1 – 11	<1
	STEC	14 – 22	0	0	0
23 Apr 2015	*E. coli*	4 – 17	<1 – 20	<1	<1
	STEC	20 – 60	0	0	0
28 Apr 2015	*E. coli*	3 – 13	<1 – 7	<1 – 1	<1
	STEC	10 – 38	0	0	0
7 May 2015	*E. coli*	5 – 15	<1 – 2	<1	<1
	STEC	30 – 62	0	0	0
11 May 2015	*E. coli*	7 – 387	<1	<1	<1
	STEC	56 – 146	0	0	0
18 May 2015	*E. coli*	6 – 17	<1	<1 – 2	<1
	STEC	40	0	0	0
28 May 2015	*E. coli*	2 – 15	<1	<1	<1
	STEC	3 – 4	0	0	1 – 3

[1]*E. coli* values are given as MPN 100 ml^{-1}

Table 4. Range of pathogen concentrations measured in irrigation water before and after treatment during the fall of 2015 cabbage trial. (Source water was pond-2.)

Date	Organism	Before Treatment	Treated Water		
			PAA	ClO_2	UV
		CFU 100 ml^{-1}	CFU 100 ml^{-1}		
30 Aug 2015	*E. coli*[1]	5.2 – 10.9	<1	<1	<1
	STEC	760	2	0	0
4 Sept 2015	*E. coli*	4.1 – 11	<1	<1	<1
	STEC	0	0	2	1
10 Sept 2015	*E. coli*	5.2 – 6.3	<1	<1	<1
	STEC	150 – 470	0	0	0
17 Sept 2015	*E. coli*	4.1 – 7.4	<1	<1	<1
	STEC	60 – 140	0	0	0
24 Sept 2015	*E. coli*	1 – 4.2	<1	<1	<1
	STEC	20 – 60	0	0	0
1 Oct 2015	*E. coli*	1 – 2	<1	<1	<1
	STEC	-	0	0	0
8 Oct 2015	*E. coli*	3.1 – 4.2	<1	<1	<1
	STEC	0 – 20	0	0	0
15 Oct 2015	*E. coli*	1 – 4.1	<1	<1	<1
	STEC	0 – 40	0	0	0
23 Oct 2015	*E. coli*	10.4 – 22.3	<1	<1	<1
	STEC	60 – 80	0	0	0
28 Oct 2015	*E. coli*	24.9 – 36.9	<1	<1	<1
	STEC	10 – 30	0	0	0

[1]*E. coli* values are given as MPN 100 ml^{-1}

Table 5. Comparison of water quality parameters for the water sources.

Parameter	Pond-1	Pond-2	Municipal
Total Suspended Solids (mg/L)	0.01 – 0.02	0.008 – 0.02	0.001 – 0.003
Total Dissolved Solids (mg/L)	0.1 – 0.2	0.1 – 0.2	0.08 – 0.1
pH	6.9	6.9	7.1 – 8.1
Total Nitrogen (mg/L)	1 – 3	0.5 – 0.8	0.1 – 0.4
Total Carbon (mg/L)	20 – 30	16 – 19	4 - 8
Turbidity (NTU)	26 – 35	3 – 9	0.1 – 0.3
E. coli MPN per 100 ml	100 – 800	13 – 400	<1 – 1

Table 6. Overall performance of disinfection treatments to reduce populations of STEC in irrigation water.

Treatment	Mean Population of STEC (CFU/100 ml)[1]	Standard Error
Control	20.18^{A}	1.38
ClO_2	1.34^{B}	1.44
$Ca(ClO)_2$	0.97(ND[2])^{B}	0
PAA	1.30^{B}	1.39
UV	1.26^{B}	1.38
Municipal	0.97(ND)^{B}	0

[1]Means followed by different letters are significantly different ($p < 0.05$).
[2]ND, not detected per 100 ml.

Table 7. STEC detection in strawberry samples by treatment collected during the 2014 strawberry trial[1].

Treatment	STEC Not Detected	STEC Detected	Total No. Samples	% No Detect
Control	148	100	248	60
$Ca(ClO)_2$	168	83	251	67
PAA	195	61	256	76
UV	163	97	260	63

[1]This data includes all samples of berries picked before/after irrigation and on Thursdays.

Table 8. STEC detection in tomato samples by treatment collected during the 2014 tomato trial.

Treatment	STEC Not Detected	STEC Detected	Total No. Samples	% No Detect
Control	29	1	30	97
$Ca(ClO)_2$	26	0	26	100
PAA	30	0	30	100
UV	32	0	32	100
Municipal	29	0	29	100

Table 9. STEC detection in strawberry samples by treatment collected during the 2015 strawberry trial[1].

Treatment	STEC Not Detected	STEC Detected	Total No. Samples	% No Detect
Control	64	49	113	57
ClO_2	65	33	98	66
PAA	73	51	124	59
UV	72	52	124	58
Municipal	68	32	100	68

[1]This data includes all samples of berries picked before/after irrigation and on Thursdays.

Table 10. STEC detection in cabbage samples by treatment collected during the 2015 cabbage trial.

Treatment	STEC Not Detected	STEC Detected	Total No. Samples	% No Detect
Control	42	3	45	93
ClO_2	34	2	36	94
PAA	34	2	36	94
UV	26	1	27	96
Municipal	36	0	36	100

Figures 1–7

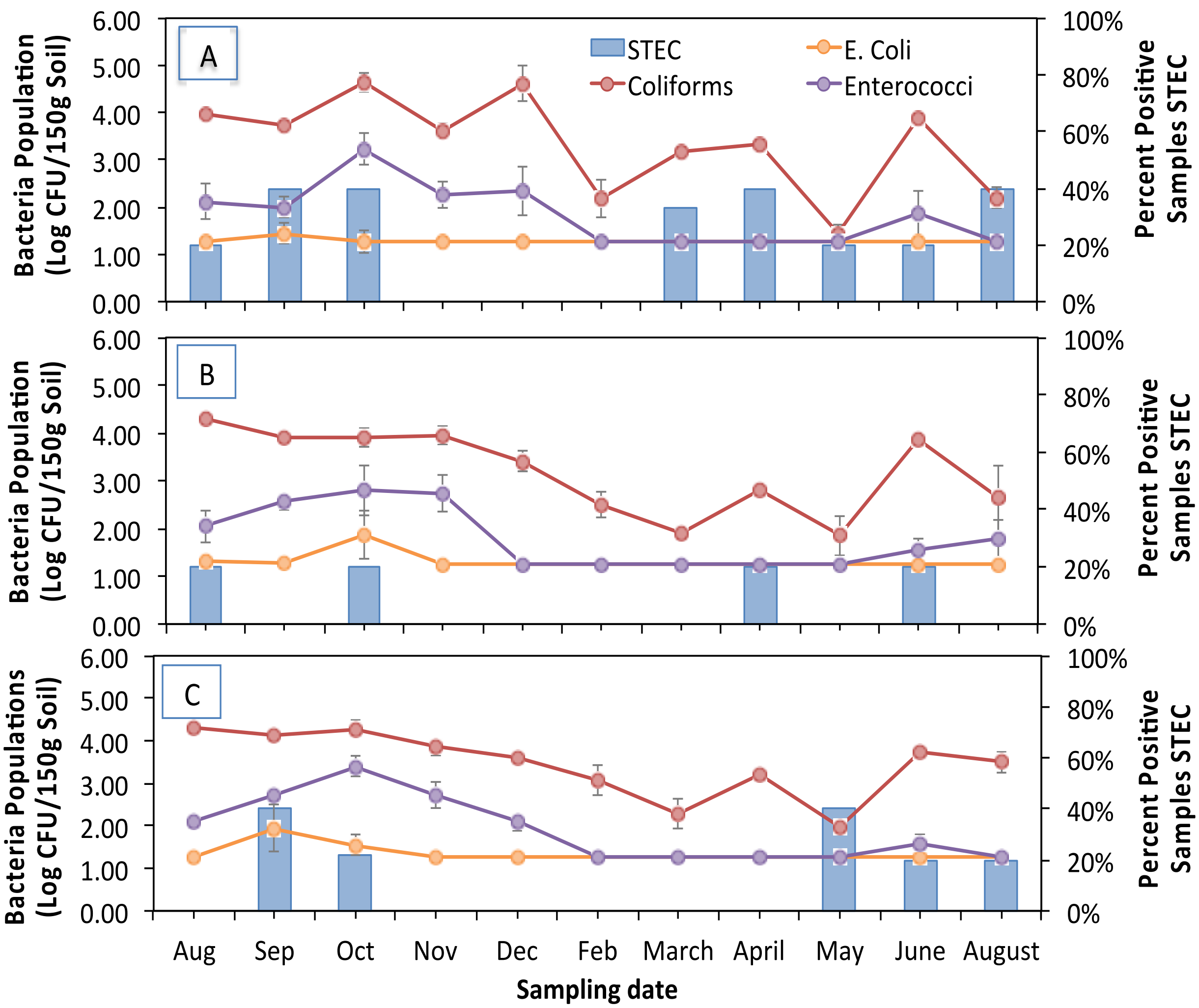


Figure 1. Distribution and prevalence of STEC and indicator microorganisms isolated from soil samples collected (A) 32 ft, (B) 200 ft, and (C) 400 ft away from dairy operations. Data represent averages of 21 samples per time point collected from different locations within each plot. Data were reported based on distance from the dairy unit instead of per crop and distance. Time 0 samples tested negative for *Salmonella* and STEC.

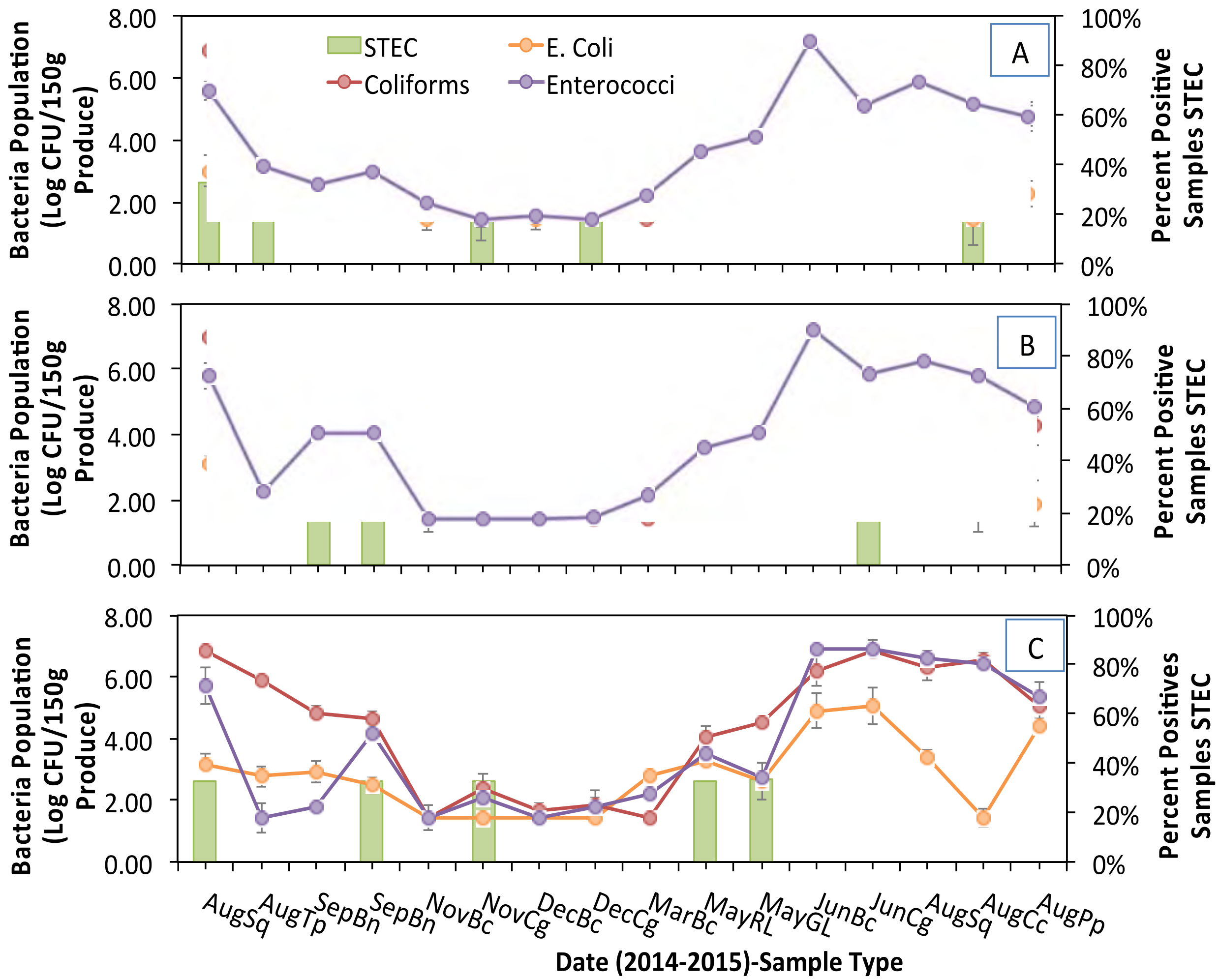


Figure 2. Distribution and prevalence of STEC and indicator microorganisms isolated from various produce samples collected (A) 32 ft, (B) 200 ft, and (C) 400 ft away from dairy operations. Data represent averages of 18 samples per time point/produce collected from different locations within each plot. Each crop was sampled on two occasions; there was a 7-day interval between sampling events. Aug=August, Sep=September, Nov=November, Jun=June; Sq=squash, Tp=turnips, Bn=bean, Cg=cabbage, Bc=broccoli, RL= red lettuce, GL= green lettuce, Cc=cucumber, and Pp=peppers.

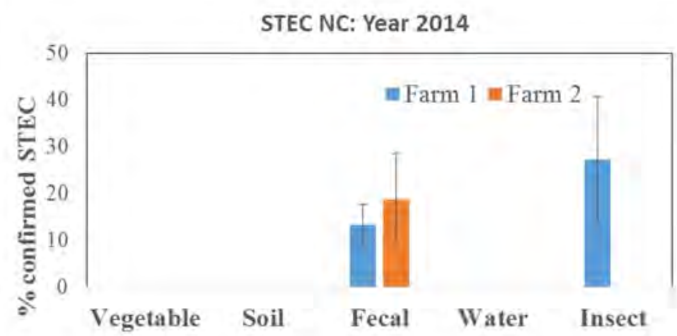


Figure 3. STEC Prevalence (NC Farm 1-2; 2014)

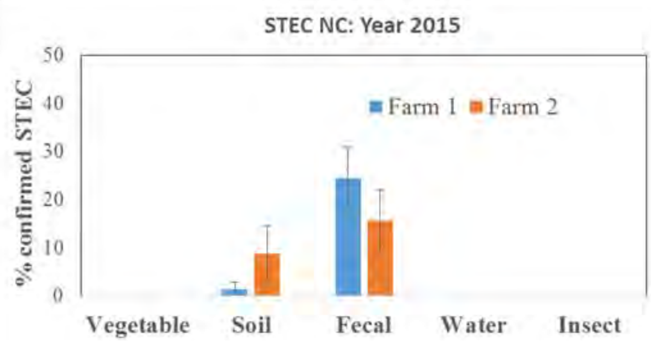


Figure 4. STEC Prevalence (NC Farm 1-2; 2015)

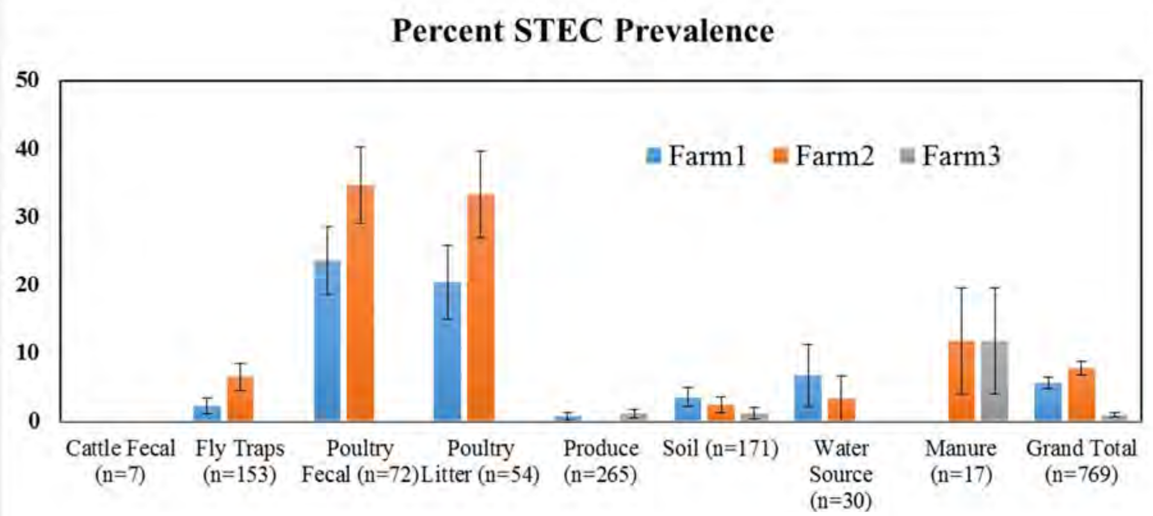


Figure 5. Percentage of STEC Prevalence (Tennessee Farm 1-3)

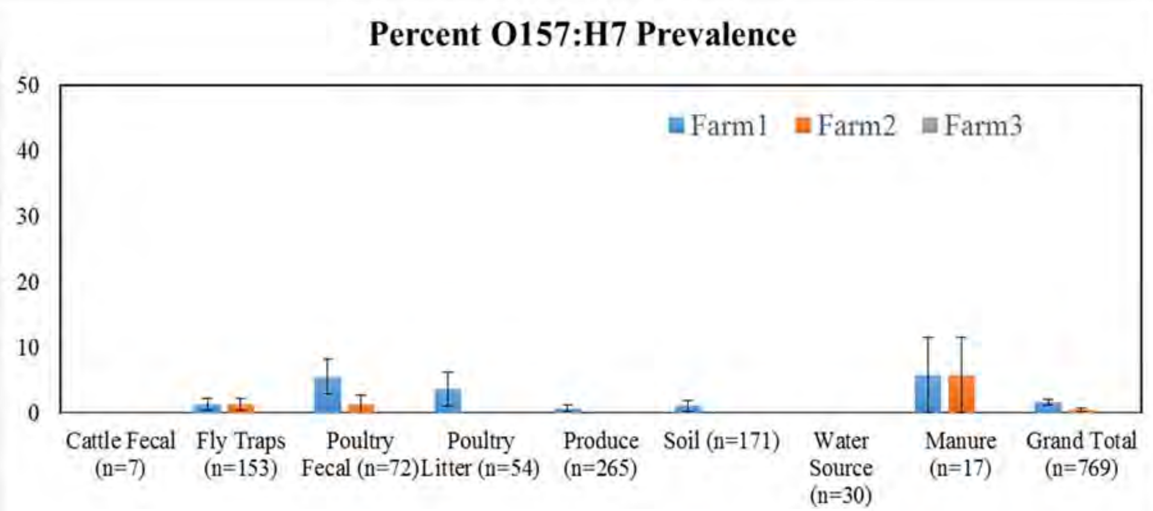


Figure 6. Percentage of *E. coli* O157:H7 Prevalence Tennessee

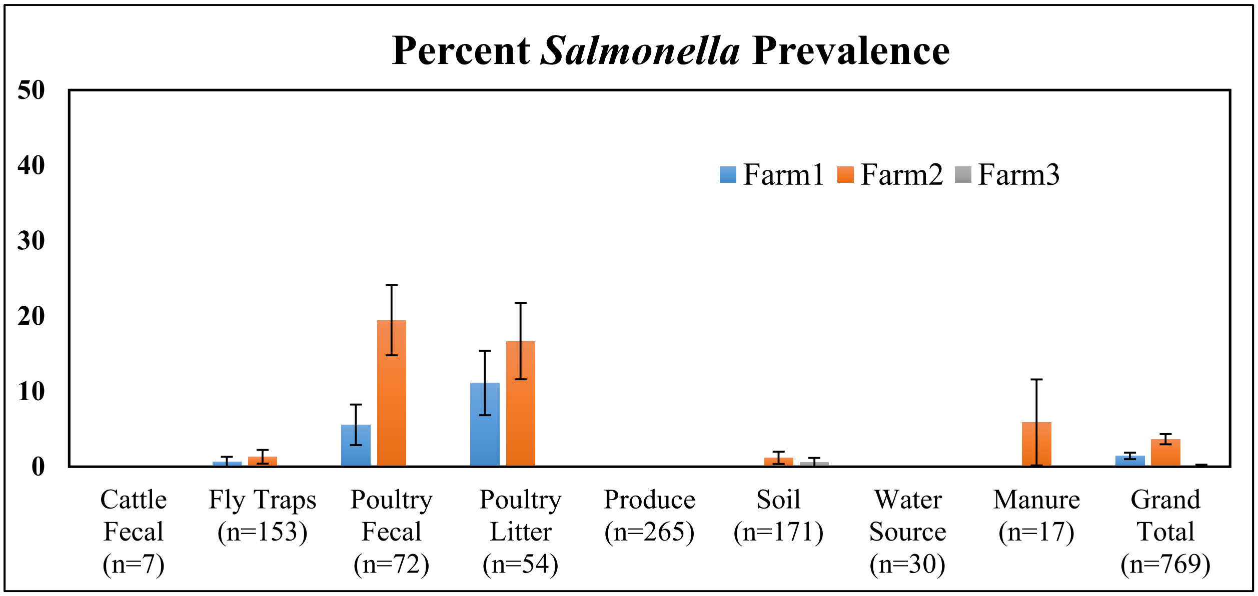


Figure 7. Percentage of *Salmonella* prevalence on Tennessee Farm 1-3

A key figure from this project is included below:

Map of predicted risk for *L. monocytogenes* prevalence for the Homer C. Thompson Vegetable Research Farm at Cornell University; the expected prevalence of *L. monocytogenes* is listed in parentheses in the legend.
Note this map is not based on any of the farms included in this study for confidentiality reasons.

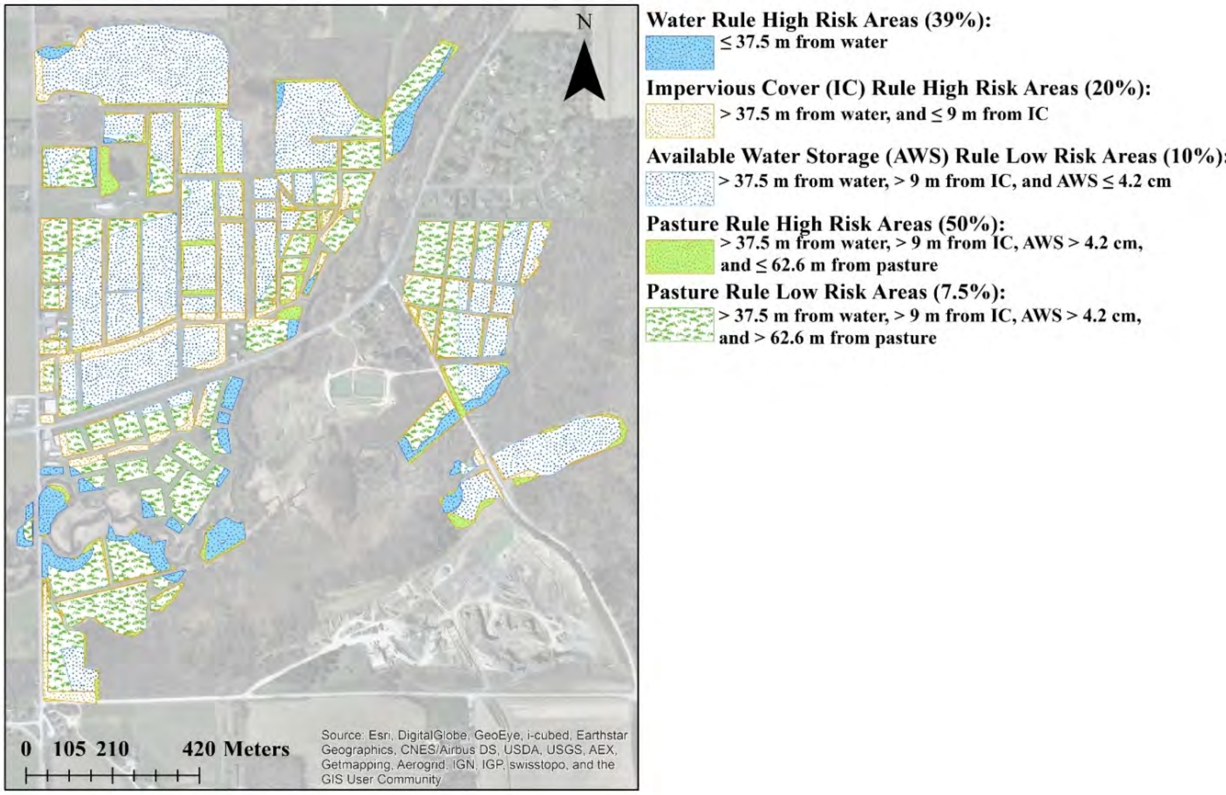


Figure 1. AgWater App example sections.