Commercialization as Conservation: Developing a Crop Production Guide for At-Risk *Salvia apiana*

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Project title Commercialization as Conservation: Developing a Crop Production Guide for At-Risk *Salvia apiana*

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Work location University of Minnesota Plant Growth Facility, 1552 Gortner Ave, St Paul, MN 55108

Project category information Crop production and Ornamentals and Turf

Start date September 2021
End date September 2022

Total NCR SARE Request $10,952

Project Description Through determining best practices for germinating and growing this new crop, *Salvia apiana,* this project will aid in ecological and cultural conservation efforts by bringing a highly sought after wild-harvested plant to market. This will additionally benefit farmers by introducing a low maintenance perennial specialty crop with the potential to command premium prices.

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Project Summary

Commercialization as Conservation: Developing a Crop Production Guide for At-Risk *Salvia apiana*

This project's aim is to understand the germination and growth requirements of *Salvia apiana* to assess the feasibility of commercial production for the "wellness" and medicinal/spiritual herb markets. *Salvia apiana* is a woody perennial shrub native to Southern California and northern Baja, California, with a long history of culinary, spiritual, and medicinal use by local indigenous peoples. It is also of interest to pharmaceutical researchers for its volatile compounds, which display antibiotic, antifungal, and cytotoxic properties. Wild populations of *S. apiana* are becoming increasingly fragmented in the wake of a boom in mainstream interest in its medicinal and spiritual benefits. The current supply chain is unregulated and there is some evidence that retailers may be purchasing plant material

that has been illegally harvested on public and private lands. This not only threatens the conservation of one of California's cornerstone endemic species, it affects the ability of local Native American tribes to collect an herb that is vital to their cultural practices. Through research at The University of Minnesota's St. Paul Plant Growth Facility, this project will determine the germination requirements of *S. apiana* in plug production, assess the efficacy of growing *S. apiana* in a protected environment, and establish guidelines for future production on a commercial scale. This will directly benefit growers by introducing a low maintenance specialty crop experiencing pent up demand by consumers, as well as aid in conservation efforts and help protect an important indigenous cultural resource.

Outcomes

Background
This research project has the goal of better understanding the germination requirements and commercial production conditions and potential for *Salvia apiana*, or white sage. These outcomes would benefit stakeholders including growers, Native American Californians whose spiritual practices require the maintenance of wild white sage populations, and retailers and customers seeking ethically sourced plant material.
Inputs and Activities
Supply inputs required for this project include seeds, soil media, labels, markers, as well as greenhouse space within the University of Minnesota's Plant Growth Facility on the St. Paul campus and the labor of the graduate student, Kate Fessler. Activities include research to determine the optimum germination requirements of white sage seeds and developing viable production methods for use by commercial growers.
Outputs

The research outcomes of this project will include a better understanding of the germination requirements of *S. apiana*, as well as a crop production guide for its preferred growing conditions. It will also include outreach to industry professionals (including researchers, plant breeders, growers' associations, professors at other land grant institutions, etc.) to disseminate results.		
Outcomes		
Economic Benefits	Scientific Benefits	Social Benefits
This project is beneficial to: growers looking to grow new specialty crops with low maintenance requirements; retailers who wish to sell ethically sourced white sage; and customers who are currently unaware of the issues associated with the purchasing of wildharvested white sage.	This project will provide a more reliable source of *S. apiana* plant material for study by breeders, growers, and the food and pharmaceutical industries. It will contribute to the knowledge surrounding growth requirements and usage of *S. apiana* for these industries.	This project's outcomes will work to ameliorate the negative impacts on Native American tribes whose local sources of wild-harvested *S. apiana* are diminishing, by finding feasible means of commercial production (thereby removing the incentive of non-tribal entities to poach wild sage from public and private land).

Figure 1. This summary table illustrates the progression of the proposed research project from the motivation for its initiation, through the inputs and activities required during the research process, and finally to its main anticipated outputs and the beneficial outcomes that will consequently arise.

Proposal Background

This grant proposal aims to increase understanding of white sage, *Salvia apiana*, a culturally important native plant of Southern California, to further domestication efforts to improve commercial crop production. Increased demand for white sage plant material has depleted its wild populations, creating a need for farmed *S. apiana* plants. The following sections of the proposal provide information about the taxonomic classification of *S. apiana*, its geographical distribution and preferred climatic conditions, crop species history, and its medicinal, ornamental, and spiritual uses.

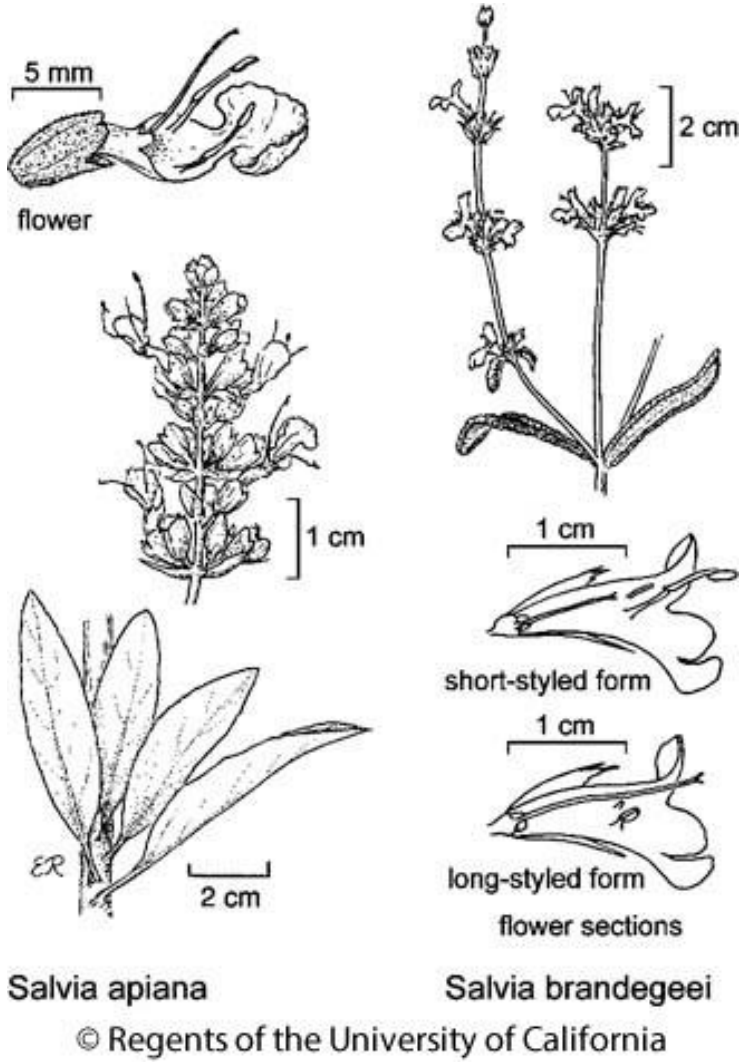

Figure 2. A biological illustration of the species of interest in this project, *Salvia apiana* (The Jepson Herbarium, 2021).

Taxonomic Classification

Salvia apiana Jepson (Figure 3) is an evergreen perennial shrub and cornerstone species of the coastal scrublands of southern California and northern Baja, California. Otherwise known as white sage, bee sage, or sacred sage, it is a member of the Lamiaceae (the mint family). This family is diversely distributed across a variety of ecosystems. Its 236 genera and ~ 6000 species are characterized by square stems, opposite leaves, and zygomorphic flowers with united petals and sepals (CarovićStanko et al., 2016). *Salvia* is the largest genera (nearly 1000 species), well known for their ornamental/culinary value and for producing many biologically active compounds. These include fatty acids, flavonoid compounds, and essential oils, some of which have antibacterial, antioxidant, and cytotoxic properties (Nikolova and Aneva, 2017). The name *Salvia* comes from the Latin *salve*r ("to heal") and *Salvia* species have long been used in medicine (University of California, 2020).

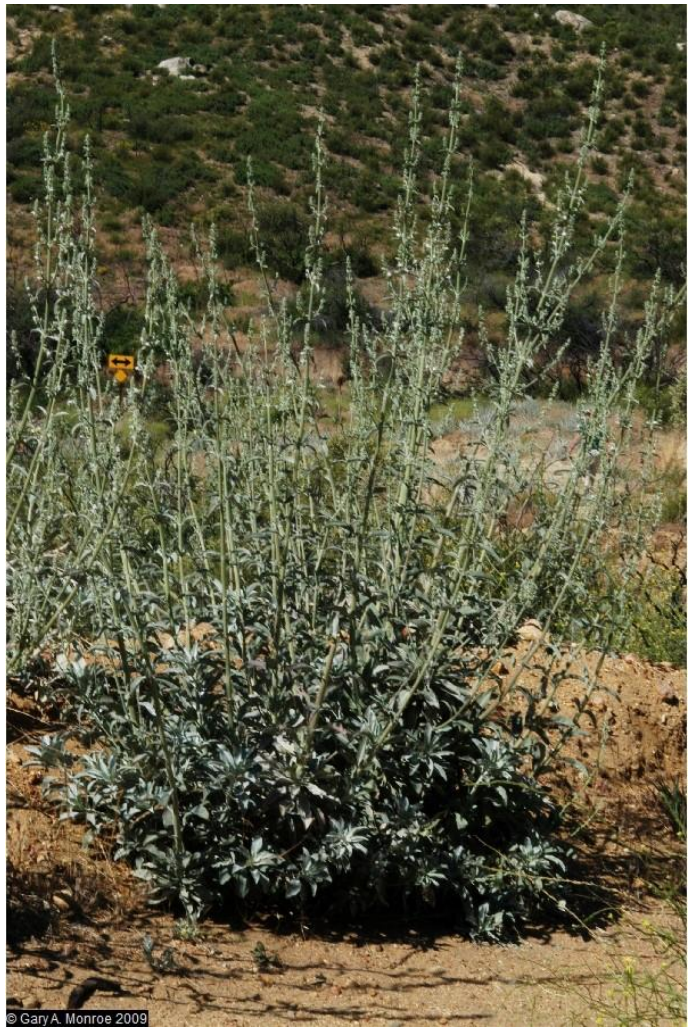

Figure 3. A mature white sage growing on a hillside in the San Jacinta Mountains, Riverside Co., CA (Monroe, 2009).

White sage grows to about a meter in height. Leaves are lanceolate with dense oily hairs and a characteristic aroma. Juveniles are green and become a smooth white as they mature. Figure 4 depicts a mature white sage plant growing at the Strybing Arboretum in San Francisco, California. Var. apiana is most commonly found in California, but one other type, var. compacta, exists and is characterized by its more compact growth habit (California Native Plant Society, 2014).

Figure 4. *Salvia apiana* at the Strybing Arboretum, Golden Gate Park, San Francisco, CA (© J.S. Peterson 2021).

Geographic Distribution and Native Habitat

One hundred species of *Salvia* are found in the U.S., with 89 growing wild in California. *Salvia apiana* is native to southern California and northern Baja, California (Figure 5), and is desirable to gardeners for attracting local pollinators. These pollinators are primarily bees, including the carpenter bees *Xylocopa varipuncta* and *Xylocopa tabaniformis*, the bumble bee, *Bombus vosnesenskii*, and the honeybee, *Apis mellifera* (Ott et al., 2016). *S. apiana* requires well-draining soils, full sun, and is intolerant of overwatering. Therefore, it is commonly found on dry slopes at elevations lower than 1500 meters. Its primary communities are coastal sage-shrublands, chaparral, and yellow pine forests (Stevens and O'Brien, 2003). It appears to grow between the approximate latitudes of 35.78° N and 30.96840° N (Engle Averett, 2012).

Figure 5. Map of the native distribution of *Salvia apiana* in southern California (Calflora, 2021).

Salvia apiana can be propagated vegetatively via cuttings, although seed is preferred. Seeds germinate in 14-21 days at 20 to 30° C (68 to 86° F) (Stevens and O'Brien, 2003).

Tendency to Naturalize or Become Invasive

There is no evidence that white sage is an invasive or introduced species outside of its native range. It is available at local nurseries in southern California as a low-maintenance ornamental shrub (Stevens and O'Brien, 2003).

Crop Species History and Potential Uses

While it is not endangered, over-harvest of white sage is concerning for ecologists and Native American communities, who use the plant for diverse applications. The seeds of *Salvia apiana* (Figure 6) are an ingredient in pinole, a staple dish of the Cahuilla tribe, who also use the roots in a tea for women to drink after giving birth. Leaves are steeped by the Diegueño people for treating the common cold. The Cahuilla, Costanoan, Diegeño, Kawaiisu, and Maidu tribes use the plant for additional medicinal uses: seeds can heal the eyes; crushed leaves can be used as a shampoo or deodorant; and leaves and stems are burned for ceremonial purifications. This species is additionally important to wildlife such as deer, elk, antelope, rabbits, or mountain sheep, and the flowers attract pollinators. The seeds are eaten by smaller mammals and birds such as quail and sparrows (Stevens and O'Brien, 2003).

Figure 6. The seeds of white sage, *Salvia apiana*, which are a culinary, medicinal, and spiritual staple for many Native American tribes (Hurst).

There is no evidence that domestication or breeding of white sage has ever occurred. The plants sold in California nurseries are the wild types of var. apiana or var. compacta. The scientific literature trends almost exclusively toward identifying medicinal properties of white sage's phenolic compounds. Decoctions of *S. apiana* suppress inflammatory responses, exhibit cytotoxicity in certain cancer lines, and are lethal against several gram-positive and gram-negative bacteria. It is therefore a promising species for pharmaceutical uses (Afonso et al., 2019; Cordova-Guerrero et al., 2016).

While these studies have interesting ramifications for human health, they do not address underlying issues of how white sage is sourced. White sage's cultural and religious importance to Indigenous Californians make it a protected plant under the American Indian Religious Freedom Act (AIRFA 1996). However, with the recent "wellness" boom, a vast unregulated market has developed for the purpose of "smudging", a traditional Indigenous purification practice that has become mainstream. This contributes to the fragmentation of the population, which once grew at high densities across southwest California (Adlof, 2015, Davis et al., 1994). One study found that only four of fifteen retailers disclosed where their white sage was sourced, and many police departments report an increase in activity and arrests associated with illegal harvesting of white sage from public and private lands (Adlof, 2015, McMahon and Johnson, 2017). For this plant to persist in the wild, domestication efforts must increase so that growers can produce sustainably sourced white sage for consumers.

Impact on sustainable agriculture in the North Central Region

The concept of sustainability is frequently conceptualized through assessing the four perspectives (or "pillars") of its impact on the human, social, economic, and environmental spheres. The legacy of this project will have a large impact on sustainable agriculture in

the North Central Region by targeting not just one, but all four of these pillars of sustainability. Beginning in an environmental context, this project will create a new source of white sage plant material for retailers and consumers to purchase from, driving down demand for illegally sourced material. As demand for illegally sourced white sage drops, there is every reason to believe that native white sage populations will be able to rebound. Economically, by introducing this low maintenance and high value crop to growers, they will be able to market directly to the highly lucrative "wellness" industry, where consumers are likely to respond positively to ethically sourced plant material. This will provide social and human benefit, as it will not only allow these wellness-focused consumers to purchase a superior product but will remove recent barriers that indigenous communities in California are facing in their effort to exercise their federally recognized rights to manage their own cultural and spiritual resources.

Inputs

The inputs required for this project include financial, supply, locational, and personnel resources. These include the labor of the primary researcher, Kate Fessler, who is a graduate student in the Department of Horticulture, pursuing her Master's degree within the Applied Plant Sciences program at the University of Minnesota Twin Cities. Her research advisor will be Dr. Neil Anderson, also of the Department of Horticulture, University of Minnesota Twin Cities.

Input Type	Resource
Financial	Provided by NC-SARE, see: Budget section
Supply	*S. apiana* seeds, soil media, labels, markers, plug trays and pots, fertilizer, paper and ink materials for education outreach purposes
Location	Greenhouse space within the University of Minnesota's Plant Growth Facility on the St. Paul campus
Personnel	Primary researcher: Kate Fessler, B.A. in Biological Sciences and Sustainable Food, pursuing M.S. degree in Applied Plant Sciences, Department of Horticulture, University of Minnesota Twin Cities Research advisor: Dr. Neil Anderson, B.S in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture

Figure 7. A summary of the financial, supply, locational, and personnel inputs and their resources required to carry out the proposed research into determining germination requirements for the new crop, *S. apiana*.

Together they will develop the design of the experiments, which will take place at the Plant Growth Facility on the St. Paul campus of the University of Minnesota (see Figure 7.)

Experimental Design

This study's aim is to determine the ideal germination and growing conditions for white sage (*S. apiana*) in order to provide recommendations for farmers cultivating white sage for commercial markets. The ideal output for these experiments will be production guidelines for plug culture including preferred level of drainage, germination temperature, and sowing depth. This study will use two different germination mixes (with and without perlite), three different germination temperatures (20C, 25C, and 30C), and three different sowing depths (⅛ inch, ¼ inch, and ½ inch) in factorial combination to yield 18 treatments (see Figure 8.) Each treatment will consist of one 32-cell tray with seeds singulated in each cell, for a total count of 576 seeds. All plug trays will spend one day in the mist house before being moved to separate growth chambers (set photoperiods of 12 h) for their respective temperature treatments.

Treatment Schematic		
Media Mix	Temperature	Sowing Depth
Germination mix with perlite	20C	1/8 in
		1/4 in
		1/2 in
	25C	1/8 in
		1/4 in
		1/2 in
	30C	1/8 in
		1/4 in
		1/2 in
Germination mix without perlite	20C	1/8 in
		1/4 in
		1/2 in
	25C	1/8 in
		1/4 in
		1/2 in
	30C	1/8 in
		1/4 in
		1/2 in

Figure 8. Schematic of all 18 proposed germination treatments for seeds of *S. apiana*. Each treatment will consist of 32 seeds in a 32-cell plug tray. All trays will spend one day in the mist house before being transferred into three separate temperature-controlled growth chambers, for a total of 6 plug trays in each chamber.

The four stages of seed germination that will be recorded are: germination (radicle penetrating soil); cotyledon emergence (embryonic leaf expansion); first true leaves; ready for transplant (when cotyledons drop). Seedlings will be fertilized with 125 ppm N CLF 15-5-15 Cal-Mag (CLF) beginning at third stage (first true leaves).

Data will be collected on each day via a simple random sample of 10 plants per treatment, and will consist of the following:

- Stage 1: Days to germination, days to radicle penetration, percent germination
- Stage 2: Days to cotyledon emergence, days to cotyledon expansion
- Stage 3: Days to first true leaves
- Stage 4: Days to cotyledon drop, size of seedlings at transplant stage

At Stage 4, seedlings will be removed from growth chambers and transplanted into 4 inch pots. To maintain drainage level, plants previously germinated with perlite will be transplanted into growing medium with perlite; likewise, plants germinated without perlite will be transplanted into growing medium without perlite. Pots will be set on benches (see Figure 9.) and will be allowed to dry out between watering/fertilization events. After transplanting, simple random samples will be collected at monthly intervals to determine plant height, number of leaves, and an overall assessment of plant health will be conducted within each treatment.

Location	Day/night temps	Lights	Fertilizer
Production House 369 C-7	21°C/21°C (Zero DIF)	16 hrs. (0600-2200 HR) at 500 umol m-2s-1	125 ppm N CLF 15-5-15 Cal-Mag (CLF)

Figure 9. Summary of environmental conditions in anticipated production house post-transplant.

Rationale: As the native range of *S. apiana* is the relatively arid coastal scrubland of southern California, there is very little rainfall in this plant's usual habitat. Seeds will therefore receive an initial soaking in the mist house but are not likely to benefit from sustained

watering. Standard or increased drainage was selected as previous literature available from Stevens and O'Brien (2003) suggests white sage seeds prefer soil that is well-draining, but this has not been studied in a controlled growing setting. Germination temperatures ranging from 20 to 30 C will be studied as *S. apiana* bloom and fruit from April through August, when temperatures in southern California can average between 21 and 26 C during the day (GIS Geography, 2020). Finally, sowing depth will be examined, as white sage seeds may respond differently to varying light levels (Stevens and O'Brien, 2003). Plants will be moved into the long day production house post-transplant as this house is maintained at 21 C, a realistic temperature these plants would experience during the growing season in their native range.

Social engagement: At the outset of this project, the primary researcher will contact Native American tribal communities who have previously participated in *S. apiana* research conducted at California State University Northridge. If members of these communities are similarly interested in collaborating with this research project, the primary researcher will schedule informal knowledge-sharing sessions. The purpose of these sessions is primarily to understand ways in which to maximize the positive impact of this project and its outputs on the experience of Native American tribes whose cultural practices rely on wild-harvested *S. apiana* plant material. In addition, the feedback of Native American community members will be used to shape the research process in accordance with treating this sacred material respectfully. Members of the community who wish to participate will receive bi-monthly progress reports and advance copies of all outreach materials.

Outputs and Outreach

The outputs from this research project will consist of a multi-pronged publicity campaign that will seek to improve the scientific, economic, and social awareness of the negative impacts of sourcing white sage plant material in the wild. This process will aim to simultaneously offer solutions and next steps to these pressing issues. The outputs will include:

- Submission of a manuscript to a peer-reviewed journal
- Publication of growing guidelines for *S. apiana*
- Development of an extension webinar to disseminate findings to growers
- Creation of educational materials to inform the industry of best practices for sourcing *S. apiana* materials

All of the aforementioned materials will be distributed to Native American community collaborators prior to their publication and subsequently edited according to any feedback that these collaborators are willing to provide. The express goal of these materials is to positively impact the local ecological processes of white sage's southern California habitat as well as the cultural well-being of the Indigenous communities who utilize these plants for their sacred cultural practices.

At the conclusion of this project, all results will be collected and synthesized into a paper for submission to a peer-reviewed journal (journal selection forthcoming). If possible, the primary researcher, Kate Fessler, will also present a talk at the accompanying conference. This will provide the scientific community with the opportunity to learn about the outcomes of this study and potentially engage future researchers in the process of domesticating this novel crop. Growing guidelines will also be compiled and published on the University of Minnesota Extension website, and will be publicized via industry publications, newsletters, and email listservs. An extension webinar

presentation will be developed to disseminate these findings to growers who may be interested in adopting the cultivation of this promising new crop.

As the wellness industry is currently relatively unregulated, it will be important to create further educational materials that help spread scientifically reliable information about the issues surrounding current methods of sourcing white sage. Crucially relevant to this educational effort is the fact that on one social media platform alone, Instagram, there are over 144, 000 posts hash-tagged with the phrase #whitesage, and over 270,000 posts hash-tagged with the word #smudging (referring to the practice of using white sage smoke to ceremonially purify spaces). This is indicative of the high level of public interest and usage of this plant material. Therefore, increased public awareness coupled with the provision of these educational materials to industry professionals and retailers, will hopefully bring pressure to slow the sale of illegally sourced white sage to consumers, and help bridge the gap between new *S. apiana* growers and the public.

Project evaluation

In order to assess the efficacy of this project, we will look at several important indicators of increased knowledge about how to propagate *S.*apiana, as well as increased awareness of the issues surrounding the sustainable sourcing of *S. apiana* plant materials.

Short term impacts: This project will be evaluated based on whether it met the short-term goal of generating meaningful and useful information that increases our understanding of the germination and growth requirements of white sage plants. Short term impacts that

will also be evaluated include increased knowledge among: farmers, regarding the growing of *S. apiana* as a novel crop for the wellness market; retailers, regarding the source of the white sage plant material they sell; researchers, regarding the propagation requirements of *S. apiana*; and consumers, regarding the ecological ramifications of purchasing illegally harvested white sage.

Long term impacts: This project will be considered successful if, in the long run, there is an increased level of ecologically responsible white sage plant material being grown and distributed across the United States. This could be measured via: a survey of online purveyors of *S. apiana*; a survey of social media posts citing the sources of their "smudging" materials; assessing southern California police reports for relative frequency of reports concerning illegal white sage harvesting; and through assessments of white sage abundance in its native habitat. These impacts will also be assessed through conversations with our Indigenous community collaborators who are best positioned to share whether the impacts of this project met the goal of positively impacting how they exercise their federally protected right to harvest white sage plant material for cultural spiritual uses.

Experience and roles

Primary researcher: Kate Fessler, B.A. in Biological Sciences and Sustainable Food, pursuing M.S. degree in Applied Plant Sciences, Department of Horticulture, University of Minnesota Twin Cities

Research advisor: Dr. Neil Anderson, B.S in Ornamental Horticulture, M.S. in Horticulture, Ph.D. in Horticulture A curriculum vitae for Kate Fessler, the primary research, is included below.

Education:

Anticipated: University of Minnesota, Twin Cities, MN
Department of Horticulture

Master of Science in Applied Plant Sciences | GPA 4.00 May 2018:

Smith College, Northampton, MA

Bachelor of Arts Biological Sciences

Sustainable Foods Concentration | GPA 3.94

Awards & Fellowship:

Franc Pomeroy Daniels and Marion Brimhall Daniels Fellowship in Horticulture | 2021

Honeycrisp Professional Travel Fellowship Recipient | 2021

Fulbright Finland EDUFI Fellowship recipient | 2018-2019

Dean's List | Academic honors for top 15% of class | 2014-2018

Experiential Learning program with The Andean Alliance for Sustainable Development | 2017

BOLD Women's Leadership Network Scholarship Recipient | 2016-2017

Susan Cohen '62 and Paula Deitz '59 Prize in Landscape Studies for Excellence in a thesis, paper or project that examines the science, design or culture of the built environment | 2016

Work Experience:

Anna Scripps Whitcomb Conservatory | Assistant Floriculturist | 2019-2020

University of Eastern Finland | Research Fellow | 2018-2019

Smith College | Summer Undergraduate Research Fellow | Summer 2018

Genomes and Genetic Analysis Tutor | Spring 2018

Smith College Residence Life Student Staff | Head Resident | 2016-2018

Jampa Ling Tibetan Buddhist Center | Farm Intern | Summer 2017

Michigan Urban Farming Initiative | Sustainability Intern | Summer 2016 Belize

Public Health | Pamphlet Illustrator | 2015-2016

Research Experience:

Graduate Assistantship | Assessing the Efficacy of a Tabletop Strawberry Production System for Minnesota | University of Minnesota Twin Cities, Department of Horticulture, Research Advisors: Emily Hoover and Neil Anderson | 2020-present

Fulbright Fellowship: Using Genomics of Saimaa Seal Parasites to Aid Species Conservation | University of Eastern Finland, Department of Environmental and Biological Sciences, Research Affiliate: Tommi Nyman | 2018-2019

Marine Mammal Nematode Genetics | Smith College, Department of Biological Sciences, Research Advisors: Robert Dorit and Steven Williams | 2015-2018

Publications:

Williams, Kalani, **Fessler, M. K.**, Bloomfield, R. A., Sandke, Will, Malekshahi, Clara, Keroack, Caroline, Duignan, Pádraig, Torquato, Samantha, Williams, Steven A. "*A novel quantitative real-time PCR diagnostic assay for fecal and nasal swab detection of an otariid lungworm, Parafilaroides decorus*", International Journal for Parasitology, 2020.

Keroack, Caroline, Williams, K. M. **Fessler, M. K.** DeAngelis, Kaela E. Tsekitsidou, Eirini, Tozloski, Jillian M. Williams, Steven A. "*A Novel Quantitative Real-Time PCR Diagnostic Assay for Seal Heartworm (Acanthocheilonema spirocauda) Reveals the First Reported Infection in the Grey Seal (Halichoerus grypus)*", International Journal for Parasitology, 2018.

Presentations:

Fessler, K. Hoover, E. Anderson, N. "*Assessing the Efficacy of a Tabletop Strawberry Production System for Minnesota."* April 2020. Applied Plant Sciences Seminar, St. Paul, MN

Fessler, K. Hoover, E. Anderson, N. *"Lessons Learned Setting up a Tabletop Strawberry Growing System."* January 2020. Minnesota Fruit and Vegetable Growers Convention, St. Paul, MN

Fessler, K. Williams, K. Williams, S.A. "*Development of a Species-Specific Quantitative PCR Diagnostic Assay for the Sea Lion Lungworm (Parafilaroides decorus)*" July 2018. 93rd Annual Meeting of the American Society of Parasitologists, Cancun, Mexico

Fessler, K. Gallay, M. Williams, K. Williams, S.A. Katz, L. "*California Sea Lion Lungworm (Parafilaroides decorus) Species-Specific Quantitative PCR Assay Design*" January 2018. Pioneer Valley Microbiology Symposium, Amherst MA Posters presented at several other regional and national meetings.

Relevant Coursework:

Applied Experimental Design | Statistics for Agriculture and Natural Resource Professionals | Introduction to Landscape Studies | Economic Botany: Plants and Human Affairs | Common Medicinal Plants: Growing and Processing | Scheduling Crops for Protected Environments | Horticultural Marketing | Horticulture: Botany for Gardeners | Horticulture: Botany for Gardeners Laboratory

Programming and Software Skills:

SeaView | NCBI BLAST | Muscle | FinchTV and 4Peaks | Galaxy / RepeatExplorer | Adobe Photoshop | Adobe Illustrator | Microsoft Office | R/Rstudio

Professional Memberships:

Sigma Xi Scientific Research Honor Society Associate Member

Committees, Teaching, & Service:

Teaching Assistant | HORT 4110: Spring Flowering Bulbs | Professor: Dr. Neil Anderson | Spring 2021

Volunteer Monitor | University of Minnesota Extension's Annual Ecology Science Fair | Contact: Lisa Curtis (curtisl@umn.edu) | Winter 2021

Matching Committee Co-Chair | CFANS Alumni Mentorship Program | Contact: Abby Little (chapm166@umn.edu) | Fall 2020

Certified Peer Social Justice Mediator (Social Justice Mediation Institute) | 2016

Budget

The budgetary costs outlined below are based on the estimated cost associated with personnel salaries, materials and supplies, travel for the primary researcher, and the direct costs associated with renting space in the University of Minnesota's Plant Growth Facility. The total costs associated with this project can be seen in Figure 10.

Salary: The primary researcher on this grant, Kate Fessler, will work for a stipend of $700.00 per month for a 12-month period. As the primary researcher, she will engage in all activities required to carry out this experiment, including sowing seeds, monitoring germination and plant growth, watering, and recording measurements and notes.

Total cost: $8400.00

Materials and Supplies: The list of materials and supplies are itemized below.

- *Salvia apiana* seeds
- Soil media including germination mix and potting soil
- Plant labels
- Permanent markers
- 32-cell plug trays
- Four-inch transplant pots
- Fertilizer
- Paper and ink for education outreach materials
- Other miscellaneous supplies such as yellow sticky cards, etc.

Total estimated cost: $500.00

Direct costs: In order to carry out this project, space must be rented at the Plant Growth Facility on campus. For this project, the following costs have been calculated:

- Eight ft^2 growth chambers (x3): $1.50/day for approx. 182 days = $273.00 per chamber = $819.00
- One 75 ft^2 bench: $0.025 ft^2/day = $1.88/day for approx. 183 days = $344.04

Total cost: $1164.00

Travel: The cost for a student parking pass on the University of Minnesota campus is $74.00/month. For a 12-month period this cost is $888.00.

Total cost: $888.00

Total Budget Requests	
Category	Total Cost
Salary	$8400.00
Materials and supplies	$500.00
Direct Costs	$1164.00
Travel	$888.00
Grand total:	**$10,952.00**

Figure 10. Total budgetary requests, by category of expenditure. Total costs are estimated at $10,952.

References

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