Chronica Horticulturae

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Chronica Horticulturae

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Pubhort is a service of ISHS as part of its mission to promote and to encourage research in all branches of horticulture, and to efficiently transfer knowledge on a global scale. The PubHort platform aims to provide opportunities not only to ISHS publications but also to other important series of related societies and organizations. The ISHS and its partners welcome their members to use this valuable tool and invite others to share their commitment to our profession. The PubHort eLibrary portal contains over 62,000 downloadable full text scientific articles in pdf format, and includes The Journal of Horticultural Science & Biotechnology, Journal of the American Pomological Society, Journal of the International Society for Mushroom Science, Fruits, Proceedings of the International Plant Propagators' Society, Journal of the Interamerican Society for Tropical Horticulture, Plant Breeding Reviews, Horticultural Reviews, etc.

Additional information can be viewed on the PubHort website **www.pubhort.org**.

Cover photograph: Tomato transplants growing in a greenhouse under LEDs supplementing limiting sunlight. See article p. 6.

A publication of the International Society for Horticultural Science, a society of individuals, organizations, and governmental agencies devoted to horticultural research, education, industry, and human well-being.

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Erratum

In the 'In Memoriam' on Piers Trehane on page 47 of *Chronica Horticulturae* 51(4) it should read: As rapporteur of the Commission for the *sixth* edition of the International Code of Nomenclature for Cultivated Plants, Piers assisted in the creation of a work of reference for many generations of taxonomists to come.

Scientific Publications: Now a Marketing Decision?

Kim E. Hummer, Vice President of ISHS

Kim E. Hummer

In 1978, the *Journal of the American Society of Horticultural Science* added a new disclaimer on each of their published manuscripts. Because we scientists paid for page charges for publication in the Journal, which was then sent through the mail, the US postal regulation (Section C200.3.5.4.4 of the USPS Domestic Mail Manual) required that each article be marked:

> The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement solely* to indicate this fact.

At the time, professors thought that the idea of science being labeled "advertisement," implying "commercial," by the post office or anyone else, was silly. However, they acquiesced. Scientists thought that the commercial implication was amiss. Research should be independently performed, analyzed, written, and published; not be commercialized or sponsored in any way. The idea that a sponsor would pay for research to be done smacked of the dictation of results and conclusions; bias was not to be tolerated. But the footnotes were required by federal regulation, the kind of things scientists obey. They did. The footnote continued for years, and publications and science marched on. In March 2002, after a new interpretation of the US Postal code was obtained from post office officials, the "advertisement" statement was eliminated.

That statement of advertisement may have portended the present day dilemma where sponsorship of science seems to be in vogue with the new general opinion. Public or independent sources of research funds have diminished or disappeared in many parts of the world. Scientists now compete for grants from sponsors who have their own agenda, with direction on what topics to study and what not to study. Successful grants are awarded to those who best meet the sponsor's requirements. Scientists have to walk the fine line of independent thought and findings, while pleasing the funding "masters."

Lately, commercialization and science have taken another interesting twist regarding publication. Our boxes are full of emails from emerging new journals from the four corners of the world. It has become a relatively easy enterprise to start these electronic publications with the advent of the internet. Editors, generally people, not necessarily scientific experts that we know or recognize, are extolling us to write more chapters and books, to join their Editorial Board, or to submit papers. Some standard journals that we have come to know have changed their names; others have increased advertising to compete with the start ups. Each of these outlets is vying for our written intellectual property, requiring that what we submit to them is new and free, and not previously published in another source.

Private publishing houses now are pushing for a lucrative market to produce print and online media in the realm where previously only small scientific societies printed their results aimed at a limited technical audience. These private publishing companies now require that submissions include non-technical public relations summaries and language that speaks to an expanded customer audience. Publication options now abound to researchers and are competing for their market share of science.

In previous issues of *Chronica Horticulturae*, Janick (2008) and Warrington (2009) explained

Table 1. Summary of impact factor statistics for selected sciences in 2010, as provided by JCR®: http://admin-apps.webofknowledge.com/JCR/JCR?PointOfEntry=Home&SID=Z1efKIpnHfb5CFe6Eii, accessed 18 November 2011.

Scientific discipline	Total citations	Median impact factor	Aggregate impact factor	Aggregate immediacy index	Aggregate cited half-life	Journals	Articles
Biochemistry and Molecular Biology	2814701	2.799	4.346	0.857	7.4	286	50169
Biophysics	470368	2.679	3.29	0.69	7.2	73	11865
Genetics and Heredity	867506	2.488	4.674	0.847	6.6	156	17015
Nutrition and Dietetics	270371	2.162	2.942	0.584	6.7	70	8147
Ecology	644868	1.808	2.961	0.608	8.1	130	14642
Energy and Fuels	253610	1.345	2.784	0.507	4.9	79	14432
Biology	346005	1.339	3.146	0.559	6.7	86	15511
Surgery	804840	1.263	2.105	0.339	7.6	188	29589
Plant Sciences	644454	1.102	2.501	0.447	8.3	188	17498
Biodiversity Conservation	90415	1.058	2.434	0.576	6.9	34	2939
Food Science and Technology	375442	0.93	1.823	0.313	7.2	128	17763
Forestry	86906	0.853	1.406	0.276	8	54	3636
Horticulture	68373	0.601	1.221	0.207	8.9	30	3014
Agriculture - Multidisciplinary	115869	0.41	1.35	0.252	7.8	55	5859

Table 2. Selected horticultural and plant science journals and their JCR® impact factor statistics for 2010 as provided by: http://admin-apps.webofknowledge.com/JCR/JCR?PointOfEntry=Home&SID=Z1efKIpnHfb5CFe6Eii, accessed 18 November 2011.

Type	Journal	Total citations	Median impact factor	5-year impact factor	Aggregate immediacy index	Aggregate cited half-life	Articles
Horticulture	Am. J. Enol. Viticult.	4459	1.667	2.568	0.313	> 10	67
	Aust. J. Enol. Viticult.	1056	2.534	3.3336	0.614	6.6	44
	Euphytica	7237	1.597	1.784	0.206	9.3	238
	Eur. J. Hort. Sci.	158	0.489	0.48	0.128	4.2	39
	Fruits*	382	0.348		0.111	> 10	36
	Hortic. Sci.	140	0.533		0	7.6	21
	HortScience	5955	0.886	0.996	0.16	> 10	306
	HortTechnology	1082	0.596	0.793	0.084	7.2	154
	Indian J. Hortic.	258	0.229		0.058	6.9	121
	J. Amer. Pom. Soc.*	116	0.522	0.394	0	6.7	28
	J. Amer. Soc. Hortic. Sci.	4519	0.905	1.206	0.25	> 10	64
	J. Hortic. Sci. Biotech.*	2251	0.546	0.769	0.158	> 10	95
	J. Jpn. Soc. Hortic. Sci.	958	0.677	0.709	0.082	> 10	49
	Mol. Breeding	2536	2.193	2.538	0.522	7.1	115
	New Zeal. J. Crop. Hort.	399	0.247	0.397	0	> 10	26
	Postharvest Biol. Tech.	4821	2.256	2.649	0.373	6.5	126
	Propag. Ornam. Plants	90	0.366	0.48	0	0	34
	Sci.Hortic-Amsterdam	4309	1.045	1.482	0.128	6.8	335
	Seed Sci. Technol.	1178	0.605	0.631	0.049	> 10	82
	Theor. Appl. Genet.	18838	3.264	3.785	0.667	8.9	252
	Tree Genet. Genomes	612	2.416	2.619	0.314	2.6	86
	Vitis	1022	0.662	0.927	0.258	> 10	31
Plant Science	Acta Physiol. Plant.	991	1.344	1.234	0.127	4	142
	Adansonia	196	0.512	0.438	0	> 10	14
	Am. J. Bot.	13713	3.052	3.452	0.376	> 10	237
	Ann. Bot. London	12114	3.388	3.884	0.794	7.8	199
	Ann. Mo. Bot. Gard.	2549	1.8	2.095	0.16	> 10	25
	Ann. Rev. Phytopathol.	4687	10.412	13.438	0.545		25
	Ann. Rev. Plant Biol.	11673	28.415	27.648	4.862	9.9	29
	Appl. Veg. Sci.	868	1.802	2.081	0.348	5.7	46
	Aust. J. Bot.	2531	1.681	1.739	0.194	> 10	72
	J. Nat. Prod.	16840	2.872	2.855	1.02	3.2	102
	J. Syst. Evol.	207	1.295	1.295	0.289	2.3	45
	J. Torrey Bot. Soc.	516	0.633	1.114	0.054	5.7	37
	J. Veg. Sci.	4985	2.357	3.002	0.283	9.2	99
	Planta	13997	3.098	3.451	0.545	9.7	224
	Protoplasma	2472	1.488	1.677	0.34	> 10	106
	Rhodora	338	0.6	0.515	0.062	> 10	16
	Russ. J. Plant Physiol.	727	0.558	0.684	0.08	5.7	112
	S. Afr. J. Bot.	1044	1.106	1.144	0.612	5.8	98
	Seed Sci. Res.	1093	1.25	2.065	0.222	9.3	27
	Sys. Bot.	2168	1.897	1.917	0.284	9	74
	Trends Plant Sci.	11060	10.095	10.736	1.714	6.5	84

* Journals found on www.pubhort.org

that the *Acta Horticulturae*, our flagship publication, is a *proceeding*, i.e., a summary of the presentations that occurred at a meeting. Janick (2008) suggested that we accept that *Acta* will not have an impact factor (IF) and forget the worry. Unfortunately, this discussion continues to rage within our membership and working groups. Many continue to worry about IF.

While the manuscripts submitted to *Acta* are thoroughly reviewed, at a similar rigor to that of journal articles, Thomson Reuters, the private company who manages the (Journal Citation Report JCR®) Web of Knowledge for profit, denied journal status to *Acta Horticulturae* (although our Secretariat negotiated considerably with them over this possibility). *Acta,* they point out, is not published serially with frequent regularity, such as monthly or quarterly, so it is

not a "journal." Thereby, it does not qualify for an IF.

Other serial horticultural journals have an IF. Take care to note that the IF of applied horticultural journals is very low compared with that of other basic sciences (Tables 1 and 2). We horticulturists are quite applied in our disciplines and recognize the value of a long aggregated cited journal half-life. Other sciences appreciate rapid turnover of information. In horticulture, significant results can be cited for decades. The JCR® promotes basic science and its short half-life, while continuing to devalue long term applied research despite highly significant practical value.

In our horticultural discipline, excellence in both applied and fundamental sciences are needed to satisfy our clients. ISHS has the obligation to serve both. We do this through *Acta* and through Pubhort, our scientific associations on www.pubhort.org, the publishing portal for ISHS. A number of journals on Pubhort have IF (Table 2), although *Acta Horticulturae* does not. The ISHS board is discussing how to better serve the need for IF journal publication in the Society.

Despite not having an IF, *Acta* definitely has impact. The latest statistics (February 2012) show more than 153,886 views for the most consulted *Acta* abstract. The top 50 *Acta* each have more than 10,000 views. The most consulted citation for an *Acta* article is 1,116 views. While these views do not constitute Journal Citation Report JCR® counts, they are indicators of the high use of *Acta* articles within the horticultural scientific community, and probably resulted in thousands of citations, uncounted by this system.

As Seglen (1997) pointed out, high IF are not statistically representative of individual articles, and correlate poorly with their actual citations. None the less, many of our members are directed by their supervisors to publish in high IF journals or their promotion will be in peril.

Some individuals in several long-standing ISHS sections have used this situation to plan spin-off working areas and symposia, breaking away from ISHS working groups. Those that choose, as a market decision, to break-off, not sign an ISHS contract, and not publish an *Acta Horticulturae* for a symposium, cannot expect access to the ISHS logo, advertisement on the ISHS calendar, provision of start-up symposium funding, or other ISHS benefits.

Those who choose to breakaway for long term may find that publishing in a high IF journal loses the scientific continuity found in *Acta*. In contrast to other horticultural and plant science journals, the *Acta* series constitute a remarkable, continuing, and very popular repository for specific horticultural topics spanning decades. For example, there are 20 separate volumes on virus and virus-like diseases of temperate fruit crops; 14 on apricot breeding and culture; 12 volumes on virus diseases of ornamental plants; 12 on fireblight; 11 on grape genetics and breeding; 11 on plant growth regulators in fruit production; 11 on pears; 9 on blueberries; 8 on mango; 7 on pineapple, and many more crops or disciplines with multiple issues. With more than 925 *Acta* issues published from 1975 until today, this compendium of horticultural knowledge is unrivaled. In addition, the range of topics is expanding continually, reflecting flexibility as new series are formed, and depth and breadth of horticulture as established *Acta* continue. Additional ISHS benefits that would be missed along with the extremely useful compilation of long term series of information for working groups, would be the snapshot of a complete set of international expertise for that working group; and the nurturing and outreach to young scientists, who have never before published in English.

Of course some symposia within the horticultural umbrella will continue to be outside the purview of ISHS. Also, much of the quality information initially presented at ISHS symposia is worth augmenting, amending, and publishing in an IF journal. That is one way to satisfy a need for applied and basic science: publish in *Acta* and then in an IF journal, maybe even one of the www.pubhort.org IF journals. We encourage all to do so.

The binding force of our society between its members is strong. The true benefit of attending an ISHS conference combines excellent horticultural science with the chance to experience regional cultural activities, to be exposed to broad international diversity, and to develop a base international scientific community of cherished colleagues. The VALUE per cost ratio of an ISHS symposium is great. The market decisions to attend ISHS sponsored symposia, publish YOUR science in *Acta Horticulturae*, and when called upon, to convene an ISHS symposium, are yours. Choose your scientific conference and publication markets wisely. Publish your results with ISHS!

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Postcard

Indigenous plants are becoming a must in our landscape design. However, some landscape designers are so fundamentalist that they see a threat in non-indigenous plants occupying our green spaces. Others are rather concerned with the ecological impact of plant introductions, so common throughout horticulture history, as can be recognized from the ubiquitous presence of exotic species in urban parks and landscape.

Should we be alarmed about non-native plants invading gardens and landscapes in our urban areas?

Introducing and cultivating useful plants is a major contribution of Horticulture to Humankind. I cannot imagine a garden without the beauty of plants from various parts of the world that add to ecosystem biodiversity and contribute to sustainable and diversified green spaces.

Our urban areas require more horticultural input than ever to select plants well fitted to local conditions, requiring minimum care and consuming less water. Fitness should prevail over indigenousness when considering specific plants for our gardens, or otherwise they will not be distinguishable from the wilderness.

António Monteiro, President of ISHS

LEDs: The Future of Greenhouse Lighting!

Cary A. Mitchell, Arend-Jan Both, C. Michael Bourget, John F. Burr, Chieri Kubota, Roberto G. Lopez, Robert C. Morrow and Erik S. Runkle

Supply & Demand in the greenhouse industry dictate that product quality and delivery schedule be maintained at high market standard for intensively cultivated food and ornamental crops. Product supply and market demand determine wholesale prices that growers can expect to receive for their horticultural products. Even as growers achieve economies of scale, there continues to be increasing pressure on operating margins to compete for economic viability. Specialty (horticultural) crops represent an important sector of the economy generating approximately 50% of total crop production in the USA (USDA, 2005). Any advantage that growers can leverage to reduce production costs while maintaining product quality and schedule integrity is worthy of consideration.

ENERGY A MAJOR QUESTION MARK

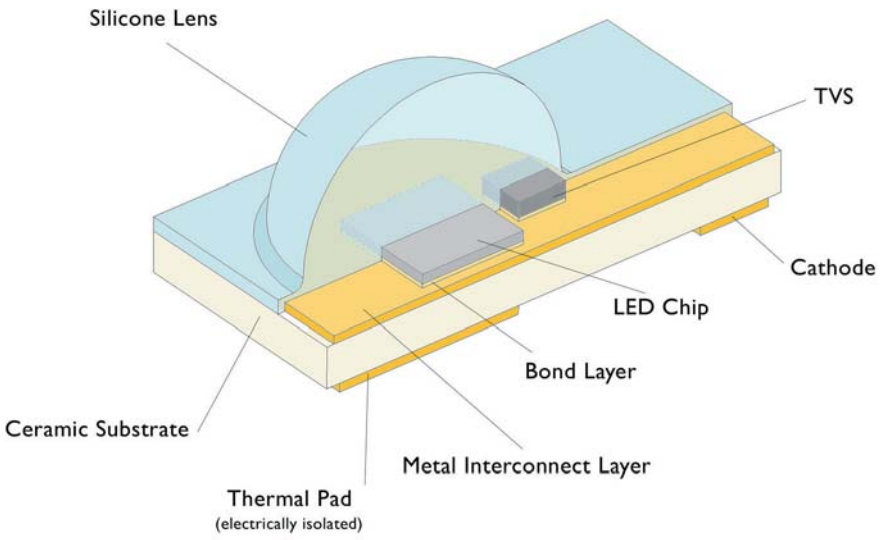
Since energy inputs range from 10 to 30% of total production costs for the greenhouse industry (Brumfield, 2007; Langton et al., 2006), energy is an important candidate for cost reduction. The two major energy inputs for greenhouse operations include temperature control and lighting. The need for both varies considerably with climate and latitude. Crop lighting is an energy-intensive necessity of the greenhouse industry, particularly with increasing latitude in either direction away from the equator resulting in significant swings in seasonal photoperiod. Cost per kilowatt-hour of electricity varies widely depending on local fuel sources for generating electrical power. Most energy used in greenhouse production today is derived from fossil fuels, which are under attack for their negative impacts on the environment. Such concerns may reduce fossil-fuel use in the long term, but drive up energy prices in the short run. Thus, any new lighting technology that significantly reduces consumption of electricity for crop lighting while maintaining or improving crop value is of great interest to growers.

LIGHT-EMITTING DIODES

Light-emitting diodes (LEDs) represent a promising technology for the greenhouse industry that has technical advantages over traditional lighting sources, but are only recently being tested for horticultural applications. LEDs are solid-state light-emitting devices (Fig. 1), and as such, are much more robust and longer-lived than traditional light sources with fragile filaments, electrodes, or gas-filled, pressurized lamp enclosures (Bourget, 2008). LEDs can be designed to emit broad-band (white) light or narrow-spectrum (colored) wavebands specific for desired plant responses (Morrow, 2008). One of the most important features of LEDs for horticultural application is that waste heat is rejected separately from light-emitting surfaces by active heat sinking (Bourget, 2008). This is particularly important for high-intensity LEDs of 1 watt or more. Thus, emitters can be placed close to crop surfaces without risk of overheating and stressing plants (Bourget, 2008). In contrast, high-intensity discharge (HID) lamps require considerable separation between lamps and plants to ensure uniform light distribution as well as to avoid heat stress from lamps. As already is done for HIDs, the waste heat rejected from LEDs can be leveraged for greenhouse heating to offset fuel costs during cold weather. Designs of LED arrays allow waste heat to be placed within the greenhouse when and where desired during cold weather, or vented from the greenhouse during warm weather.

LEDs can be manufactured to emit photon colors that match the absorbance peaks of important plant pigments, such as the red and far-red-absorbing forms of phytochrome, or the red and blue peaks of leaf photosynthetic action spectra. Thus, energy is saved using narrow-band LEDs for specific plant responses by not providing extraneous colors of broad-band

Figure 1. A LUXEON Rebel, surface-mount, high-voltage LED used for lighting applications in horticulture. The main components include a high-brightness LED chip array on a ceramic substrate that provides mechanical support and thermally connects the chip to a heat pad on the substrate, an electrical interconnect layer to a cathode and anode on the bottom of the substrate, a silicone lens shielding the chip, and a transient voltage suppressor (TVS) under the lens to protect the emitter against electrostatic discharge. Permission to use the image courtesy of Philips Lumileds.



light that otherwise would be an inefficient energy burden.

Another, major advantage of LEDs over all other lamp types used for plant lighting is that the technology is evolving in electrical-use efficiency at a rapid pace. For example, blue LEDs that were only 11% efficient a few years ago (Massa et al., 2006) were reported to be 49% efficient converting electrical energy to photon energy last year (Philips data sheet #DS68). LED efficiency, in general, is projected to rise considerably over the coming decade (Haitz and Tsao, 2011). A dynamic requiring almost immediate change is the imminent phasing out of incandescent (INC) lamps (IEA paper, 2010). Although INCs have been used in the greenhouse industry almost exclusively for low-intensity photoperiod control, they are short-lived, are very electrically inefficient, and can cause undesirable stem elongation due to their high far-red (FR) output. LED technology represents a promising replacement. HID lamps traditionally used in greenhouses to supplement solar light for photosynthesis also emit significant amounts of long-wave radiation (Brown et al., 1995) that increase temperature of the foliar canopy without increasing air temperature. LEDs emit no such long-wave radiation. Rather, waste heat is dispersed through the base of the device. Thus, LEDs are well positioned to be phased into service for multiple greenhouse-lighting applications following suitable testing and technology innovations.

HISTORY OF LEDS AND PLANT GROWTH

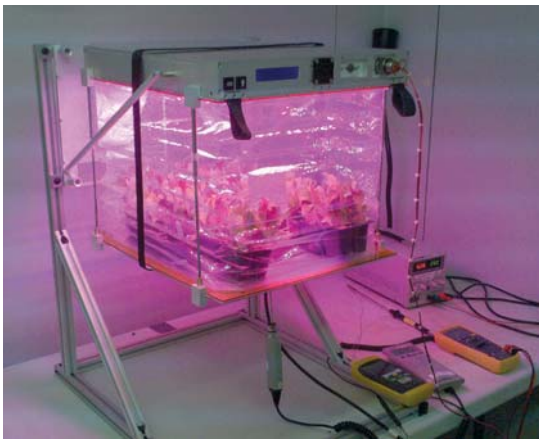
LEDs were first used for sole-source plant lighting more than 20 years ago when lettuce was grown under red (R) LEDs supplemented with blue (B) fluorescent lamps (Bula et al., 1991). Seedlings grown only under R LEDs became elongated, but if as little as 15 $\mu mol.m^{-2}.s^{-1}$ of B was added, plants developed normally (Hoenecke et al., 1992). Diverse species have been grown successfully under LEDs as a sole source of lighting, including wheat, brassica (Barta et al., 1992; Morrow et al., 1995), potato (Croxdale et al., 1997), arabidopsis (Stankovic et al., 2002), and soybean (Zhou, 2005). Photosynthesis in kudzu was similar under equivalent photosynthetic photon flux (PPF) from white xenon lamps or R LEDs (Tennessen et al., 1994), and R LEDs gave higher quantum efficiency for strawberry photosynthesis than did B LEDs (Yanagi et al., 1996). However, R + B LEDs gave higher photosynthetic rates in rice than did R alone (Matsuda et al., 2004). For wheat, 1 to 10% B combined with R LED light was needed for normal tillering, leaf expansion, and seed yield (Goins et al., 1997). Yield of lettuce, spinach, and radish grown under R LEDs alone was less than if 35 $\mu mol.m^{-2}.s^{-1}$ of B radiation was included to give the same final PPF, and yield under R + B LEDs was equivalent to that under fluorescent (Fl) lamps at the same PPF (Yorio et al., 1998). Pepper leaf thickness depended more upon the level of B light than the R : FR ratio (Schuerger et al., 1997). Lettuce grown under R + B LEDs with up to 24% green (G) light developed more biomass and larger leaf area than plants grown under equivalent PPF from Fl or R + B alone (Kim et al., 2004). Even a small amount of G light makes assessment of stress or disease symptoms much easier for the human eye than if plants are grown under R + B only (Massa et al., 2008).

The relative coolness of energized LED surfaces allowed the development of intra-canopy lighting systems for self-shading crop stands in which vertical LED strips extend throughout leaf canopies (Massa et al., 2005a, b). These air-cooled LED "lightsicles" had the desirable effects of reduced electrical input for crop lighting, increased biomass produced per $kW.h^{-1}$ consumed, and eliminated premature senescence and abscission of lower leaves that otherwise occurs in closed crop canopies (Massa et al., 2006). Not all effects of using LEDs for sole-source plant-growth lighting have been positive. Some solanaceous and leguminous species develop abnormal intumescence growth on leaves and shoot tips under narrow-band LED lighting (Massa et al., 2008). Such abnormal growth typically does not occur if broad-band light provided to plants includes ultraviolet (UV) wavelengths (Lang and Tibbitts, 1983). It also is promoted by R light and inhibited by FR, so sole-source LED lighting could be either a problem or a solution (Morrow and Tibbitts, 1988).

NEWLY INITIATED WORK WITH LEDS RELATED TO GREENHOUSE CROP PRODUCTION

Much less is known about effects of LED lighting in a greenhouse setting, where solar radiation provides part or most of the light used for crop production. A multi-institutional group of U.S. researchers working with industrial stakeholders is investigating the feasibility of using LEDs for diverse horticultural lighting applications and evaluating the socio-economic-environmental implications of LEDs entering the greenhouse lighting market. Greenhouse lighting requirements typically fall into three general categories: propagation and transplant production that involve both photosynthetic and photomorphogenic lighting; photoperiodic lighting to induce early or out-of-season flowering; and supplemental lighting to enhance photosynthesis for crop production, especially during light-limited periods of the year. This multi-disciplinary group has been funded by the National Institute of Food and Agriculture Specialty Crop Research Initiative (SCRI) Program for a project entitled *Developing LED Lighting Technology and Practices for Sustainable Specialty-Crop Production.* Institutions involved in the project include the University of Arizona,

Figure 2. ORBITEC's "Veggie" unit designed to light crops growing on the International Space Station with LEDs. The accordion walls of the unit expand as the crop grows in height to keep the LED light bank a constant distance above the crop.



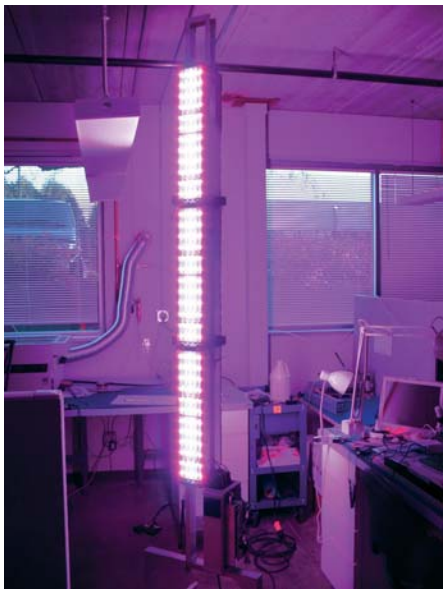
Michigan State University, Purdue University, Rutgers University, and the Orbital Technology Corporation (ORBITEC). The LED project website can be found at http://leds.hrt.msu.edu/.

CUSTOM LED ARRAY DEVELOPMENT

Solid-state lighting devices (LEDs) have electrical, physical, and operational properties not available in existing horticultural lighting that allow new modes of plant lighting to be explored. ORBITEC has been developing custom LED systems for specialty applications such as lighting for space-based plant-growth research (Fig. 2), as well as for ground-based research applications (Emmerich et al., 2004). ORBITEC's role in the SCRI project is to develop and test new designs for LED lighting systems and new techniques for their fabrication that facilitate manufacturability and ease of maintenance, while allowing customization of spectral composition and device configuration. A critical component of this work is to apply fundamental thermal knowledge to improve LED array cooling techniques (critical to device function and operating life) and advanced control systems to improve energy efficiency and crop manipulation capabilities. ORBITEC has fabricated and delivered LED supplemental lighting units to Purdue University for crop-production research. Two lighting configurations have been developed, including distributed horizontal lighting arrays (Fig. 3), and vertical intra-canopy lighting (Fig. 4). These systems allow independent control of R and B LEDs, and the overhead bar systems also are capable of providing FR light. The overhead systems allow maximum passage of solar light between widely spaced bars during the day. Both systems allow exploration of alternative thermal-management systems and

Figure 3. Mike Bourget, ORBITEC's Electrical Engineering Manager, and Purdue Graduate Student Celina Gomez calibrate red : blue ratio and total photon flux on an overhead open-bar LED array that minimizes shading of solar irradiance throughout the day in the greenhouse.

Figure 4. A newly constructed ORBITEC light tower to provide intra-canopy lighting of tall greenhouse crops in two directions within rows. Two-foot-long panels of red and blue LEDs can be switched on or off individually.



wireless control capabilities that make large-scale use of such systems manageable.

ORNAMENTAL PROPAGATION

Most herbaceous ornamentals are propagated from seed (plugs) or cuttings (liners) and are considered to be high quality transplants if they are compact, have a thick stem, high root mass, and flower shortly after transplanting (Lopez and Runkle, 2008; Pramuk and Runkle, 2005). In order to reduce propagation and shipping costs, seedlings are grown in dense plug trays that promote unwanted stem elongation due to the shade-avoidance response (caused by low R : FR). In addition, flowering of ornamental bedding plants is influenced by photoperiod and irradiance (Mattson and Erwin, 2005). In northern regions, propagation typically begins in January or February when ambient light levels are low and day lengths are short (Korczynski et al., 2002). This is problematic in that bedding-plant species have different photoperiodic response groups that flower earlier or only under long days (LD). Graduate student Michael Ortiz is evaluating R and FR LEDs as end-of-day (EOD) light treatments to control stem elongation during the seedling stage for potential to reduce time to flower (TTF) of LD species. A long-term goal is to determine species-specific minimum FR light requirements that avoid stem elongation and potentially reduce TTF.

In northern climates, supplemental lighting is required in winter and early spring to produce high-quality transplants (Lopez and Runkle, 2008; Torres and Lopez, 2011; Oh et al., 2010; Currey et al., 2012). This information will help growers reduce their square meter weeks (SMW) and save on energy costs by reducing overall propagation time. Further savings of space and energy may be realized by shorter finishing times for crops propagated using supplemental light to increase the photosynthetic daily light integral (DLI). The objectives of the research of graduate students Chris Currey and Michael Ortiz are to identify the best R : B ratio to reduce propagation time and produce high-quality, marketable bedding-plant plugs and liners (Fig. 5). We postulate that plants grown under LEDs will be comparable in output quality to those grown under high pressure sodium (HPS) lamps as a source of supplemental light. While there are several beneficial plant responses to B light, the level of supplemental B light required to elicit desired responses in combination with ambient solar light is unknown. There exists potential for narrow-spectrum supplemental lighting to control plant growth and development at the young-plant stage for cuttings and seedlings.

Figure 5. Herbaceous New Guinea Impatiens cuttings being propagated under red + blue supplemental lighting from LEDs. Image was taken after sunset at Purdue University.

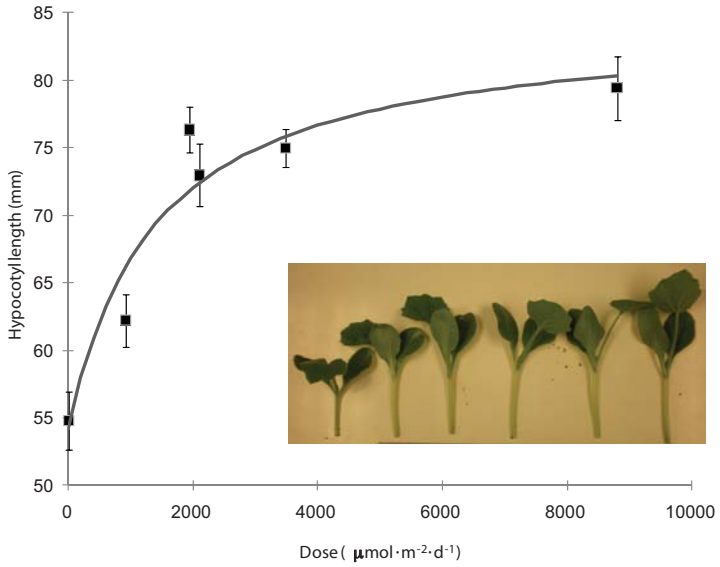
Figure 6. Young tomato seedlings growing under 80% red + 20% blue supplemental lighting (left) or 100% red supplemental lighting (right) with both treatments at the same total photon flux from LEDs. Image was taken after sunset at Purdue University.

Figure 7. Cucumber seedlings growing under red + blue LED lighting after sunset in a greenhouse at the University of Arizona.

VEGETABLE PROPAGATION

Supplemental lighting is needed for greenhouse vegetable propagation during winter when DLI is a major factor limiting transplant production. In sunny Arizona and less-sunny Indiana, growth, development, and morphology of tomato and other vegetable transplants are being compared under different R : B ratios of supplemental LED or HID lighting (Figs. 6 and 7). Electrical energy consumption by the two different supplemental lighting sources also is being compared. A preliminary study conducted by University of Arizona graduate student Ricardo Hernandez suggests that R LED supplementation alone is sufficient for growing tomato seedlings under different DLIs in Arizona. A parallel study conducted at Purdue University by graduate student Celina Gomez propagating various cultivars of tomato at

Figure 8. End-of-day far-red (EOD-FR) light dose-responses of interspecific squash rootstock hypocotyl elongation after ten consecutive days of EOD-FR treatment. Different doses were achieved by combinations of different light intensities and durations (Yang et al., 2012). Seedlings in the inset are aligned in the increasing order of doses from left to right.



different times of year is defining the spectral and DLI requirements for transplant propagation. Some B supplementation may be needed during the most light-limiting times of year in the cloudier northern climate. In Arizona, a potential low-intensity application of LEDs for EOD lighting is being explored to improve the stem morphology of seedlings (Chia and Kubota, 2010; Yang et al., 2012). The dose of FR needed to induce maximum hypocotyl elongation for grafting is saturated at 2-4 mmol.m^{-2}.d^{-1} (Chia and Kubota, 2010; Yang et al., 2012) (Fig. 8). EOD R and FR lighting can be a potential non-chemical means to control plant morphology. EOD lighting with LEDs will allow specific spectral and dose requirements to be defined for FR to extend rootstock hypocotyls for better grafting, as well as to prevent seedlings from becoming too leggy. It also was demonstrated that moving LED fixtures for EOD lighting are as effective as stationary fixtures (Yang et al., 2012).

ORNAMENTAL PHOTOPERIODIC FLOWERING

Flowering of many specialty crops, especially ornamentals, is hastened under a particular photoperiod (Erwin and Warner, 2002; Heins et al., 1997). To induce flowering for predetermined market dates, photoperiod is commonly modified using low-intensity (photoperiodic) lighting. R and FR are known to influence the flowering of photoperiodic plants, and in some LD plants a minimal amount of FR light is required for the most rapid flowering (Downs and Thomas, 1982; Runkle unpublished). Incandescent lamps have been a common choice to deliver photoperiodic light because of their efficacy and low purchase cost. However, their energy efficiency is very low, they have a short operating life, they emit light that is rich in FR light (which promotes undesirable elongation growth), and are being, or have been, phased out of production. We are developing guidelines for the development and implementation of LED fixtures to deliver photoperiodic lighting to inhibit flowering in short-day and promote flowering in long-day specialty crops. We are testing the hypothesis that LEDs containing R and FR light will be as or more effective than conventional light sources at inducing flowering of plants with a photoperiodic flowering response, while growers will benefit from reduced operating and maintenance costs, increased durability, etc. Experimental LEDs were developed by CCS (Kyoto, Japan) containing different ratios of R and FR, and a number of SD and LD plants are being grown with night-interruption lighting (Fig. 9). Preliminary research conducted by Michigan State graduate student Daedre Craig indicates that flowering is promoted most when night-interruption lighting is provided by both R and FR LEDs; using only R or FR was less effective.

HIGH-WIRE TOMATO PRODUCTION

Overhead supplemental lighting for greenhouse crop production is problematic. For one thing, overhead-mounted HID lighting fixtures including reflectors, lamps, and ballasts block substantial sunlight throughout the day. Thus, a minimum number of high-power HID lighting fixtures typically are installed high above crop canopies to minimize shading and to ensure maximum uniformity of light distribution. HID lamp surfaces are very hot, also requiring considerable separation between lamps and crop surfaces. Equally problematic is that not all greenhouse crops have a low vertical profile. In fact, high-wire greenhouse crops such as tomato, cucumber, or pepper utilize indeterminate cultivars that grow in length throughout production cycles approaching a year. Greenhouses designed to accommodate high-wire crops may exceed 25 ft (7.62 m) in height. High-wire crops are trained to grow up a support line. As fruit are harvested from the bottom of the vine, the lower vine is defoliated and coiled, leaned, or wound to keep the top of the crop at constant height, which is considerably above the greenhouse floor and considerably below overhead HID lamps. Levels of overhead supplemental lighting decline below the top of a high-wire crop due to beam spreading and light absorption by the upper leaf canopy. Another factor contributing to light deficiency in the lower canopy of high-wire crops is that they form tall "hedges" or solid "blocks" of vegetation that shade themselves or adjacent rows as the sun

Figure 9. Bedding plant species receive different red: far-red ratios from CCS experimental LEDs during night-interruption studies of floral induction and development being conducted at Michigan State University.

tracks across the greenhouse daily. Intra-canopy lighting has been shown to prevent mutual shading and to enhance the productivity of closed-canopy crops (Frantz et al., 1998, 2000, 2001; Staziac et al., 1998). Because of their relatively cool photon-emitting surfaces, LEDs are amenable for intra-canopy lighting, either as a sole source (Massa et al., 2005a, b, 2006) or for supplemental inter-lighting in the greenhouse (Dueck et al., 2011; Philips, 2011; Trouwborst et al., 2010). For the SCRI project, vertical LED light towers straddling troughs within rows of high-wire tomato irradiate R + B light in two directions within and along rows populated by tomato plants (Fig. 10). The ORBITEC light towers have LED panels that switch on (or off) incrementally with independent control of R and B LEDs. Research by graduate student Celina Gomez is underway at Purdue University to investigate effects of R : B ratio, DLI, cultivar, and time of year on yield and fruit quality of high-wire tomato grown with LED vs. HPS light supplementation.

ECONOMIC ANALYSIS / LIFE-CYCLE ASSESSMENT

Even with mounting evidence that there are technical advantages to using LEDs for specialty crops, there are significant unknowns that could affect LED viability or rates of adoption. Using INC or HID lighting is a known practice with much history. There is little risk of adopting these technologies (other than the fact that INCs are disappearing) as they are known to work successfully. LED technology is still maturing. There are unknowns regarding dominant design, parameters of use, mix of wavelengths, effects upon crop yield and quality, capital investment, and subsequent return on investment. The intent of the current effort is to determine usage scenarios that are economically viable and which permit risk-adjusted, positive economic value added. These scenarios will take several forms. LEDs could be used to supplement current systems to better control plant growth and improve value. This could mean that LEDs either lead to improvements in plant value itself or improvements in supply chain such as better control of flowering during the wholesale and retail stage. It also is possible that LED systems could fully replace current systems. Replacement represents risk in that it is a large departure from current industry norms and ignores the large sunk cost of current systems. This scenario of replacement of current practice to LED is much more likely only after the usage science of LEDs is better developed and as manufacturing cost of LED systems is reduced. Further, industries such as specialty crop production, which operate on thin margins and low free cash flow, are relatively intolerant of financial risk. Yet, the better we understand the benefits and pitfalls, the more incentive there may be to drive LEDs into practice. We must be cautious to understand the total life cycle impact of new products and processes. A positive economic driver in use could be nullified if there was a negative effect economically at the end of the product's life cycle, a negative environmental effect, by-product, or side effect.

Figure 10. The young tomato plants in the foreground are receiving supplemental side lighting from LED towers during the cloudy days of January in Indiana. Only the lowest LED panel is energized while the plants are small to save electrical energy. Unlighted control and HPS-supplemented plants are being grown for comparison in the background.

BEST MANAGEMENT PRACTICES AND STANDARDS FOR LEDS IN THE GREENHOUSE INDUSTRY

Parallel to the development and testing of LED lighting prototypes, we plan to develop Best Management Practices (BMPs) and design and operating standards. BMPs are a set of evaluation tools that growers can use to assess, implement, and operate LED lighting systems. The assessment of LED lighting systems for a particular application should include an evaluation of crop needs, installation requirements and constraints, and an economic analysis that includes, for example, installation and operating costs and a return on investment analysis. BMPs are often based on experiences gathered over longer periods of time and by a multitude of users. Since LED lighting systems are relatively new to the green industry, the BMPs will initially be largely a set of dynamic evaluation tools that will go through multiple iterations before they will be widely adopted by the industry. Additionally, LED lighting standards for the green industry can be useful for both growers and manufacturers. Standardized features will allow for more easy application in a wide array of situations and crops, as well as provide design guidelines for manufacturers and installers. Such standards cover not only operating specifications (e.g., energy consumption and efficiency, power supply, light intensity and distribution, spectral output, color rendering, cooling requirement, control strategy, life expectancy), but also manufacturing specifications (e.g., component materials used, lens shape, beam angle, manufacturing tolerances), mounting specifications (e.g., distance, pattern, wiring, serviceability), and other specifications (e.g., the degree of light pollution, psychological impact of different color schemes on workers). Plant growth facilities are typically humid environments, and occasionally chemicals are used to control diseases and pests. Therefore, it is likely that LED systems used for plant lighting will require special design features that should be captured in the proposed standards. Like the proposed BMPs, the new LED lighting standards are intended to aid the industry-wide adoption process.

THE FUTURE OF LED HORTICULTURAL LIGHTING RESEARCH

Anticipated technology advancements should continue to make LEDs more electrically efficient and robust over time. UV and FR-emitting LEDs should be among the types improved in efficacy, as well as LEDs emitting maximally at wavelengths corresponding to peak absorbance by major plant pigments. Adaptive control systems will be developed, including use of sensor feedback providing information regarding ambient solar light conditions at different times and locations in the greenhouse. Such data will trigger switching and/or dimming systems so that greenhouse LED supplemental lighting can occur where, when, and to the extent needed at any given time. Adaptive control of DLI needs to respond to seasonal, daily, and momentary swings in solar availability. As well, physical configurations of LED lighting systems for greenhouses need to be optimized for intra-canopy and overhead light distribution. Waste-heat-distribution systems will be refined to direct heat into crop canopies when desired or reject it from greenhouses as needed. Power systems also will be improved for greater efficiency.

Horticultural research is needed to optimize wavelength and intensity of LED supplemental lighting needed for a range of important plant responses at various stages of crop development. Researchers will use targeted lighting to enhance crop timing, yield, and specific responses such as antioxidant content, organoleptic and ornamental quality, and post-harvest shelf life. LED technology also will be applied in horticultural facilities used for propagation, graft healing, sorting, and grading of harvested products. LEDs would appear to have a very bright and colorful future in commercial controlled-environment agriculture.

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High Value Horticulture: Lessons from New Zealand

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New Zealand has a benign growing environment with mild temperatures, adequate winter chill and reasonable access to water throughout the year. Its southern hemisphere location means that temperate horticultural production is out of synchrony with northern hemisphere countries. These attributes provide comparative advantages for the country in growing horticultural crops, compared with its major global competitors. Nevertheless, New Zealand has a tiny domestic market and needs to export an unusually high proportion of its products to achieve economies of scale; and in doing so, has to compete with countries with cheaper land and labor. New Zealand therefore has adopted a number of strategies so that its horticultural products remain competitive internationally.

One strategy is that of varietal differentiation and rigorous protection of the intellectual property. A successful example of this approach is seen in the kiwifruit industry. New Zealand innovation established the green 'Hayward' cultivar as a distinctive novel fruit on the world market, but, as the plant material was freely distributed, the country lost control of structured marketing, as the plant material is now grown widely around the world. Learning from this, a breeding programme was established by Plant & Food Research to develop the world's first commercial gold-fleshed kiwifruit cultivar, 'Hort16A'. This cultivar has been available for offshore production only under license from ZESPRI® International and marketed as ZESPRI® GOLD Kiwifruit, right from the outset. The cultivar rapidly climbed in export value, reaching some NZ$250M per annum in 2010. 'Hort16A' has proved to be susceptible to a virulent form of *Pseudomonas syringae* pv. *actinidiae* (Psa-V), and the industry has a recovery plan involving rapid grafting of a new gold cultivar which appears to be less susceptible to Psa-V. This is intended to fill the marketing gap until a resistant cultivar can be developed. The apple industry had a similar experience to the kiwifruit industry. New Zealand developed cultivars such as 'Royal Gala' and 'Braeburn', which were freely disseminated around the world and this meant that New Zealand lost control over these cultivars. Newer cultivars such as

Gold-fleshed kiwifruit cultivar 'Hort16A'. Photo courtesy of Robert Lamberts, The New Zealand Institute for Plant & Food Research Limited.

'Scifresh'/Jazz™ and 'Scilate'/Envy™ are solely handled by ENZA International Limited, which means that ENZA can manage the production and control the quality of these premium apple cultivars.

A second strategy for the success of horticultural exports from New Zealand relies on the global value attached to the New Zealand 'brand'. As a country, New Zealand is globally recognized both for its relatively clean environment and for its integrity. Together, these attributes mean that if the country tells the world that a particular production system involves (for example) minimal use of chemical sprays, it is a believable claim. All New Zealand primary producers are acutely aware of the fragility of an environmentally friendly claim and there was a flurry of interest when the country's geographic isolation was briefly linked to a high carbon footprint for our exported products. In fact, closer examination has demonstrated that the benign growing environment and highly energy-efficient use of sea freight generally result in products that reach consumers around the world with a smaller carbon footprint than locally produced products. This has helped to sustain exports of products as diverse as apples, avocados and cherries.

Another distinctive attribute that has been vitally important for the success of New Zealand kiwifruit exports has been the existence of a 'single-desk' marketing company. New Zealand prides itself on having primary production relatively unfettered by government interference (and almost entirely unsubsidized, which means that there are strong incentives to seek efficiencies along the entire production system), but the clear benefit of restricting domestic competition for the right to export kiwifruit has been voluntarily adopted by the kiwifruit industry and has strongly contributed to the success story of ZESPRI. When the apple export industry was de-regulated, it chose not to establish a similar industry discipline and the statistics suggest it has suffered as a result.

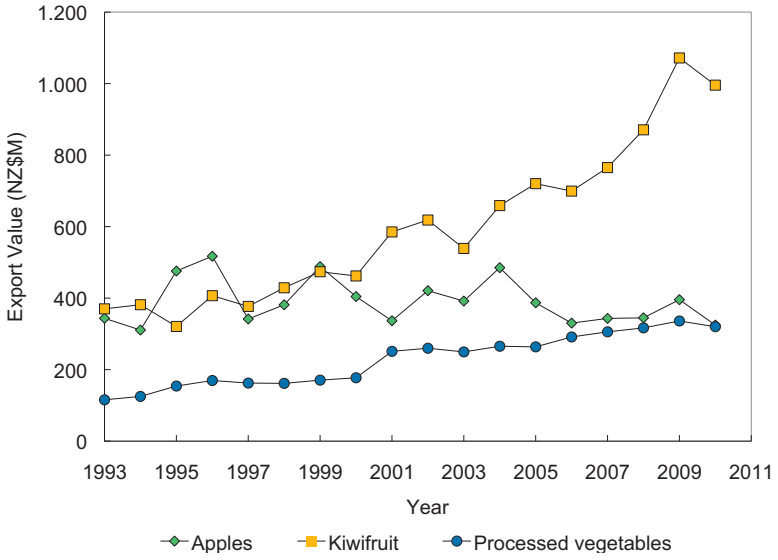
A new opportunity exists to characterize the composition of New Zealand-grown fruits and vegetables and differentiate its products on the strength of their phytochemical content. There is a growing international appetite for 'functional foods', with a known content of bioactive molecules associated with some health benefit. The choice of varieties strongly influences their phytochemical composition but there may also be a positive contribution from the country's high insolation: New Zealand's strong UV light exposure increases the content of many health-beneficial compounds. As the proportion of health-conscious consumers with higher disposable incomes increases, particularly in New Zealand's northern neighbors in Asia, this export opportunity is likely to grow.

It has to be said that a significant proportion of New Zealand's growth in fresh product exports has not come from high-value differentiated products. One of the fastest growing horticultural export sectors is processed vegetables: an example of astute businesses recognizing a market opportunity based on New Zealand's reputation as a source of convenient and safe products.

The New Zealand wine industry is at an interesting phase in its development. There was an explosive growth in production and exports from the 1990s supported by the premium prices paid for its wines, based on their reputation for high quality. In the last three years there has been significant growth in bulk sales, particularly of Sauvignon blanc. At present these bulk sales are bottled in market and still achieve premium pricing and are differentiated by the use of 'New Zealand' as a geographical indicator (GI). There are also moves to emphasize narrower GIs such as particular growing regions (e.g. Marlborough for Sauvignon blanc).

As long as the industry can retain its reputation for premium quality wines there is scope for long-term growth of exports in both volume and value.

New Zealand's success as an exporter of high-value horticultural products is a result of smart science and business practices. The underlying comparative advantage of appropriate soils and climate would not have been enough for the country to remain successful in the face of international competition. Instead New Zealand has made a habit of understanding the markets, developing differentiated products and supporting its horticultural industries to deliver those products as efficiently as possible.



Export value (NZ$M, f.o.b.) of selected horticultural products from New Zealand for each year (ending in June) since 1993. Data from Statistics New Zealand.

Using a portable near infrared spectrophotometer to estimate soluble solids concentration of apricot fruit in an orchard. Photo courtesy of Robert Lamberts, The New Zealand Institute for Plant & Food Research Limited.

Monitoring temperature effects on grape development. Photo courtesy of Robert Lamberts, The New Zealand Institute for Plant & Food Research Limited.

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History

Revelations from *Histoire Naturelle des Indes* known as *The Drake Manuscript*: Horticulture and History

Jules Janick

Histoire Naturelle des Indes, an anonymous illustrated manuscript with captions in 16th century French, believed to have been written between 1586 and 1600, is a mysterious work (Schwerdt, 1928; Lestringant, 1994; Klinkenborg, 1996). Consisting of 134 leaves of text and illustrations it has been published in a beautiful facsimile edition by the Pierpoint Morgan Library in 1996 entitled *The Drake Manuscript* with a foreword by the historian and novelist Patrick O'Brian, an introduction by Verlyn Klinkenborg, and translations by Ruth S. Kraemer. The manuscript is roughly divided into three parts: 62 botanical illustrations; 89 drawings of fish, animals, and birds; and 43 illustrations emphasizing activities involving indigenous people of the Americas that include scenes with Spaniards and African slaves as well as a scene in the Moluccas (Muluku) and Cape Verde Islands. The manuscript is of considerable historical and horticultural interest since it portrays food plants consumed by the indigenous people of the Americas and provides evidence of crop introduction from the Old World used by indigenous Americans. The objective of this paper is to review the horticultural implications of this work and to speculate on the unknown artist/author.

THE MANUSCRIPT

The manuscript was acquired by the Pierpoint Morgan Library in 1983 as a bequest of Clara S. Peck who acquired it in 1947 (Klinkenborg, 1996). In 1928 the manuscript was owned by the book collector C.F.G.R. Schwerdt who purchased the manuscript in 1911 from the collection of the bibliophile Henry Huth, hence its name at one time as the Huth manuscript (Wallis, 1984). The antiquarian bookseller, Bernard Quaritch, writing in 1867, and others since then, supposed the manuscript to have been written and drawn by a Frenchman who accompanied Sir Francis Drake on his circumnavigation of 1577-1580 and his voyage to the West Indies of 1585-1586 (Schwerdt, 1928). The name of L'abbé Jean-Paul Bignon (1662-1743), a French royal librarian, appears on one of the work's margins. The title page was added in the 18th century, presumably when the manuscript was bound. An analysis of the illustration sequence suggests that the folios were not always inserted in a logical order.

The illustrator was neither artistically nor scientifically trained, since the drawings although spirited, are amateurish and the flora and fauna exhibit many errors in the morphology of plant and animal that a trained botanist or naturalist would not have made. The drawings appear to be by two different hands (Brochard and Chambon, 1991) and there are two or more different caption styles. Most of the flora and fauna and 17 of the 44 scenes, most in the beginning, include captions in all capital letters (hand A), while the other captions are in capital and lower case letters (hand B) (Table 1). In the drawings of scenes, hand A shows more accurate depictions of facial features than B. Lestringant (1994) suggests that five people worked on the manuscript, two or three artists and three scribes. However, there

Table 1. Distribution of captions.

Type of drawings	Capital byline Hand A	Script byline Hand B	Total
Botanicals	59	4	63
Fauna	89	3	92
Scenes	17	27	44

are common stylistic features such as flocks of birds in the sky similarly drawn in the shape of a cross (see Figs. 4 and 6). Despite the possibility of multiple contributors of *Histoire Naturelle des Indes*, they will be collectively referred to as the *Histoire* Artist (HA).

ILLUSTRATIONS OF CROPS AND ANIMALS

Sixty-two plants are illustrated and named in 16th century French in the botanical section (Table 2), while two, wheat and grapes, are found only in the scenes of Indian life. Most of the plants illustrated in the manuscript are of the New World (Figs. 1 and 2) but eight Old World crops are included: eggplant, garlic, cowpea, grape, onion, plantain, watermelon, and wheat (Fig. 3). Many of the plants cannot be identified with certainty (Table 2). Old World animals include cow, dog (mastiff), goat, pig, and sheep.

There are many botanical inaccuracies. For example, many of the tree fruits are reasonably drawn but shown to be produced on herbaceous plants! Two different cucurbit fruits are drawn on the same plant (f.5v). Some plants are depicted fairly accurately including coconut, onion, palm tree, papaya, and pineapple. Yet, it is clear that some of the depicted subjects are fabricated as indicated in the drawings of sheep for llamas in the drawings of Peru (f.62). Many of the animal drawings are imaginative, such as the many teeth on the drawings of serpents and rays, and the eel-like creatures protruding from the mussel shell (probably based on a worm infested mussel).

Old World Plants

Alliums. Two alliums, garlic (f.2) and onions (f.13), are portrayed in the botanical section. These Old World species must have become naturalized. Garlic is described as sweeter than the ones of France and it is mentioned that they are roasted by the Indians. The onions are described as sweet and very large, "more so than in France," and are white inside and red outside. The captions note that the Indians consume them like apples and they are grown from seed with three harvests per year.

Cowpea. A leguminous plant in the botanical section is referred to as couscous (f.31), which is clearly a misnomer since this term refers to a durum wheat product. The double pods resemble cowpea (*Vigna unguiculata*), which was well known to the Spanish as an Arab introduction to the Iberian Peninsula.

Eggplant. The image of eggplant (f.12v) in the botanical section was unexpected. However, eggplant has entire leaves, not lobed as indicated. The Spanish were very familiar with the eggplant, which was introduced to Iberia by Arabs about 900, probably from Persia (M.-C. Daunay, pers. commun.). It was recommended as being good cooked with meat.

Figure 1. New World herbaceous crops in *The Drake Manuscript*: A. maize, B. bean, C. tomato, D. squash, E. tobacco, F. cassava, G. sweet potato, H. cotton.

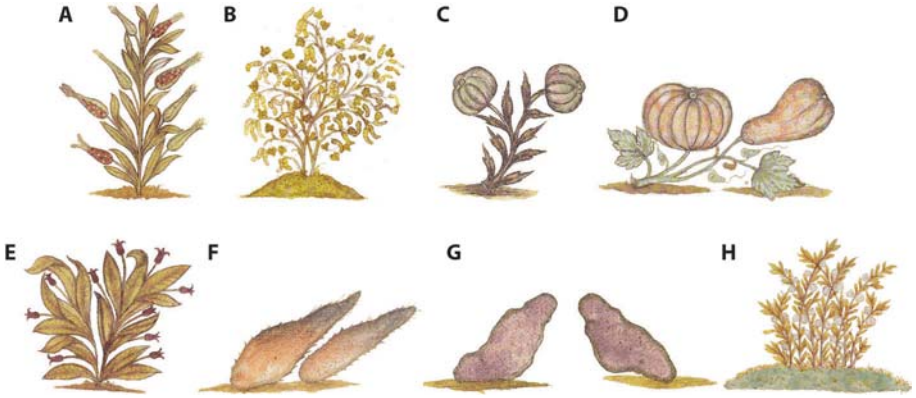


Figure 2. New World fruit crops in *The Drake Manuscript*: A. papaya, B. pineapple, C. mamey, D. avocado, E. soursop, F. guava, G. annona, H. cacao.

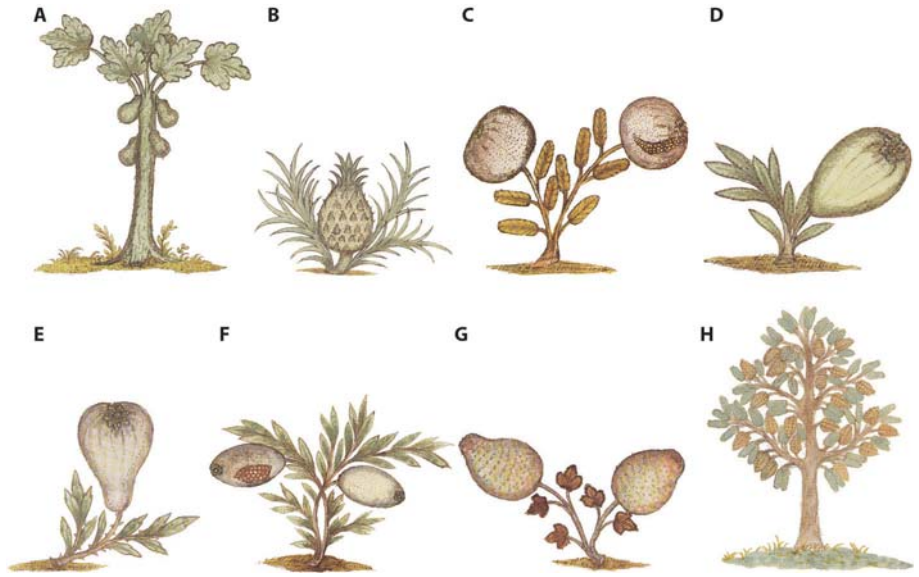
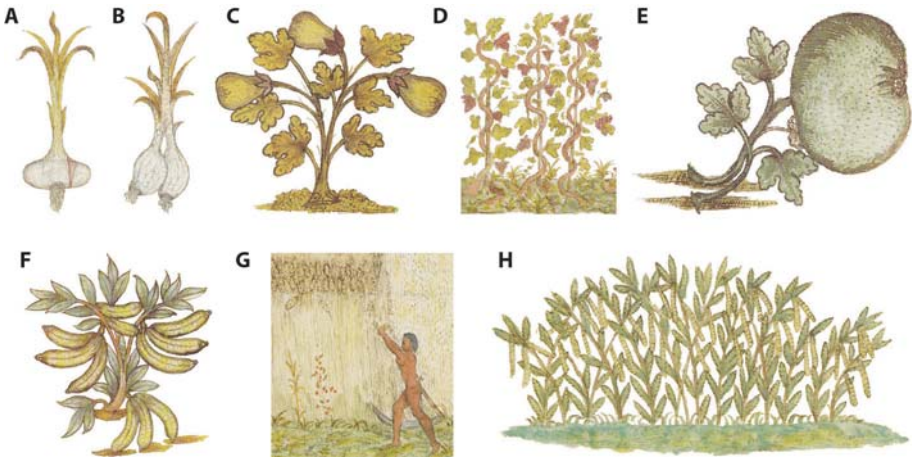


Figure 3. Old World plants in *The Drake Manuscript*: A. onion, B. garlic, C. eggplant, D. grape, E. watermelon, F. plantain, G. wheat, H. cowpea.



Grape. This crop trained on wooden poles is only presented in the section on Indian life (f.112). Based on the text these plants are likely to be *Vitis vinifera* imported by the Spanish, although many American species of grapes are found in North America. The text indicates that Indians are "allowed" to plant grapes only in their gardens, and that both the Indians and Spaniards are restrained from planting grapes (as well as olives) in abundance by the King of Spain, so as not to compete with imported wine from the Canaries.

Table 2. Horticultural plants in the botanical section of *The Drake Manuscript* with the French name from manuscript, the English name, and the Latin binomial.

Folio	French name in *The Drake Manuscript*	English name	Latin binomial
2	Ache des Yndes	Garlic	*Allium sativum*
3	Annone	Soursop	*Anonna muricata*
3	Icaques	Icaco plum	*Chrysobalanus* icaco
3v	Havoqates	Avocado	*Persea americana*
4	Honnes	"Berries"	
4	Hinnes	Pineapple	*Anannas comosus*
4v	Petun	Tobacco	*Nicotiana tabacum*
5	Agouques	Cassava	*Manihot esculenta*
5	Prennelles	Prunelle, sloe	*Prunus orthosepala*
5v	Agouiamme	Squash	*Cucurbita pepo*
6	Petonnes ??	Bottle gourd	*Lagenaria siceraria*
7	Inhames	Cherimoya	*Annona cherimola*
7	Pineulles	Quenepa?	*Melicoccus bijugatus*
7v	Tomates	Tomato	*Solanum lycopersicum*
8	Sirov(u)eles		?
8	Mamee	Mamey	*Mamea americana*
8v	Gouiave	Soursop	*Anonna muricata*
9	Prannonques	Agave	*Agave tequilana*
10	Gouiaves	Guava	*Psidium guajava*
10	Mamonne	Soursop	*Anonna americana*
10v, 18, 23v	Patates	Sweet potato	*Ipomoea battas*
11	Pimente	Pimento	*Capsicum annuum*
11	Coques	Coconut	*Cocos nucifera*
11v	Plantainnes	Plantain, banana	*Musa sapientum*
12	Patille	Watermelon	*Citrullis vulgaris*
12	Papae	Pawpaw tree, papaya	*Carica papaya*
12v	Venragiere	Eggplant	*Solanum melongena*
13	Cibolles des Indes	Onions of the Indes	*Allium cepa*
14	Acogoua	Cashew nut	*Anacardium esculenta*
14	Palmites	Paom marrow	Species of *Aracaceae*
13v	Mil	Maize	*Zea mays*
15	Balce		
15v	Figue sauvage	Wild fig	*Ficus* or *Clusia* spp.
16	Torchales	Cactus	*Cereus* sp.
17	Caboucle	Cabuya, Fique	*Furcraea andina*
17v	Bregele	Unidentified softens iron?	
18	Roumerre		
18v	Canbre		
19	Frigolles	Beans	*Phaseolus vulgaris*
20	Avilannes Blanches Gomites	White physic nut	*Jatropha curcas*
21	Avilannes Noires Gomites	Black physic nut	*Jatropha curcas*
22	Hagis Ruges, Ianne, Vert	Pepper: red, yellow, green	*Capsicum frutescens*
23	Chatane des Indes	Chestnut of the Indes	
23	Mennil	Cassava	*Manihot esculenta*
24	Mielsauvage	Wild honey tree	
24	Barbeque		
24v	Pite	Silk grass	
25	Madae	Madera	
26	Carane	Carane (resin)	
27	Mensenille	Menchineel tree (little apple of death)	*Hippomane mancinella*
27v	Canifiste	Cassia tree, Golden shower	*Cassia fistula*
28	Lacique	Lacique	
28	Sacafras	Sassafras	*Sassafras albidum*
28v	Cacine	Holly tree	*Ilex cassine*
29	Miatona		
30	Chuppe	Cacao	*Theobroma cacao*
31	Couchequou	Couscous= Cowpea	*Vigna unguiculata*
32	Coton	Cotton	*Gossypium hirsutum*
33	Palme	Palm tree	*Aracaceae* spp.
91	Bled	Wheat	*Triticum vulgare*
112	La Vigne	Grape	*Vitis vinifera*

Plantain. The name in French, *plaintainnes*, indicates that they are plantains, and it is likely they are the False Horn type (triploid AAB hybrids of *Musa acuminata* and *Musa bulbisiana*) known to be imported via the Canary Islands from Africa. The long fruit is yellow and described as good tasting but causing flatulence. Plantain is illustrated both in the botanical section (f.11v) and in the drawings of Indian life (f.103, 123). The plant in the botanical section is inaccurate (Fig. 8C left), suggesting that the illustrator never saw it.

Watermelon. These fruits are illustrated only in the botanical section and named *patille* (f.12). It is noted that it promotes urination.

Wheat. This grain is found only in the drawings of Indian life (f.91) but the plant is twice the size of the harvester who is reaping the grain with a metal scythe. The scene is set in the Province of Leresne, "200 leagues from Peru, where the La Margarita River originates." There are a number of small plants in front of the wheat, one of which resembles maize. Because of the scythe it can be assumed that the harvester is a laborer or slave. The text mentions that the wheat is harvested twice a year and exported in exchange for wine from the Canaries, linen, knives, hoops, and other things such as fishhooks "because they have only those made of fish bone." The unrealistic size of the wheat plants makes it unlikely that this scene was observed by the illustrator.

New World Plants

Cactus. A cactus plant (f.16) that resembles a branched columnar type (*Cereus* or *Selenicereus*) is shown. The statement is made that it does not bear fruit.

Fruit Vegetables. A squash plant (*Agouiamme*) with two types of fruit, globular and pyriform, is shown in the botanical section (f.5v) and appears to be *Cucurbita pepo*. A viney cucurbit, probably *C. moschata*, is shown in a garden scene (f.121) with nine large globular fruits. There are various depictions of capsicum peppers (f.11, 22, 121) with either red, yellow, or green fruit. Deeply lobed (ribbed) tomato fruits (f.7v) growing on a single plant are similar to illustrations found in early herbals in the 16th century and resemble a sculpture in the bronze doors of the Pisa cathedral made in 1601 (Daunay et al., 2008). The fruit labeled *petonnes* in the botanical section (f.6) is very strange and according to the text "the Indians call it Caribara." It is mislabeled bottle gourd in *The Drake Manuscript*. However, various bottle gourds are used as vessels in various scenes (f.92, 116, 117, 123).

Grains. Maize is found both in the botanical section (f.13v) and in the Indian garden scene (f.21) where there are three plants. All drawings show 5 to 8 ears per plant on single stems with no tassel but an ear on the tip of the plant. In the botanical section four ears show intermingled yellow, red, and purple seeds

indicating genetic segregation for aleurone color. The ears are attached to the stem with a long shank but the nodes are not articulated, the same error that is displayed on the ceiling of the Farnesina Palace in Rome, where the first illustration of maize appeared in 1515-1518 (Janick and Caneva, 2005) indicating that the drawing was made from detached ears with the plant drawn from memory. The leaves are long and narrow.

Fruits and Nuts. A plethora of New World fruits are illustrated (Fig. 2). These include various annonas, avocado, berries, cashew nut, coconut, guava, icaco plum, mamey, papaya, and pineapple. Oranges are mentioned in f.97 but not illustrated.

Fiber Crops. Cotton (*Gossypium hirsutum*) is shown on a plant in the botanical section (f.32) and being spun by an Indian (f.119). New World tetraploid cotton (*G. hirsutum* and *G. barbadense*) would change the entire world cotton industry.

Legumes. The common bean (*Phaseolus vulgaris*) called *frigolles* is found in the botanical section (f.19). Beans trained on a pole can also be shown in the garden scene (f.121).

Palms and Trees. Various palms and trees are illustrated as shown in Table 1.

Tobacco. Tobacco called *petun* is shown in the botanical section (f.4v) and smoking is described along with many medicinal uses. In one scene (f.92), an Indian mortally wounded by arrows is being treated by burning tobacco in an oven with smoke directed in a pipe toward the wound (Fig. 12 left). The text indicates that tobacco leaf with balsam will be applied to the wound as a plaster.

Tubers. *Patates*, both yellow (f.18) and purple-skinned (f.10v, 23v), are considered to be sweet potato and the description indicates that it can be multiplied by planting small pieces. Potato (*Solanum tuberosum*) is not mentioned although Drake has been credited with introducing the potato to Europe in 1586, associated with the rescue of the Roanoke colonists (Salaman, 1949). A 14 foot tall statue of Drake by Andreas Friedrich (1798-1877) in Offenburg, Germany, erected in 1854, had his right hand holding a map of America and his left hand holding a flowering potato plant. However, sweet potato and not potato was grown in Roanoke. The potato may have been on Drake's ship, possibly brought on board in Cartagena according to Salaman (1949).

Mennil or cassava (f.23) is illustrated and it is noted that it is dried in the sun and then consumed as bread. It may be that the bread cooked by the Indian illustrated in f.124 was made from cassava brought by her fiancé (f.122).

INDIAN LIFE

The drawings, although crude, are lively, especially the ones involving Indian daily life that are presented in a sympathetic, non-patronizing manner. Although there is one violent episode of a fight between two individuals (Fig. 11 left, f.85), most are peaceful scenes of food production and collection, hunting, fishing, mining, healing, fire making, spinning, net making, as well as touching scenes of domestic life including courtship, cooking, bathing, and childbirth. The living structures of the Indians are either circular with a thatched cone-shaped roof (*caney*) or rectangular with a thatched hipped roof (*bohio*) typical of the Taino (Arawak) culture (Rouse, 1992). Males and females are generally unclothed but a few wear loin cloths or tunics (f.81). The Indians of Santa Marta (f.87) and Caribara (f.89) have penis sheaths, and two (f.81, 87) have nose rings. From the locations mentioned it is conceivable that the Indians portrayed include Carib, Taino, Tairona, and Algonquin cultures.

The richest horticultural scenes involve a romantic courtship series (f.113-116, f.121-124). A young man meets his beloved and her father (f.113), shows off his life skills in hunting, fishing, spinning cotton, net making, and gardening (f.11-117, 121-123), culminating in a confrontation with the father. The richest horticultural illustration (Fig. 4) shows the young unclothed Indian male in a garden enclosed by a wattle fence. He distributes seed with one hand to a rectangular bed outlined with a wooden frame, and holds a long pointed dibble stick in the other. Among the plants that can be identified are trellised bean, green capsicum pepper, maize with multiple ears, melons (probably *Cucurbita moschata*) with nine large fruits, papaya, pineapple, and perhaps sweet potatoes on the ground. There are four unidentifiable plants – three with red, berry like fruit, and one plant (between the legs of the Indian) with larger fruit that resemble soursop on a herbaceous plant, similar to the drawing called *Annonne* in the botanical section. Horticultural plants can also be seen in the collecting scenes. In the first (f.122), the young suitor carries a pole across his shoulders from which is suspended cassava root (*manil*) and an empty basket on one end, and a dead snake on the other. In the next illustration (f.123), the basket on one end is now filled with fruits and a number of crops are attached to the other end (Fig. 5). Prominent is a stalk of plantain bearing six fingers of long yellow fruit as well as a bottle gourd and cassava root. The other fruits cannot be identified with certainty. A similar collection of fruits (f.104) hangs from a beam in part of a mining series. In the last courtship scene (f.124), the young man, now dressed to impress in an ornamented loin cloth, carrying a rabbit confronts his intended who is preparing food ("bread") and his prospective father-in-law (still carrying a big stick) who, according to the text, encourages the match. The plethora of details suggests that HA observed the scene.

Extraordinarily, the work contains a self-portrait of HA (f.111) as a guest in the home of an Indian, likely the one involved in the courtship scenes, based on his house (Fig. 6). The text explains that his fearlessness of the *Athoua*, the Indian Devil, is due to his belief in Jesus Christ – the emphasis of belief suggests that the artist was a French Protestant or Huguenot

Figure 4. Garden scene in *The Drake Manuscript* (f.121).

Figure 5. Gathering fruit in *The Drake Manuscript* (f.123); inset from f103-103v.

Figure 6. Self portrait of HA in the house of an Indian friend and the devil Athoa (f.111-111v).

(Klinkenborg, 1996). The portrait shows a bearded young man dressed in a "loose short coat of a sailor" (Schwerdt, 1928), in tights, and a hat.

ASSOCIATION OF HA WITH SIR FRANCIS DRAKE

There are two direct references to Drake in the manuscript. The first is in the caption entitled Canoe of the South Sea (f.44) showing a canoe labeled with the word *Cacique* (an Indian term for Chief), with two ranks of 11 rowers each, with a figure of authority seated in an elevated chair. The text indicates it is from an island called Gilolo (in the Moluccas, now Maluku) "where Francis Drake, an English man, had his ship cleaned to make it ready for his voyage to the South Sea." Drake was in Ternate during his circumnavigation voyage, which is near Gilolo (Halmahera) where he encountered Babu, the Sultan of Ternate, at the end of his circumnavigation voyages of 1577-1580. But, the Sultan arrived with three galleys each of 80 oarsmen. The inaccuracy of the drawing of the boat (Lessa, 1984) indicates that the artist illustration is based on hearsay. There was a botanist on that voyage named Lawrence Eliot and his work is referred to by Charles de l'Écluse (Clusius) in 1582 (Clusius and Garcia da Orta, 1582; Sugden, 1990, p.154).

The 1585-1586 voyages of Drake included stops in Portugal, Cape Verde islands, Santo Domingo, Hispaniola, Cartagena, Columbia, Cuba, St. Augustine, Florida, and Roanoke, Virginia (now North Carolina). *The Drake Manuscript* contains an illustration of the volcano at Fire Island (*Fougue*) (f.93-93v) in the Cape Verde Islands, Drake's first landfall. However, this scene is wildly imaginative and was probably based on hearsay. The caption of an illustration (Fig. 7) entitled *Hinde de Loranbec* (Indian of Loranbec) (f.90) contains the second mention of Drake:

> *"These Indians dressed in skins are extremely skillful in battle on account of their strength, as the English could tell fighting under Sir Francis Drake in 1586 when they attempted to conquer this land, but were forced to weigh anchor and retreat because of the resistance they encountered. Its location is between Florida and Terre Neuve [Newfoundland] at 36 ½ latitude."*

Note that the text mentions Drake, an Indian battle, the year 1586, and a location at 36.5°N. However, there was no battle at Roanoke when Drake arrived, although there was a skirmish near St. Augustine a week earlier (Sugden, 1990). The location is critical since Roanoke Island in North Carolina (lat. 35°85') is where Drake picked up 105 colonists from the colony established by Sir Walter Raleigh in 1584. These were mostly soldiers, but included the artist John White who painted pictures of Indian life in the colony, the scientist Thomas Harriot, and Ralph Lane, the leader in the second of the ill-fated expeditions to Roanoke. White was destined to return as the leader of the colony in 1587 and was the grandfather of Virginia Dare, the first English child born in America.

The word Loranbec, mentioned three times in *The Drake Manuscript*, is an enigma. In addition to the Indian of Loranbec, there is an illustration of an oyster (*houitre*) from "Loranbec" (f.44v) and a seal (*chatille*) (f.48) in the land of "Lorembec (sic) between Florida and Terre Neuve [Newfoundland]". Both oysters and harbor seals exist in North Carolina. The word *Loran* is presumably of Algonquin origin (Bourinot, 1897) and there are now two small sea villages in Cape Breton called Big Lorraine and Little Lorraine (or Little Loran). There was a Port of Loranbac or Noranbeque, a little harbor on the eastern shore of Cape Breton, Nova Scotia. Loranbec may be a corruption of Norumbega, originally Oranbega, a legendary province in Verrazzano's 1529 map of America. The transition from Oranbega in Italian to l'oranbega,

Table 3. Locations mentioned in *The Drake Manuscript* compared to those visited by Drake in his voyages to the New World.

Location	*The Drake Manuscript*	Year of Drake's voyages
Brazil (in passing)	f.111, 111v Santa Marta, Region of Bahia	1578
Caiman Island	f.93v-94; incorrectly listed as off Peru	-
Cape Verde Islands, Fire Island (Fougue)	f.93-93v	1585-1586
Maluccas, Gilolo	f.44	1577-1580
Peru	Sheep (f.61-62); Leresne Province (f.91)	1577-1580
	Coins (f.103-103v); Mines close to Lima (f.104); La Margarita (f.18); f.56, f.57	-
SPANISH MAIN		
Antiqua	f.45	-
Borburat(a)	f.101	1566-1567
Caribara	f.89	
Columbia	Baillahonde on the Guajire Peninsula in Columbia (f.43); La Reyne in Columbia (f.60-61); Honda on the peninsula of La Guajira (f.87); Magdalena River (f.90-91); Lerayne Province, Columbia near capital city of Santa Fe (f.98-98v)	1595
	Rancharia (f.57)	1595
	Rio de la Hacha (f.57)	1566-1567, 1595
	Cabo de la Vela (f.57)	1571
Florida, Saint Augustine	f.28	1586
Ihona	perhaps Guiana (f.84-85)	
Indies (woman of)	f.82, 84, 86	
Loranbec (Roanoke)	Oysters from Loranbec (f.44v); seal of Lorembec (sic) (f.48); Indian of Loranbec between Florida and New Foundland (f.90)	1586
Nicaragua	f.188	-
Panama	Veragua (f.100-100v); Nombre de Dios (f.97-97v); Chagres River, Cap la Cruz in Panama	1570, 1572
Trinidad	f.56, f.83	Planned but did not visit

loranbeque, loranbec in French is a possibility. A 1589 map by Baptista Boazio, a cartographer who was on Drake's voyage of 1585-1586, indicates that the area northeast of Virginia was called Norumbega (Keeler, 1981, Plate I). John Gerard in his 1597 *Herball* (p.752) discussing milkweed, which he called Indian Swallow woort with a woodcut derived from a John White painting, includes the statement: "There groweth in that part of Virginia, or Norembega, where our English men dwelled intending there to erect a Colony…"

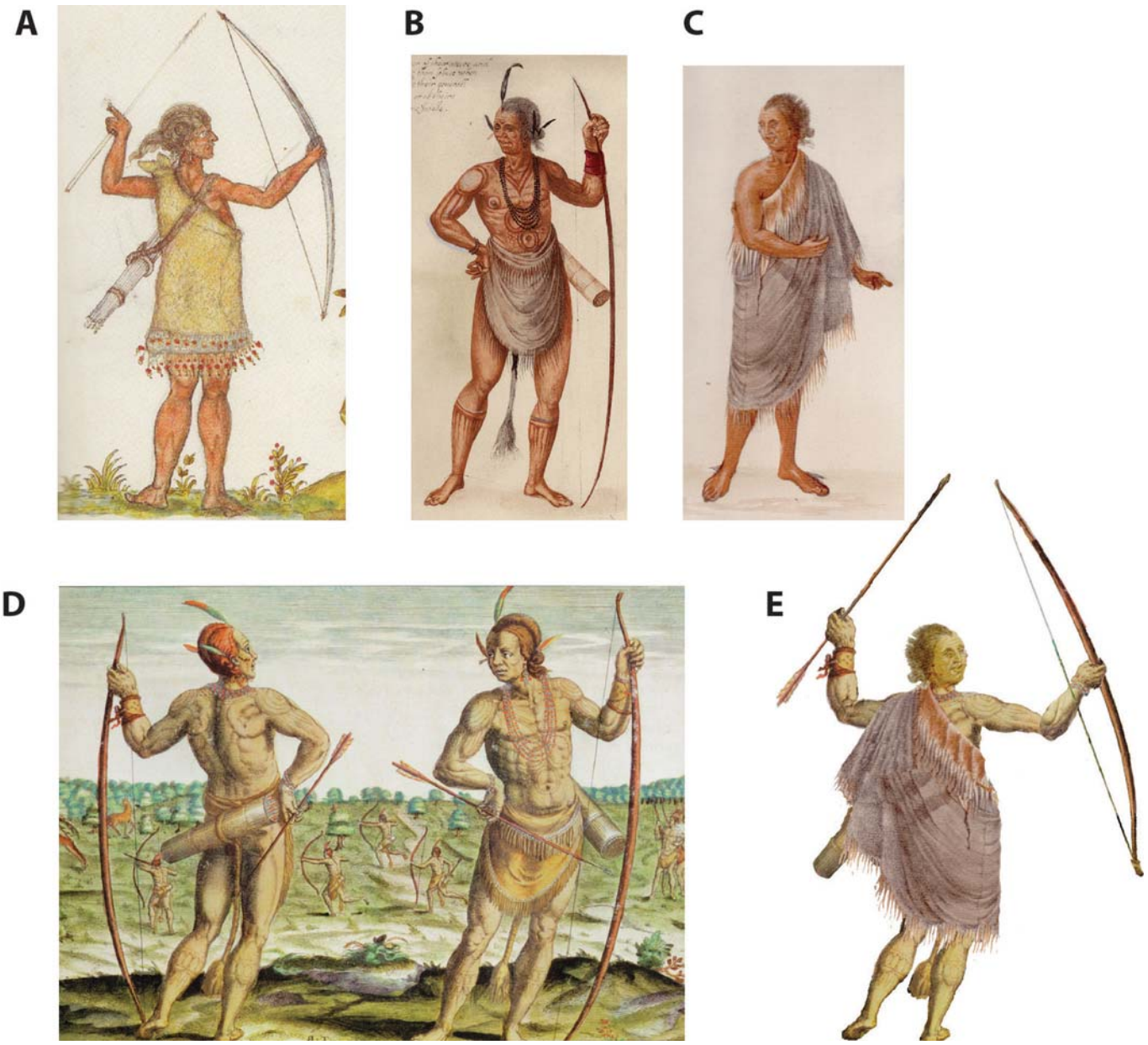
The Drake Manuscript includes names of other locations associated with the various voyages of Drake (Table 3). Not all locations in *The Drake Manuscript* were visited by Drake, suggesting that HA could have been in the New World independent of Drake or obtained information from verbal descriptions of others. There are images close to Lima, Peru (f.62, 91) but Drake did not stop there, although he was near the port of Callao in his circumnavigation voyage of 1577-1580 that included the landing in California.

Did HA actually accompany Drake? The evidence is circumstantial and conjectural. There is an abundance of evidence that Frenchmen accompanied Drake. Francis Pretty, one of Drake's Gentlemen at Arms who authored a 1589 work on the circumnavigation voyage in English, is referred to as a "Gentleman of Picardy" in the French translation (Schwerdt, 1928). The translator, Francois Louvencourt, is credited with a reference to the fact that one of the tenants of Baron de Courtomer had been with Drake (Schwerdt, 1928). Drake also encountered Frenchmen in his 1585-1586 voyage to the West Indies. He set free 18 or 19 Frenchman in Santo Domingo (Keeler, 1981, p.244) and rescued Frenchmen from prison in St. Augustine just before arriving in Roanoke (Quinn, 1985, p.133). When Cartagena was attacked and destroyed by Drake in 1586, he picked up Frenchmen along with Turks and Negroes and "recruited" them to his crew (Keeler, 198l, p.169; Sugden, 1990, p.195).

It is conceivable that HA could have been one of the French group picked up by Drake in Cartagena and perhaps had been making a study of Indian life for a commercial commission, which would have been of extreme interest at that time. Since Drake was known to be a painter (his work from his last voyage was sent to Queen Elizabeth with his report but was lost), he likely would have appreciated art work of the new French artist, impressed or recruited. Cartagena, although unmentioned in *The Drake Manuscript*, is in the middle of many locations that are along the Spanish Main from Panama to the Guajira Peninsular of Colombia (Table 3). HA includes pictures of gold mining in Veragua and a detailed scene of the port Nombre de Dios, both in Panama, and there are various references to locations in Columbia. HA seems to have been intimately associated with indigenous people and locations in this area based on the details of the illustrations.

If HA participated in the West Indian 1585-1586 voyage he could have received information of other voyages of Drake based on discussions with the crew. When the crew landed in England in 1586 it can be assumed that HA

Figure 7. The Indian of Loranbec (A) compared to White's portraits of the Chief (B) and Old Man (C) and the engraving (mirror image) of Theodore De Bry (D), and a reconstruction based on the White images (E).



made his way back to France and then completed the manuscript. The provenance of the manuscript suggests that it became part of the library of a well-connected French nobleman who may have been the sponsor.

ASSOCIATION BETWEEN THE WORK OF HA, JOHN WHITE, JACQUES LE MOYNE, AND THEODORE DE BRY

Evidence from the Indian of Loranbec

The Indian of Loranbec illustration in *The Drake Manuscript* is of a warrior ready to load an arrow, perhaps at a bird perched on a limb (Fig. 7A). The somewhat humorous situation suggests that the drawing was not made from life. The figure is dressed in an off-the-shoulder fringed tunic tied at the neck with red beads on the bottom and the text indicates it is made of skins. He wears an earring. His calves are painted with a zigzag design suggestive of tattooing and the back of his neck shows evidence of a painted symbol. He holds a quiver of arrows attached to his shoulder with a strap. His hair is short with a pony tail.

If the Indian of Loranbec drawn by HA is from Roanoke, this would be strong evidence that he accompanied Drake on at least part of the 1585-1586 expedition. There is a way to determine this. The Indians of Roanoke were well illustrated by John White who was there in 1584, August 17, 1585 to June 18, 1586, and from July 22 to August 27, 1587. Two of his paintings, An Indian Chief (Fig. 7B) and An Old Man of Pomeiock (Fig. 7C) show similarities to the Indian of Loranbec (Feest, 2007). Many of the watercolors of White, including these two portraits, were engraved by Theodore De Bry and subsequently published in 1590 to illustrate Harriot's 1588 report of the Roanoke colony entitled *A Briefe and True Report of the New Found Land of Virginia* (Lorant, 1946). However, the Indian Chief engraving was reconfigured to include a front and a back view (Fig. 7D). The Indian of Loranbec figure and the two paintings of White along with the corresponding engravings of De Bry which are presented in mirror image are scaled to the same size in Figure 7. A comparison of the images suggests that all are related and that the Loranbec Indian image of HA is a composite of the Indian Chief (especially the back image of the engraving) and the Old Man. Figure 7E reconstructs the Loranbec image by combining versions of the White painting and De Bry engraving.

Figure 8. Flora and fauna from *The Drake Manuscript* (left) compared to watercolors of John White (right): A. tortoise, B. flying fish, C. plantain, D. pineapple, E. mamey.

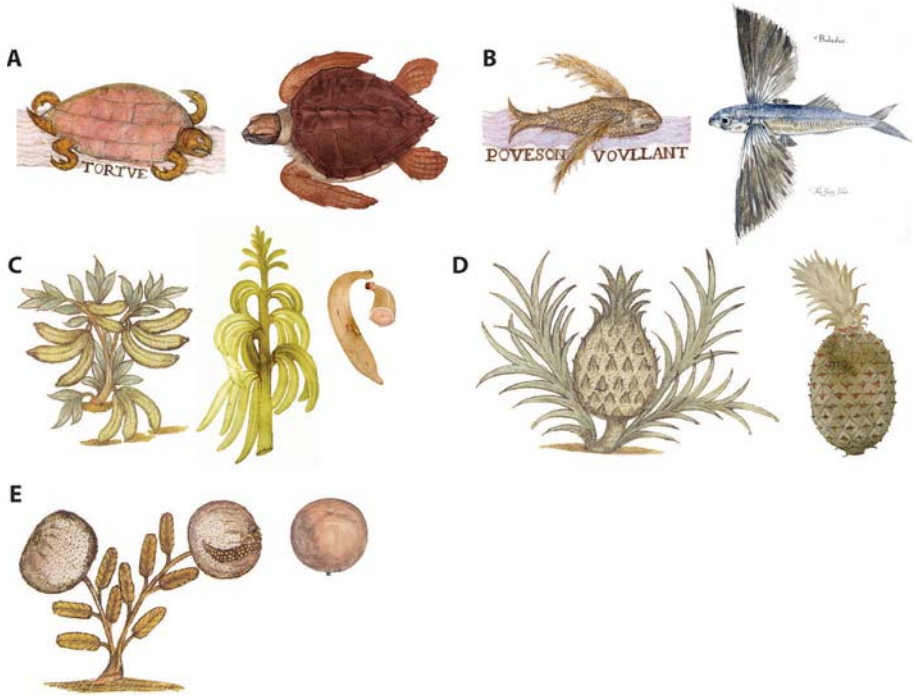


Figure 9. Grilling fish: A. image from *The Drake Manuscript*, B. image from John White, C. reversed De Bry engraving.

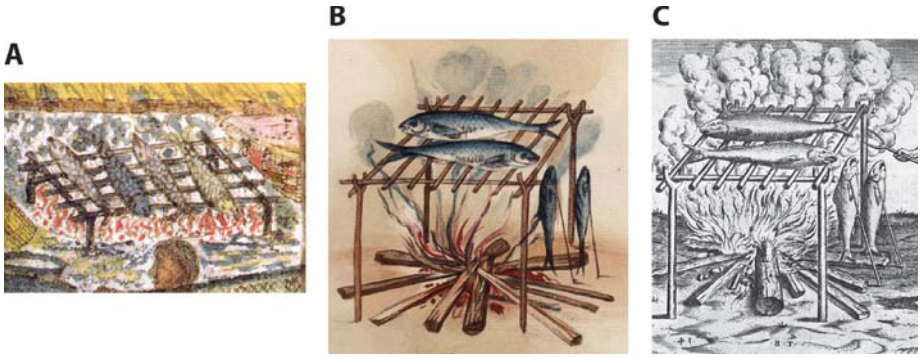
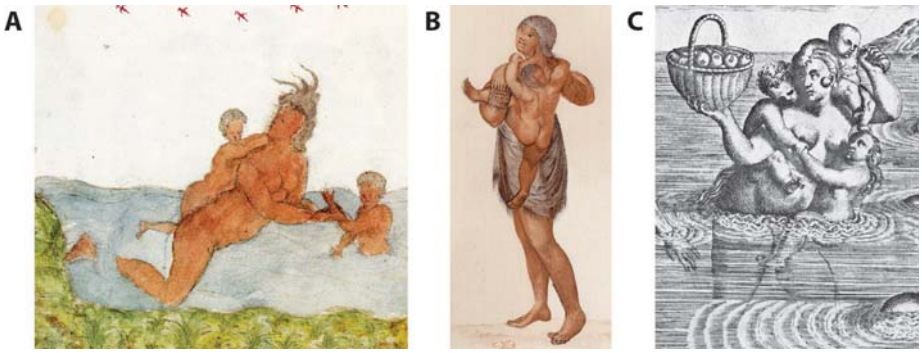


Figure 10. Women and children: A. Woman and children bathing from *The Drake Manuscript*, B. Floridian women and child by John White, C. Floridian women and child crossing to an island by Jacques Le Moyne.



Jacques Le Moyne

The artist Jacques Le Moyne de Morgues (1533-1588) sailed on the disastrous Jean Ribault expedition to Florida in 1564-1565 and drew scenes of the life of the Timucua Indians where most of the colony was murdered by the Spanish. However, Le Moyne escaped destruction and eventually returned to France where he is thought to have worked on his gorgeous botanical illustrations. He emigrated to London, probably after the St. Bartholomew's Day Massacre of 1572, dying there in 1588 (Harvey, 2008). Apparently his Florida drawings were made from memory in France or London, that, with one disputed painting, are now lost. Le Moyne's pictures were purchased from his widow, by the engraver Theodore De Bry to illustrate his famous 1591 Latin work *Florida* (Lorant, 1946). Le Moyne and John White met in London in 1585 and White copied Le Moyne's work. Examples include Indians of Le Moyne reflected in White's watercolors, and ancient Picts of England (Hulton and Quinn, 1964; Birch, 2009). HA was clearly aware of De Bry's engraving since many of his images have echoes of both Le Moyne and White's work (Figs. 8-12). This is evidence that HA was aware of some of the paintings of White directly, since a number of his images that are paralleled in HA's paintings such as the tortoise, pineapple, mamey, plantain, and flying fish, are not found in the engravings.

CONCLUSION

From the information presented above, various conclusions can be drawn as follows. HA was a Frenchman and was involved in some way with at least one of the voyages of Sir Francis Drake, probably the 1585-1586 voyage to the West Indies. Drake had contacts with Frenchmen on his voyages and picked up a number of them in Cartagena in 1586 (Keeler, 1981; Sugden, 1990). HA's knowledge of the latitude of Roanoke and the illustration of the Indian of Loranbec suggest that he was aware of John White's rescue at Roanoke by Drake in 1586. There are similarities in some of HA's illustrations to those of White and Le Moyne, and the corresponding etchings of De Bry, all of whom were present in London between 1587 and 1588.

Drake arrived with at least eight ships on the Carolina coast in 1586, but if HA was on board Drake's 400 ton flagship *Elizabeth Bonaventure* he certainly would not have landed with Drake and select officers who braved the shallows in a smaller boat to confer with Ralph Lane on Roanoke. Thus, the picture of the Indian of Loranbec by HA offers no evidence that the artist was actually ashore at Roanoke but he could have been on board one of the ships in the area, most likely Drake's flagship. The mention of a battle of the Loranbec Indians by HA may be explained by confusion with a skirmish at St. Augustine. If HA accompanied Drake on his West Indian voyage, he would have accompanied White (as well as Baptista Bozio who also used some drawings of White in his maps) from Roanoke to Plymouth from June 18 to July 27, 1586. Since Le Moyne was known to White and De Bry they might have connected in London at some point between 1585 and Le Moyne's death there in 1588. The surmise that HA was picked up in Cartagena by Drake has the virtue of explaining the possible relationship

Figure 11. Indians of Ionia [Guiana?] in *The Drake Manuscript* (left) compared to sleeping sentinel execution image of Jacques Le Moyne (right).

Figure 12. Healing: Indians healing an arrow wound with smoke from tobacco from *The Drake Manuscript* (left); Healing of Floridian Indians by Jacques Le Moyne (right).

of White, Le Moyne, and De Bry; HA's deep familiarity with the Spanish Main and Indian culture; and his inclusion of bits of information about Drake's various voyages that could have been picked from his crew. The precise identity of HA remains a mystery, but his work remains a valuable resource for information about horticulture and culture of the indigenous Indians of the New World.

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Cashew Industry in India – An Overview

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CROP HISTORY, BOTANY AND USES

Cashew (*Anacardium occidentale* L.) is a native of tropical America from Mexico to Peru and Brazil and also the West Indies. Four centuries ago, the adventurous Portuguese came sailing down the Indian coasts and brought with them the priceless nut tree to control soil erosion on the coasts. Cashew came, conquered and took deep root in the entire coastal region of India. The crop found the Indian soil more homely than its homeland. The first introduction of cashew into India was made in Goa from where it spread to other parts of the country's west and east coasts, especially in the states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (Sham Singh et al., 1963). In the beginning it was mainly considered as a crop for afforestation and soil binding to check erosion. Although its commercial exploitation began from the early 60s, only marginal land and denuded forests were set apart for plantation development.

The word 'cashew' is derived from the Portuguese name for the nut 'caju', which was adopted by them from the native name 'acuju'. The cashew is a low, sprawling evergreen tree (Fig. 1) with a gnarled or twisted trunk, possessing alternate, simple, leathery, oval or obovate glabrous leaves (10-12.5 cm long, 5-10 cm wide) that are rounded and often notched at the apex. The wood of the tree exudes a yellow gum. The flowers are borne in clusters on lax terminal panicles at the end of the branches. The fruit consists of a soft, shiny, pear-shaped, swollen, juicy basal portion or hypocarp, commonly known as cashew apple. In fact, the swollen peduncle and receptacle is reddish or yellow in colour when ripe. The cashew apple bears at its summit a kidney-shaped, single-seeded nut with a hard, grey-green pericarp or shell. This true fruit attains its full size before the enlargement of the receptacle. The shell of the nut contains an acrid juice or sap that causes severe irritation of the skin resulting in painful blisters. The seeds are exalbuminous with reddish brown testa, two large white cotyledons and a small embryo. They are inedible when raw and must be cooked or roasted to drive off the volatile oil before it is opened or shelled.

In the field of international development, cashew cultivation has attracted considerable interest from the development agencies, producers, governments and advocates of sustainable economic and environmental development. As a resilient and drought resistant tree that is adaptable to poor soil conditions, it offers environmental benefits in the fight to combat deforestation and soil erosion. Most importantly, its cultivation and exploitation are regarded as economically promising for both rural growers and urban industrial processors in terms of employment generated and value added to emerging economies.

Cashew nuts have a relatively high fat content (12 g per ounce and 2 g saturated fat), but it is considered "good fat". Even with a relatively high fat content, cashew nuts are considered to be a "low-fat" nut. In fact, cashew nuts contain less fat per serving than many other popular nuts commonly found in grocery stores and health food stores, including almonds, walnuts, peanuts and pecans. Cashew is composed

Figure 1. Low, sprawling evergreen cashew tree.

Table 1. Composition of cashew kernel and cashew apple (CSIR, 1985; Augustin, 2001).

Constituents	Kernel (%)	Apple (%)
Moisture	6.9	87.9
Protein	21.0	0.2
Fat	47.0	0.1
Carbohydrates	22.0	11.6
Fiber	1.3	0.9
Minerals	2.4	0.2
Phosphorous	0.45	0.01
Calcium	0.55	0.01
Iron	5 mg/100 g	0.2 mg/100 g
Carotene	100 I.U/100 g	-
Vitamin B1	630 mg/100 g	-
Riboflavin	190 mg/100 g	0.5 mg
Vitamin C	-	170-350 mg/100 g

mainly of unsaturated fatty acids (nearly 80%), which in humans raise the levels of high density lipoproteins (HDLs), which are associated with a decreased risk of atherosclerosis and coronary heart disease. Cashew kernels contain polyunsaturated fatty acids in a 1:1 ratio with saturated fatty acids, which also is considered to have potential good health effects (Nair, 2009).

There are various recommendations for use of cashew nut consumption for diet and weight loss. Cashew nuts have a high energy density and high amount of dietary fibers, both of which have been credited as having a beneficial effect on weight control, but only when eaten in moderation.

STATUS OF AREA, PRODUCTION AND PRODUCTIVITY

India is the leading country in the world in cashew production area (923,000 ha) and production (613,000 MT). Cultivation of cashew in India is confined mainly to the peninsular areas. It is grown in Kerala, Karnataka, Goa and Maharashtra, along the west coast of the country and in Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast of the country. To a limited extent it is being cultivated in Chattisgarh, North Eastern States (Assam, Manipur, Tripura, Meghalaya and Nagaland) and on Andaman and Nicobar Islands (Table 2 and Fig. 2).

EXPORT SCENARIO

India has a creditable record of attaining good foreign exchange by exporting cashew kernels. During the year 2009-2010, India exported 108,120 MT of cashew kernels valued at US$590 million (Table 3). USA, The Netherlands, UK, Japan, UAE, France, Canada, Saudi Arabia, Singapore, Italy, Germany, Austria, Israel and Spain are the major international buyers of Indian cashews. Further, cashew nut is also imported into India from other producer countries. These nuts are processed in the country and then are either distributed in the local market or re-exported.

The first commercial cashew processing unit was set up in Kollam in the mid-1920s. However, early exports were not followed up because the cashew kernels were not vacuum-packed, but wrapped in newspapers and packed in reused tea chests. World War II put a halt to any further development of the trade. Export volumes picked up only after the introduction of airtight tins infused with carbon dioxide in the mid-1950s. Soon after this technological advancement, processing plants were established in Mangalore and Goa. Another small but important processing centre is located in Panruti, the South Arcot district of Tamil Nadu.

A major problem facing the Indian cashew industry is the acute shortage of raw cashew nuts within the country. The processing requirement is about 1,200,000 MT per annum while the domestic production is only 600,000 MT per annum. Consequently, the cashew processing industry has resorted to importing raw nuts for processing and export. Along with the increasing world demand for cashew, Indian consumption is also growing.

India and Brazil were the major suppliers of cashew to the world market until about five

Table 2. Area, production and productivity of cashew in the different states of India (2009-2010).

State	Area ('000 ha)	Production ('000 MT)	Average productivity (kg/ha)
Maharashtra	175	198	1186
Kerala	72	66	957
West Bengal	11	10	909
Orissa	143	84	641
Andhra Pradesh	183	99	544
Goa	55	26	473
Tamil Nadu	133	60	472
Karnataka	118	53	461
Others	33	17	680
Total	923	613	695

Source: http:/dccd.gov.in/stat.htm

Figure 2. Major cashew growing areas in India.

Table 3. Export of cashew kernel, cashew nut shell liquid (CNSL) and import of raw cashew nut.

Year	Cashew kernel export		CNSL export		Raw nut import	
	Quantity (MT)	Value (Million US$)	Quantity (MT)	Value (Million US$)	Quantity (MT)	Value (Million US$)
2009-2010	108,120	590.8	9748	4.90	752,894	617.5

Source: http:/dccd.gov.in/stat.htm

years ago. In recent years, Vietnam has also emerged as a major supplier, replacing Brazil in second position. At present, USA and West Europe are India's major markets, followed by Japan, West Asia and Australia. New emerging markets like Eastern Europe, Commonwealth of independent state countries and China are becoming active buyers of cashews. Another area where there is potential for significant market growth is export of organically produced cashews. Moreover, new products are being developed apart from the cashew kernels, including cashew apple, cashew nut shell liquid (CNSL), cashew shell and cashew testa.

Cashew apples can be sold fresh as soon as they have been picked, and are then used as a culinary ingredient or further processed into drinks (juice, wine), marmalade or vinegar. There are interesting prospects for setting up processing plants for utilization of cashew apples, which, at present, are mostly wasted. Many preparations like juices, jams, candies, pickles, chutneys, and alcoholic beverages can be prepared from this by-product.

Cashew nuts consist of 35-45% seed and around 55-65% shell. The shells contain 15-30% oil. A ton of nuts contains around 200 kg seeds and 180 kg oil (cashew nut oil or CNSL). CNSL is a naturally occurring phenol, which is contained in the soft honeycomb mesocarp of the shell. CNSL is a viscous, oily or balsam-like substance, pale yellow to dark brown, having bitter taste and caustic properties. Fresh CNSL contains 90% anacardic acid, which is converted into cardanol on heating. The remaining 10% is cardol, which is mainly responsible for the vesicant property. CNSL, a by-product of cashew processing, is used as oil in industry. It is a versatile industrial raw material that has applications in polymer-based industries such as friction dust, brake linings, paints and varnishes, laminating resins, cashew cements, polyurethane based polymers, surfactants, and epoxy resins (Peter, 2002).

Cashew shell, after removal of the kernel and extraction of shell liquid, is currently used as fuel. However, this shell can also be used to manufacture particle-based boards for the packaging industry. Tannin can also be extracted from the testa of the kernel. It has application in the leather industry and many other chemical industries. The major products for industrial applications are cashew lacquer, insulating varnishes, electrical windings and electrical conductors impregnated with CNSL and cashew cement (CNSL reacted with formaldehyde).

INSTITUTES IN CASHEW INDUSTRY

Directorate of Cashew Research (DCR)

In India, research on cashew was first carried out in the early 1950s. In 1971, Indian Council of Agricultural Research (ICAR) sanctioned the All India Coordinated Spices and Cashew Improvement Project (AICS and CIP) with its headquarters located at Central Plantation Crops Research Institute (CPCRI), Kasaragod. The National Research Centre for Cashew was established at Puttur on 18th June, 1986, after which it was upgraded and renamed by ICAR in 2009 as Directorate of Cashew Research (DCR). Subsequent to the bifurcation of AICS and CIP, the headquarters of All India Coordinated Research Project on Cashew was shifted to DCR, Puttur. At present, this Coordinated Research Project is operating in ten centers, one sub-center and three co-operating centers located in major cashew growing areas of the country.

Table 4. Cashew processing units in India.

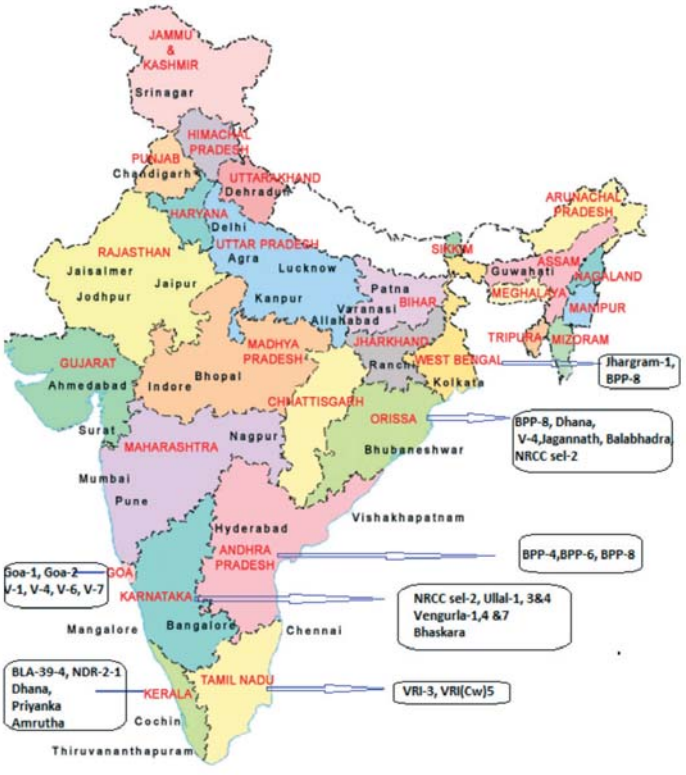
States	Processing units (Nos.)	Capacity ('000 MT)	Utilization ('000 MT)		
			Indigenous	Import	Total
Tamil Nadu	417	400	294	225	519
Kerala	432	600	67	320	387
Andhra Pradesh	175	100	92	-	92
Karnataka	266	300	45	20	65
Goa	45	50	21	-	21
Maharashtra*	2200	50	20	-	20
NE States	22	10	15	-	15
Orissa	209	100	11	-	11
West Bengal	30	8	8	-	8
Chattisgarh	3	5	-	-	-
Total	3799	1623	573	565	1138

*Includes 1850 small scale cottage industry
Source: http:/dccd.gov.in/stat.htm

Directorate of Cashew Nut and Cocoa Development (DCCD)

The Directorate of Cashew Nut and Cocoa Development (DCCD) established in 1966 under the Union Ministry of Agriculture gave a greater impetus to the development of cashew in a more scientifically oriented manner. This marked the first step towards the integration and co-ordination of cashew development in association with developmental agencies of States and Research Institutes. The prime objective of DCCD is the formulation and execution of various development programmes on cashew nut and cocoa in the country.

Figure 3. Recommended and popular cultivars grown in different states of India.



Cashew Export Promotion Council of India (CEPC)

The Cashew Export Promotion Council of India (CEPC) was established by the Government of India in the year 1955, with the active cooperation of the cashew industry, to promote exports of cashew kernels and CNSL from India. Through its very set up, the Council provides the necessary institutional frame-work for performing the different functions that serve to intensify and promote export of cashew kernels and CNSL. The Council provides the necessary liaison between foreign importers and member exporters of cashew kernels. The enquiries received from foreign importers are circulated amongst Council members. The Council also extends its role to settling complaints amicably in the matter of exports/imports, either on account of quality and/or variation in fulfillment of contractual obligations.

RESEARCH ACCOMPLISHMENTS

Breeding and Varietal Improvement

Systemic collection, conservation, cataloguing and evaluation of germplasm of cashew was attempted only very recently. At the centres of cashew research in India over one thousand collections including 69 exotic collections from Brazil, South Africa, Mexico, Tanzania, Malaysia, Nigeria, Tanganyika and Sri Lanka are being evaluated for yield and associated characters and quality of nut and apple. Five hundred and thirteen accessions in DCR, Puttur and over 1300 accessions in regional field cashew gene banks in centres under All India Coordinated Research Project (AICRP) on cashew were being maintained. A total of 40 high yielding cashew cultivars have been released in the country for commercial cultivation (Table 5 and Fig. 3).

The efforts at different research centres to improve varieties, both by germplasm evaluation as well as hybridization programmes, aim at developing superior strains with high yield, bold nuts and high shelling percentage (Bose and Mitra, 1990). Current researchers in India strive to incorporate maximum levels of pest tolerance/resistance in these cultivars so that the benefits of high yield can be realized with minimum pest control programmes. Rationalization of fertilizer input, developing cultivars with nuts containing improved nutritive qualities and developing cost-effective packaging that is within the reach of marginal farmers are the priorities at present being pursued by different research stations in India.

Propagation

Since cashew is a cross-pollinated crop, seed propagation leads to variability in the progeny in growth and yield characters. Vegetative propagation of elite mother plants results in the production of true-to-type plants, which contributes to increased production and pro-

Table 5. Cultivars or hybrids released from various cashew research stations in India.

S. No.	Cultivar	Hybrid/ selection	Year of release	Yield (kg/tree)	Nut weight (g)
Regional Research Station, Vridhachalam, Tamil Nadu					
1.	VRI-1	Selection	1981	7.2	5.0
2.	VRI-2	Selection	1985	7.4	5.1
3.	VRI-3	Selection	1991	10.0	7.2
4.	VRI(Cw)-5	Hybrid	2007	13.2	7.2
Regional Fruit Research Station, Vengurla, Maharastra					
5.	Vengurla-1	Selection	1974	19.0	6.2
6.	Vengurla-2	Selection	1979	24.0	4.3
7.	Vengurla-3	Hybrid	1981	14.4	9.1
8.	Vengurla-4	Hybrid	1981	17.2	7.7
9.	Vengurla-5	Hybrid	1984	16.6	4.5
10.	Vengurla-6	Hybrid	1991	13.8	8.0
11.	Vengurla-7	Hybrid	1997	18.5	10.0
Agricultural Research Station, Mangalore, Karnataka					
12.	Ullal-1	Selection	1984	9.0	6.0
13.	Ullal-2	Selection	1984	14.7	6.0
14.	Ullal-3	Selection	1993	9.5	7.0
15.	Ullal-4	Selection	1994	10.5	7.2
National Research Centre for Cashew, Puttur, Karnataka					
16.	NRCC-sel-1	Selection	1989	10.0	7.6
17.	NRCC-sel-2	Selection	1989	9.0	9.2
18.	Bhaskara	Selection	2005	18.5	6.5
19.	Goa-1	Selection	1999	7.0	7.6
Agricultural Research Station, Chintamani, Karnataka					
20.	Chintamani-1	Selection	1993	7.02	6.9
21.	Chintamani-2	Selection	2007	29.8	7.9
Cashew Research Station, Bapatla, Andhra Pradesh					
22.	BPP-1	Hybrid	1980	10.0	5.0
23.	BPP-2	Hybrid	1980	11.0	4.0
24.	BPP-3	Selection	1980	11.0	4.8
25.	BPP-4	Selection	1980	10.5	6.0
26.	BPP-5	Selection	1980	11.0	5.2
27.	BPP-6	Selection	1993	10.5	5.2
28.	BPP-8	Hybrid	1989	14.5	8.2
29.	Bhubaneswar-1	Selection	1989	10.5	4.6
30.	Jagannath	Hybrid	2008	10.5	8.6
31.	Balabhadra	Hybrid	2008	10.0	7.4
Regional Research Station, West Bengal					
32.	Jhargram-1	Selection	1989	8.5	5.0
Cashew Research Station, Annkkayam & Madakkathara, Kerala					
33.	Annkkayam-1	Selection	1985	12.0	6.0
34.	Madakkathara-1	Selection	1987	13.8	6.2
35.	Madakkathara-2	Selection	1987	17.0	7.3
36.	Dhana	Hybrid	1993	17.5	9.5
37.	Kanaka	Hybrid	1993	19.0	6.8
38.	Priyanka	Hybrid	1995	16.9	10.8
39.	Amrutha	Hybrid	1999	18.4	7.2
40.	K-22-1	Selection	1987	13.2	6.2

Figure 4. Drip fertigation system in cashew orchard.

Figure 5. A. Tea mosquito bug (*Helopeltis antonii*). B. Cashew stem and root borer (*Plocaederus ferrugineus*).

ductivity. Soft wood grafting methods have been standardized and the technique is being commercially utilized for large scale production of planting material in the countryside. In India, over 6,000,000 grafted cashew plants are being produced annually by this method. Over 80 regional nurseries approved by DCCD are producing quality grafts of improved cultivars.

Research on Growing Techniques

Field crops such as groundnut (*Arachis hypogeae*), blackgram (*Phaseolus mungo*), greengram (*Vigna radiata*), vegetables such as cucumber (*Cucumis sativus*), bottlegourd (*Lagenaria siceraria*), tuber crops and fruit crops such as pineapple (*Ananas comosus*), spices such as turmeric (*Curcuma longa*), ginger (*Zingiber officinale*) and pepper (*Piper nigrum*) have been found to be suitable and profitable intercrops in cashew plantations, increasing the total return per land unit during the early stage of establishing a cashew plantation.

High density planting with 4 x 4 m spacing (625 plants/ha) was shown to be better than traditional spacing (8 x 8 m), resulting in a yield increase of 2.5 times over the control in the initial ten years.

In the summer months, providing irrigation of 200 L of water per tree once every 15 days after flowering was found to increase the cashew yields profitably. Irrigating cashew at 60-80 L water per tree once in four days through drip irrigation (Fig. 4) after flowering till fruit set and development in combination with the application of 750:188:188 g of N-P-K/tree led to significantly higher yields (Bhat et al., 2009).

Cashew is a deciduous tree that provides approximately 5 tons of cashew biomass residues (leaves, twigs, flowers and apples) per hectare in a well-established cashew orchard. Use of earthworms for the production of vermicompost from cashew biomass is a low cost technology with great potential; 3.5 tons of vermicompost can be produced per ha of adult cashew orchard per year.

Beheading seedling trees in old cashew plantations at 1 m height during June-July and soft wood grafting with 60-day-old scion shoots of high yielding cultivars, recorded a higher survival of 72.14% compared to beheading and grafting trees at 0.75 m height.

Research on Phytosanitary Treatments

A recommended spray schedule has been developed both at DCR and centres of AICRP for effective control of tea mosquito bug (TMB - *Helopeltis antonii*) (Fig. 5a). Recently, new insecticides have been tested for the control of TMB. Among the new insecticides evaluated against this pest, l-cyhalothrin was found to be very effective in reducing the damage. Sprays are recommended during the most vulnerable periods of crop production such as flushing, flowering and fruiting.

Another devastating pest of cashew is cashew stem and root borer (CSRB - *Plocaederus ferrugineus*) (Fig. 5b). It was found that spread of the pest could be prevented by adopting phytosanitation practices. Chloropyriphos (0.2%) and Carbaryl have been shown to be effective as curative treatments after the extraction of CSRB grubs from the tree trunk (post treatment prophylaxis).

Research on New Cashew Based Products

Technologies for production of many new value-added products of cashew apple and cashew kernels have been developed. Cashew apples can be utilized for preparation of jam, jelly, syrup, juice, etc. (Fig. 6). A sweetened and flavoured spread can also be prepared from the young tips of cashew kernels. Optimum coating of tips with honey and cane sugar occurs at 100°C at 70% concentration. Sweetened and flavoured young tips can be stored without quality deterioration for up to twelve months at ambient temperature.

CASHEW DEVELOPMENT

The cashew development programme started with distribution of seedlings of the crop to farmers. A concerted effort to develop the cashew industry started with the focus on production, area expansion, improvement of quality planting material and development of production technology, which included rejuvenation and plant protection. Research was strengthened by establishing the All India Coordinated Research Project on Cashew. At the same time,

Figure 6. Value-added products of cashew apple.

Table 6. Cultivars released by Regional Research Station (TNAU), Vridhachalam and other research stations.

Cultivars released by Regional Research Station (TNAU), Vridhachalam

VRI-2: Selection from germplasm collected from Kathupalli village. Multiple branching with late flowering and medium sized fruit. The percentage of bisexual flowers is 10% with 5-8 fruits/bunch and average yield of 6.0 kg/tree. The nut size is medium (5 g) and shelling percentage is 28.

VRI-3: Seedling progeny selected from Edianchavady village of South Arcot district. The nuts are large in size. The mean weight of 100 nuts was 718 g having a shelling percentage of 29.1. The kernels conform to a grade W 210. This genotype had a mean yield of 14.17 kg/tree/year, which would equate to a yield of 2700 kg/ha. The apple is pear shaped and pink with a weight of 50.8 g.

VRI-4: Selection from Vazhisodanaipalayam, Cuddalore district of Tamil Nadu, which is a mid season flowering type. The apple is round shaped and thick red in colour. The average fruit weight was 42.80 g. The nuts are medium size with an average nut weight of 6.63 g and a kernel weight of 1.7 g. The shelling percentage was 28.5 with grade W 320 kernel count. It is moderately resistant to the tea mosquito bug.

VRI (Cw) H1: High yielding selection suitable for cashew growing districts of Tamil Nadu. The hybrid is a cross between M 26/2 and M 26/1. It has a typical cluster bearing property with 4-6 fruits per panicle. The nuts are bold, 7.2 g, kernel 2.2 g, easy peeling testa, high shelling percentage of 30.5, grade W 210. The cashew apple is pink with a yellow tinge, 50-53 g weight, with TSS of 12.5° brix. The trees are moderately resistant to tea mosquito bug under field conditions.

Other Research Station released cultivars

VENGURLA – 7: Released from Cashew Research Station, Vengurla, Maharashtra. Mean nut yield/tree: 18.5 kg. Nut weight: 10 g. Shelling %: 30.5. Export grade: W180.

BPP 8: Released from Cashew Research Station, Bapatla, Andhra Pradesh. Mean nut yield/tree: 14.5 kg. Nut weight: 8.2 g. Shelling %: 29. Export grade: W210.

BHASKARA: Released from Directorate of Cashew Research, Puttur, Karnataka. Mean nut yield/tree: 10.7 kg. Nut weight: 7.38 g. Shelling %: 30.6. Export grade: W240.

PRIYANKA (H-1591): Released from Cashew Research Station, Madakkathara, Kerala. Mean nut yield/tree: 17.03 kg. Nut weight: 10.8 g. Shelling %: 26.57. Export grade: W180.

the State Forest Departments started systematic plantation of this crop using seedlings from high yielding plants. The formation of Cashew Development Corporations and Forest Development Corporations was a significant developmental step in the promotion of cashew to the public. Due to the absence of any recommended cultivars and suitable multiplication techniques, massive areas were covered using seeds and seedlings as planting material.

High yielding cultivars suitable for different agro-climatic conditions have been identified. The establishment of regional nurseries, both under public and private sectors closely monitored by DCCD, provided an excellent infrastructure for the production of quality planting material. Forty high yielding cultivars were developed (Table 6). A standardized soft wood grafting technique and standardized production practices were developed. These efforts continued with substantial increase in allocation of funds coupled with accelerated growth in production and productivity. The emphasis is now placed on removal of old unproductive plantations and replanting with high yielding cultivars.

Constraints in Cashew Production

Even though cashew production is blessed with a huge research effort, a vast network of processing industries and elite private processing sector, and the most congenial climatic conditions, there are still a number of constraints on production. For example, many early cashew plantations were established with poor quality seedling progeny and are now unproductive. Also, poor soil fertility in cashew growing areas, seedling progeny of indistinct origin and neglect of crops have resulted in low yields. This was prevalent in most of the cashew growing areas of Karnataka, Goa, Andhra Pradesh, Orissa and Tamil Nadu. The lack of transfer of technology programmes to better equip farmers is yet another constraint.

Opportunities for Enhancement of Production and Productivity

There is enormous scope to introduce cashew into the nontraditional states of Orissa, Maharashtra, Andhra Pradesh and Karnataka. Massive replanting programmes to replace the aging cashew plantations with improved cultivars, establishing cashew export zones, using quality clonal planting material, establishing cottage industries for the processing of raw nuts and cashew apples, effective transfer of technology programmes, and introduction of a contract farming system, provide opportunities to enhance production and productivity and to overcome the shortage of raw nuts required by the processing industries.

PROSPECTS OF INDIAN CASHEW

Among the cashew growing countries, India has the largest planted area, and is the largest producer, exporter and importer. The Indian cashew industry is one of the few industries in the country that is so export oriented. Apart from earning valuable foreign exchange, the cashew industry is providing many concrete employment opportunities. In global trade contracts, cashew is one of the items supporting the multilateral trade policy. Indian production is meeting only 50% of its industrial capacity. Any effort to increase the production will therefore not be in vein in the context of expanding consumer preference and market absorbability. Clonal material of high yielding cultivars are proving better and, if such material can be used for replanting in the ever increasing aging areas, Indian production can very well touch one million tons within a period of 15 years.

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About the Authors





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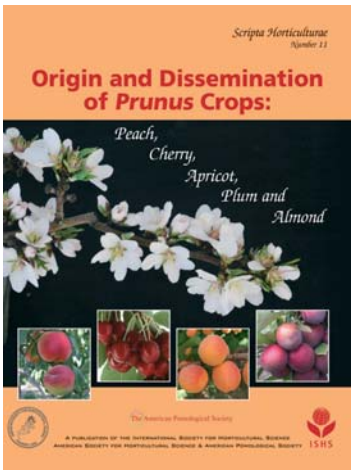
New Books, Websites

BOOK REVIEWS

Origin and Dissemination of *Prunus* Crops: Peach, Cherry, Apricot, Plum and Almond. Edited by Jules Janick. 2011. *Scripta Horticulturae* 11. A publication of the International Society for Horticultural Science. 241p. ISBN 978-90-6605-436-3. € 30. Available from the ISHS Secretariat (www.ishs.org/pub/scripta.htm).

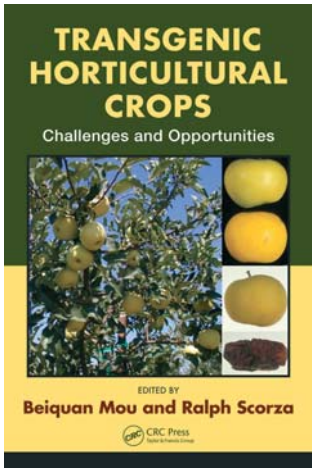


Scripta 11, dedicated to the late Miklos Faust, contains reviews on the origin and dissemination of *Prunus* fruit and nut crops that were published in *Horticultural Reviews* between 1995 and 2011. The five tree crops covered originated in Europe, Central Asia, or China and are now distributed worldwide where they are considered among the most well-known and beloved fruits or nuts of temperate and subtropical climates. The first four reviews (peach, cherry, apricot, and plum) were coauthored by Miklos Faust and colleagues Bela Timon, Dezsö Surányi or Ferenc Nyujtó, while the last one on almond was authored by Thomas M. Gradziel. The collection is sponsored by the International Society for Horticultural Science, The American Society for Horticultural Science, and the American Pomological Society.

The books listed here are non-ISHS-publications. For ISHS publications covering these or other subjects, visit the ISHS website www.ishs.org or the Acta Horticulturae website www.actahort.org

Transgenic Horticultural Crops: Challenges and Opportunities. Beiquan Mou and Ralph Scorza (eds.). 2011. CRC Press (Taylor & Francis Group), Boca Raton, Florida, USA. 364p. ISBN 978-1-4200-9378-0 (hardback). $129.95 / £82.00. www.crcpress.com

This volume edited by Beiquan Mou and Ralph Scorza is composed of 20 chapters by a total



of 35 authors. It covers the area of transgenics in horticultural crops including fruit and nuts, vegetables, ornamentals, and pharmaceuticals (5 chapters); transgenics in Europe, Africa and Asia (3 chapters); and economics, development, consumer problems, and commercialization issues (8 chapters). The chapters emphasizing recent research are well written and informative but in many ways it has a very sad story to tell. Despite the enormous sums of money and resources expended and the significant technical progress achieved, there are still few signs of commercial success in horticulture. The 1994 releases of 'Flavr Savr' tomato, with delayed ripening developed by Calgene, and the Russet Burbank New Leaf potato, with resistance to Colorado potato beetle by Monsanto, proved to be either commercial failures because of quality in the case of tomato or negative marketing issues in the case of potato. The best example of transgenic success in horticulture has been the papaya ring spot virus (PRSV) resistant papaya, which has just been approved for market acceptance by Japan. The recent rejection by the India government of the GM eggplant developed by an international consortium is especially disheartening in view of the benefits it offered of reduced pesticide usage. One would have expected success at least in ornamentals, but it appears that there is only one example on the market: blue carnations. The blue rose that was so eagerly anticipated has not been released. The failure of transgenics in horticulture is disturbing in view of the fact that transgenic maize, soybean, canola, and cotton are examples of extremely high rates of commercial adoption since the first releases starting in 1996. The reasons are only partially technical. The sad fact is well expounded in chapter 8 (The Economic and Marketing Challenges of Horticultural Biotechnology), which stresses high fixed costs and regulatory issues, which make it difficult to show economic returns for crops that have low market potential compared to agronomic crops. Of course the greatest issue is marketing fears based on consumer skittishness, an issue that has been stroked by proponents of the environmental and organic movement. Clearly, as the title of the book suggests, and as many authors explain, there are opportunities for the development of transgenic horticultural crops. I do expect transgenics to eventually play a significant role in horticultural crops but it will depend on coming up with improvements that will be overwhelming enough to consumers to overcome or alleviate their fear of the unknown. The high research expenditure of biotechnology in China and their high internal demand for horticultural products, suggest to me that the success of transgenics will be achieved there. I think that this is an incredible book and I highly recommend it to all interested in this timely topic.

Reviewed by Jules Janick, Purdue University, USA

A wide range of opinions has been expressed over the years about the pros and cons of genetically modified (GM, or transgenic) crops. The intense media coverage of scientific communications reporting unintended negative impacts for insect-resistant transgenic plants against non-target organisms has triggered an unprecedented, and still ongoing, controversy over the large-scale deployment of these crops in the environment. But transgenic crops are now grown every year, over millions and millions of hectares in more than 25 countries, with a growth adoption rate reaching 5 to 10% annually. And while the so-called "Frankenfoods" they produce are now referenced in common dictionaries, these crops have rapidly become a central component of many agricultural systems, since their initial introduction on the market in the mid-1990s. According to the International Service for the Acquisition of Agri-Biotech Applications, "biotech crops are the fastest adopted crop technology in the history of modern agriculture" (James, 2010). A large proportion of plants found nowadays in cotton, soybean, maize and canola fields worldwide are transgenic, and many other plants engineered to express a variety of new traits have been developed over the last two decades.

In this context suggesting a promising future for GM crops, this new book edited by Beiquan Mou and Ralph Scorza is very welcome. Useful reference books have been published already on GM crops, but very few have given such a large place to horticultural species. Whereas the vast majority of commercialized transgenic crops are commodity crops engineered to kill herbivorous insects or to tolerate broad-spectrum herbicides, the scientific literature presents a more diversified and more balanced picture of the situation, with a wide range of plant species expressing a wide range of novel traits. Hundreds of papers have described transgenic vegetables, fruits or ornamentals engineered to exhibit new traits of agronomic or commercial value, and papers are published every week, if not every day, that describe a transgenic line of potato, grape or petunia with an interesting new characteristic.

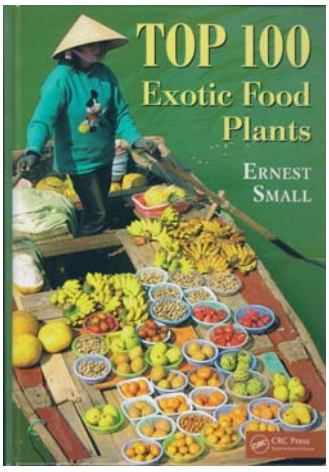
Mou and Scorza's book is a collection of chapters that address, together, the various aspects of horticulture biotechnology. Topics include current scientific knowledge on transgenic fruits, nuts, vegetables and ornamentals; horticultural crops as bio-factories to produce therapeutic proteins; implementation of transgenic horticultural species in different parts of the world; economic and marketing challenges relevant to horticulture biotechnology; consumer acceptance of GM foods; intellectual property rights, university-private partnerships and regulatory guidelines for GM fruits, vegetables and ornamentals; safety assessment and risk mitigation of GM horticultural crops; and interesting case studies on the commercialization of these new plant lines. Overall, the book is very well written, pleasant to read, and presented in a clear and uniform way despite a general format implicating numerous authors and co-authors. It is scientifically solid thanks to the excellent contributions of leading experts in the field. I warmly recommend this book to any researcher, technician or graduate student involved in the complex and fast evolving field of horticulture biotechnology. This book will also be useful to anyone simply looking for a comprehensive reference on the various aspects of horticultural crops genetic and metabolic engineering.

Reference

James, C. 2010. Global Status of Commercialized Biotech/GM Crops: 2010. ISAAA Brief No. 42. ISAAA, Ithaca, New York.

Reviewed by Dominique Michaud, Centre de recherche en horticulture, Université Laval, Québec City, Canada

Top 100 Exotic Food Plants. Ernest Small. 2011. CRC Press (Taylor & Francis Group), Boca Raton, Florida, USA. 658p. ISBN 979-1-4398-5686-4. $89.95. www.crcpress.com



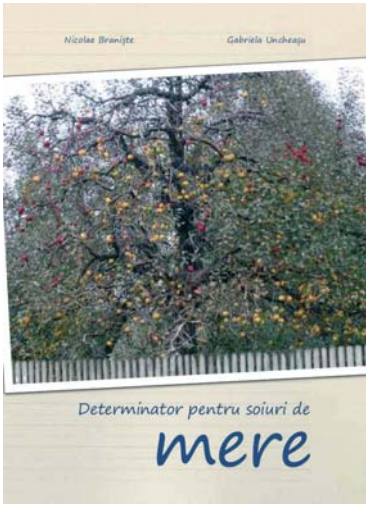
This delightful work is an extension of the author's previous volume entitled *Top 100 Food Plants* (NRC Research Press, Ottawa, Canada, 2009). The collection is basically a

factbook for 100 plants or groups that are exotic to the Western world. Many of the entries are subtropical or tropical. Although all plants included are technically consumed in some way, I would argue that the term food plant is a stretch in many cases, e.g. khat, tobacco, miracle berry, myrrh. Each of the 100 chapters on plants is divided into Names, Plant Portrait, Culinary Portrait, and Curiosities of Science and Technology. The value of this book for horticulturists is that it provides a brief technical and culinary overview of a number of plants for which this information is sometimes difficult to find. The list of references will be very useful. Plants covered include acai berry, acerola, akee, allspice, arrowroot, asafetida, bamboo, baobab, bay, betelnut, breadfruit, cacti, candlenut, cape gooseberry and tomatillo, caper, carambola, carob, cashew, cassabanana, ceriman, chayote, cherimoya and atemoya, Chinese artichoke, citron, clove, coca, coco de mer, culantro, cumin and black cumin, cycads, durian, epazote, feijoa, fenugreek, galangal, ginger, ginkgo, goji, grass pea, guarana, guava, gum Arabic, hemp, horseradish tree, jackfruit, Japanese vegetables (gobo, garland chrysanthemum, mituba and honewort, water dropwort), jicama, jujube, kava, khat, kiwi, kumquat, lemongrass, lemon verbena, loofah, loquat, lychee, longan, and rambutan, macadamia nut, mangosteen, medlar, melons (bitter and horned), miracle fruit, myrrh, neem, noni, nutmeg and mace, oca, okra, opium poppy, palmyra palm, passionfruit, peachpalm, pepino, perilla, persimmon, pomegranate, quinine, rooibos tea, rose apple, roselle, saffron, sago palm, sapodilla, sapote, sarsaparilla, sea buckthorn, exotic spinach (malabar, NewZealand, water), stevia, sweetsop and soursop, tamarind, tobacco, tree tomato, turmeric, Vietnamese herbs, wasabi, water chestnut, wax gourd, wonderberry, garden huckleberry, yard-long bean, and zedoary. The book is nicely illustrated with black and white illustrations, some of which are historic. I predict this work will be a valuable sourcebook for many writing popular articles as well as horticulturists involved with these crops.

Reviewed by Jules Janick, Purdue University, USA

Determinator pentru soiuri de mere (Determinator for apple cultivars) (in Romanian). Nicolae Braniste and Gabriela Uncheasu. 2011. Ceres Publishing House, Bucharest, Romania. 227p. ISBN 978-973-40-0901-5. € 10. www.editura-ceres.ro

Today, genetic and phenotypic biodiversity permits us to choose the best varieties for commercial and family orchards, as evidenced by the high production and quality of the fruits obtained. Determining the valuable features of apple genotypes is a permanent activity of researchers active in fruit breeding. They perform regional studies and take into account



precise criteria, which are assessed recurrently over the years.

A result of such long term studies is the book *Determinator for apple cultivars* elaborated by a group of Romanian apple breeders under the coordination of PhD Nicolae Braniste. The book appeared last year in Bucharest and is intended as a contribution to the enrichment of the specialty literature in Romania.

The work presents: the current status and evolution of research on genetic resources in fruit growing; the European Program for Preservation of Genetic Resources in Agriculture (EURISCO DB and AEGIS projects); the steps in setting up the germplasm fund and its use to obtain new apple varieties at RSFG Voinesti; the importance of preserving genetic resources for pome fruit trees (apple and pear); a description of apple shapes; the list of descriptors used to characterize apple varieties and their reference varieties; a catalogue of reference varieties; the ripening season of apple varieties from the national collection and, of course, the curated bibliography.

The "Determinator" includes a description of the main characteristics and features of trees and their fruits of 554 foreign and domestic apple varieties, old or newly created, which can be found in the national pomological collections at the Research Institute for Fruit Growing, in Pitesti, Romania, at the Research Station for Fruit Growing, in Voinesti and at the Research Station for Fruit Growing, in Cluj Napoca.

The main identification elements that define the genotype and the phenotypic expression are presented in terms of the most important characteristics and features of the tree and its fruit, such as tree vigor, color of flowers, blooming time, harvest fruit maturity, fruit size, shape, background color and covering color, as well as resistance to scab and powdery mildew (the most common and damaging diseases). Moreover, the authors refer to the variety's country of origin, as well as the name under which they are known in different growing areas. This will help rectify confusion that arises particularly in breeding/multiplication.

According to their origin or source, the book describes 147 varieties from the USA, 112 from Romania, 67 from Germany, 41 from France, 33 from Russia, 28 from England, 21 from Canada, 19 from Czech Republic, 16 from Italy, 14 from Japan, 13 from Republic of Moldavia, 7 from Netherlands, etc.

Overall, the book presents a wide overview of apple breeding, including the main varieties from the most important apple producing countries, that is: 321 varieties from Europe, 168 from USA and Canada, 12 from Australia and 53 varieties and species from Asia.

The printed form of the "Determinator" is easy to use. The varieties are presented in alphabetical order, allowing easy retrieval of the information and fast recognition of the apple varieties. The book will be useful for all categories of specialists, students and professionals acting in the field of fruit growing.

Reviewed by Mihail Coman, Fruit Research Institute, Pitesti-Maracineni, Romania

NEW TITLES

Dhankhar, B.S. and Singh, Ram 2009. Okra Handbook: Global Production, Processing, and Crop Improvement. HNB Publishing, New York, USA. 475p. ISBN 978-0-9728061-8-3 (hardcover). $110.00. www.hnbpub.com

Hadidi, Ahmed, Barba, Marina, Candresse, Thierry and Jelkmann, Wilhelm (eds.). 2011. Virus and Virus-Like Diseases of Pome and Stone Fruits. APS Press, St. Paul, MN, USA. 428p. ISBN 978-0-89054-396-2 (hardcover). $299.00. www.shopapspress.org

Segura Munguía, Santiago and Torres Ripa, Javier. 2011. Las Plantas en la Biblia. Deusto University Press, Bilbao, Spain. 384p. ISBN 978-84-9830-305-6. €42.00. www.deusto-publicaciones.es

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Wolpert, Thomas, Shiraishi, Tomonori, Collmer, Alan, Akimitsu, Kazuya and Glazebrook, Jane (eds.). 2011. Genome-Enabled Analysis of Plant-Pathogen Interactions. APS Press, St. Paul, MN, USA. 272p. ISBN 978-0-89054-393-1 (hardcover). $99.95. www.shopapspress.org

Courses and Meetings

The following are non-ISHS events. Make sure to check out the Calendar of ISHS Events for an extensive listing of all ISHS meetings. For updated information log on to www.ishs.org/calendar

Second Global Congress on Plant Reproductive Biology, 15-18 April 2012, Pécs, Hungary. Info: Dr. Agnes Farkas, University of Pecs, Institute of Pharmacognosy, H-7624 Pecs, Rokus u. 2, Hungary, Phone: +36 72 503-650 ext. 28822, Fax: +36 72 503-650 ext. 28826, Email: farkasa@gamma.ttk.pte.hu, Web: http://plantrepro.eu

Advanced Course on Weed Management in Modern Agriculture, 16-21 April 2012, Zaragoza, Spain. Info: Mediterranean Agronomic Institute of Zaragoza (IAMZ) – CIHEAM, Avenida Montanana 1005, 50059 Zaragoza, Spain, Phone: +34 976 716000, Fax: +34 976 716001, Email: iamz@iamz.ciheam.org, Web: www.iamz.ciheam.org

International Training on Improving Agricultural Productivity and Net Returns among Smallholder Farmers through Efficient Use of Nutrients and Water, 6-10 May 2012, Tel Aviv, Israel. Info: IFDC Training and Workshop Coordination Unit, P.O. Box 2040, Muscle Shoals, AL 35662, USA, Phone: +1 (256) 381-6600, Fax: +1 (256) 381-7408, Email: training@idfc.org, Web: www.ifdc.org

6th European Botanic Gardens Congress, 28 May – 2 June 2012, Chios Island, Greece. Info: ARTION Conferences & Events, 9th km. Thessaloniki – Thermi, P.O. Box: 60705, GR 57001, Thessaloniki, Greece, Phone: +30 2310257801 (direct line), +30 2310272275, Fax: +30 2310272276,
Email: eurogardvi@artion.com.gr, Web: www.eurogardvi.gr

II International Conference on Sustainable Fruit Growing: From Plant to Product, 22-24 August 2012, Riga - Dobele, Latvia. Info: Laila Ikase, Latvia State Institute of Fruit-Growing, Graudu 1, Dobele, LV-3701, Latvia, Phone: + 371 63722294, Mobile: +371 29155117, Fax: +371 63781718, Email: laila.ikase@lvai.lv, Web: http://www.lvai.lv/Konference-2012/index.htm

58th Annual Meeting of The Interamerican Society for Tropical Horticulture and 16th Congreso de la Sociedad Peruana de Horticultura, 3-6 September 2012, Lima, Peru. Info: Dr. Andrés Casas Diaz, Dpto. Horticultura, Univ. Nac. Agraria La Molina, Apdo 12-056, Lima, Peru, Phone/Fax: (51)13485796, Email: cda@lamolina.edu.pe, Web: www.lamolina.edu.pe/eventos/agronomia/2012/horticultura/

31st International Vegetable Training Course - Vegetables: From Seed to Table and Beyond, 10 September - 30 November 2012, Bangkok, Thailand. Info: AVRDC - The World Vegetable Center, East & Southeast Asia, P.O. Box 1010 (Kasetsart), Bangkok 10903, Thailand, Phone: +66 (0)2 942-8686 / 8687, Fax: +66 (0)2 942-8688, Email: info-eastasia@worldveg.org

International Conference on the Development Prospects of Fruit and Small Fruit Storage and Processing Technologies in Modern Economic Conditions, devoted to the 75th birthday of Dr. Agr. Sc. Romuald Loiko, 9-11 October 2012, Minsk, Belarus. Info: Dr. Anatoliy Krivorot, 2 Kovalev Street, Samokhvalovichy BY-223013, Minsk District, Minsk Oblast, Republic of Belarus, Phone: +375 17 506 65 78, Telefax: +375 17 506 61 40, Email: science@belsad.by, belhort@it.org.by, Web: www.belsad.by

XII International Citrus Congress, 18-23 November 2012, Valencia, Spain. Info: Prof. Luis Navarro, President of the International Society of Citriculture and Chairman of the Congress, Email: lnavarro@ivia.es, and Technical Secretariat Citrus Congress 2012, Viajes El Corte Inglés S.A., División de Congresos, Convenciones e Incentivos, Gran Vía Fernando el Católico, no. 3 bajo, 46008 Valencia, Spain, Phone: +34.963.107.189, Fax: +34.963.411.046, Email: citruscongress2012@viajeseci.es, Web: www.citruscongress2012.org

Symposia and Workshops

Section Medicinal and Aromatic Plants

First Int'l Symposium on Medicinal, Aromatic and Nutraceutical Plants from Mountainous Areas

About 100 researchers and representatives from the industry from 26 countries attended the symposium, which was organised by Agroscope Changins-Wädenswil Research Station ACW in Saas Fee, a village in the Swiss Alps, from the 6th to the 9th of July, 2011. The objective of the symposium was to present and discuss various scientific topics related to the medicinal, aromatic and nutraceutical use of plants from mountainous areas and their cultivation.

Growing at high elevation, these plants are considered to be rich in secondary metabolites and have been collected for centuries from the wild. However, industry demand for plants has drastically increased in recent years, and conservation of natural populations can be achieved only by cultivation. However, domestication and breeding of varieties can also result in well-suited genotypes with the desired phytochemical profiles, and cultivation in the field provides a sustainable source of raw material.

One hundred and nine lectures and posters related to the subject of the Symposium were presented in the following sessions: Genetic Resources and Botany; Domestication, Breeding and Molecular Assisted Selection; Cultivation, Plant Protection and Harvesting; as well as Post Harvest Treatments (Drying, Extraction, Product Formulation). Papers given at this meeting

The popular tourist destination Saas Fee (1800 m a.s.l.) in the Alps of Switzerland.

Most of the participants of the symposium.

will be published in a special volume of *Acta Horticulturae*.

A number of plants particularly caught the attention of the participants: Golden Root (*Rhodiola rosea* L.), Yellow Genepy (*Artemisia umbelliformis* Lam.) and Edelweiss (*Leontopodium alpinum* Cass.). Golden Root, native to arctic and alpine regions, increases resistance to stress or fatigue. Growing interest of the international community in this plant was illustrated by not less than six lectures on its genetics, intraspecific variability, breeding and cultivation. Yellow Genepy, the only Genepy species cultivated till now, is used mainly in bitter liqueurs in alpine regions. Eupatilin, a molecule with high topical anti-inflammatory activity that is

Participants during a lecture.

qualitatively similar to that of hydrocortisone, has been found in this species. In addition to lectures on the cultivation of Edelweiss and its anti-UV effects, a presentation showed the impact of lignan derivatives of the roots of Edelweiss on atherosclerotic processes and their application in bypass surgery. In addition to these three plant species, specific aspects of many other plants from mountainous regions were presented.

The organisers acknowledge all presentations and fruitful discussions during the symposium. Special thanks are addressed to the Sponsors, Agroscope ACW, ISHS and the Chairman of the ISHS Section Medicinal and Aromatic Plants Prof. Dr. Ákos Máthé for supporting this meeting. As a result of the success of this meeting, the ISHS Working Group "Medicinal, Aromatic and Nutraceutical Plants from Mountainous Areas" was founded.

The II International Symposium on Medicinal, Aromatic and Nutraceutical Plants from Mountainous Areas will be held in Karlova Studánka, a village in the mountains of Czech Republic from 9th to 14th June 2014. The organizer is Dr. Karel Dušek from the C.R. Haná, Crop Research Institute, Olomouc.

Christoph Carlen

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Section Nuts and Mediterranean Climate Fruits

First Int'l Symposium on Mycotoxins in Nuts and Dried Fruits

The 1st International Symposium on Mycotoxins in Nuts and Dried Fruits (ISMND) was held successfully at the Islamic Azad University, Damghan Branch, in Iran on the 10th to the 12th of September, 2011, under the auspices of the ISHS. The conference was very well attended with a total number of 270 abstracts, including 70 oral and 200 poster presentations. Participants in the symposium came from all over the world: Egypt, Canada, United States of America, Belgium, Austria, India, Italy, Tunisia, Nigeria, Turkey, Greece and South Africa. Many governmental and non-governmental representatives and scientists from several cities of Iran also attended the meeting with the common goal of transferring knowledge of mycotoxins. The symposium was organized by the Islamic Azad University, Damghan Branch and the Iran Pistachio Association, the Iran's Pistachio Research Institute, Semnan (Shahrud) Agricultural Research Center, the Damghan University, the Governorship of Semnan and Damghan, the Science Industrial Coordinator of Pistachio, the Iran Society of Horticultural Science, the Islamic Azad University, the Rafsanjan, the Garmsar, the Gorgan, the Kerman, the Mashhad, the Quchan, and the Rafsanjan Vali-e-Asr University.

The opening ceremony began with some introductory remarks by the symposium Convener, Dr. Hossein Abbaspour (Dean of Islamic Azad University, Damghan branch), in which he extended his thanks and gratitude to the distinguished participants, particularly those from other countries, and also very cordially thanked the members of the Scientific and Executive Committees and Editorial Committee and his colleagues in the university. He mentioned that the pistachios and almonds of Damghan are famous throughout the world. The geographical position of Damghan makes it very special: it is limited to the north by the Mazandaran Province's forests and to the south by the Kavir desert. It is also an important crossroad of the famous Silk Road, connecting the Far East and Europe. The second speaker was Dr. Movahedi Sobhani, Chair of Research and Technology of Islamic Azad University, who highlighted the potential of his university to improve science in Iran. The third communication was given by Mr. Aliabadi Damghan, general governor, followed by Dr. Alami, a pistachio producer. Dr. Damiano Avanzato, Chair of ISHS Section Nuts and Mediterranean Climate Fruits, gave some

Participants group in the Garden of the Islamic Azad University.

remarks as a keynote speaker and granted the medal of ISHS to Dr. Abbaspour, Symposium Convener, and offered a copy of *Scripta Horticulturae* 7 "Following Pistachio Footprints (*Pistacia vera*) L. - Cultivation and Culture, Folklore and History, Traditions and Use" to Dr. Hossein Hokmabadi, Scientific Committee Chairman of ISMND, and Dr. Vahdati, Chair of the ISHS Working Group on Walnuts. Finally, Dr. Vahdati presented a keynote speech entitled "Walnut research activities in a nutshell, emphasizing reduction of mycotoxins".

The symposium consisted of four scientific sessions:

1. Economic impact and legislative controls for mycotoxins in nuts and dried fruits
2. Mycotoxigenic fungi in nuts and dried fruits, with special attention to molecular approaches to reduce mycotoxin contamination
3. Pre- and postharvest management of mycotoxins in nuts and dried fruits
4. Mycotoxins in other crops and products.

In the first session, the effects of mycotoxins on trade of nuts, regulation and sampling were discussed. One of the best presentations was "Global Impact of Mycotoxins: FAO Programs and Activities" presented by Ms. Mary Kenny, Food Safety and Quality Officer of FAO. In the second session on the use of molecular approaches to reduce mycotoxins in nuts, biocontrol of mycotoxins was emphasized. The third session was about pre- and postharvest management of mycotoxins in nuts. In this session, Dr. H. Yazdanpanah presented a very useful review on "Contamination of Tree Nuts with Aflatoxins". Although the symposium was about nuts, there were also some useful abstracts on mycotoxins in other crops. These were discussed by a small panel in the last session of the symposium.

Dr. Damiano Avanzato (left) delivering the ISHS medal to the Convener (right).

Visiting a pistachio orchard as a technical tour.

On the first evening all guests were taken to Verkian to observe the sky under the guidance of an astronomer, Mr. Khoshnevisan. Before dinner, the vote to elect the hosting country for the 2nd International Symposium on Mycotoxins in Nuts and Dried Fruits took place. Dr. Anthony Negedu from the Raw Materials Research and Development Council announced the candidature of Nigeria, which was well accepted by all participants.

At the same time as the symposium, a commercial exhibition was organized, gathering 16 booths depicting different pistachio and almond industries, vacuum packing of pistachio and almond, processing tools and specific machinery, mycotoxin analysis kits, agriculture and mycotoxins book exhibition, Damghan handicrafts and Iran's Pistachio Research Institute.

On the second day, a technical tour to a pistachio orchard was organized and the guests also had the chance to visit a pistachio processing unit.

Beside poster and oral sessions, four workshops were held in which many students took part. Three of the workshops were in Persian and one entitled "Technological Education Institute of Kalamata, Greece Implementation of Food Safety in Pistachio Chain" was held in English. The first workshop in Persian entitled "Aflatoxin analysis and detection using HPLC and immune affinity column" was both a theoretical and practical session given by four groups of trainers. The second workshop was entitled "Basic food safety concept", while the last workshop was entitled "Aflatoxin and human health".

The closing ceremony, held on Monday the 12th of September, started with the remarks of Dr. Abbaspour, Dr. Hokmabadi and Dr. Avanzato. The main government representatives were in attendance at this session. After taking some memorable pictures the symposium ended officially. In the evening of the third day a visit to historical monuments of Damghan was organized and the following day participants were taken to Isfahan for a post congress tour.

Closing ceremony.

Hossein Abbaspour and Hossein Hokmabadi

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Section Nuts and Mediterranean Climate Fruits

First Int'l Symposium on Cashew Nut

This First International Symposium on Cashew Nut was held in Agricultural College and Research Institute, Madurai, Tamil Nadu, India from 9th to 12th of December, 2011. The meeting was organized by Tamil Nadu Agricultural University under the aegis of ISHS. This first symposium devoted to cashew nut was supported by the following sponsors: Directorate of Cashew and Cocoa Development (DCCD), Cochin, under National Horticultural Mission, The Cashew Export Promotion Council of India (CEPC), Cochin, M/s Aruna Alloy Steels Pvt.

Dr. Mini Poduval (left) and Dr. B.N. Maruthi Prasad (center) receiving best oral and poster presentation award respectively, and Dr. A. Subaiah (FAO-Hortivar Trainer) (right) honored by Dr. Gale McGranahan.



Participants of the 1st ISCN.

Ltd, Madurai. The Conveners of the Organizing Committee, Dr. K. Vairavan, Dean, Agricultural College and Research Institute, Madurai, and Dr. C. Ravindran, Assistant Professor (Horticulture), Krishi Vigyan Kendra, Madurai, welcomed the delegates. Dr. N. Kumar, Dean, Horticultural College and Research Institute, Coimbatore, Dr. V. Ponnuswami, Dean, Horticultural College and Research Institute, Periyakulam, Dr. P. Banumathi, Dean, Home Science College and Research Institute, Madurai, Dr. I. Irulappan, former Dean, HC & RI, Coimbatore, offered felicitation.

The symposium was attended by 150 participants coming from different countries of the continents Europe, Asia, North America and Africa. The theme of this symposium was "Sustainable production, post harvest and export promotion of cashew nut" and the meeting was organized into eight different sessions after the introduction by the Conveners and the opening ceremony by Dr S. Sambandamurthy followed by invited plenary lectures by the cashew experts viz., Shri Venkatesh N. Hubballi, Director, DCCD, India, Dr. Pino Calcagni, International Nut Council (INC), Italy, Dr. Gale McGranahan, Vice Chair ISHS Section Nuts and Mediterranean Climate Fruits, UC Davis, California and Dr. Anu Pillai, Vice President, ECPC, Cochin, India.

The first session entitled "Scenario of cashew industry" was chaired by Shri Venkatesh N. Hubballi, Director, DCCD, India, and N.N. Reddy (invited speaker) delivered information about cashew nut production in the Indian subcontinent with emphasis on carbon sequestration. After that all scientists discussed cashew research and development, the status of cashew, and socio-economic characteristics of cashew growers. The poster session was held concurrently with the session. The Chairman of this session pointed out that cashew is an important horticultural crop, providing employment directly and indirectly to 1.5 million people and that the industry is dominated by half-a-dozen countries.

The second session on "Biodiversity, genetic resources, conservation and utilization" was chaired by Dr. V. Ponnuswami (India). Dr. C.R. Elsy presented her invited lecture on conservation and IP protection of unique crop genetic resources and products of cashew. Dr. V. Ponnuswami reported on the diversity of cashew in India followed by evaluation, conservation, plant protection, genetic resources and varietal improvement.

The third session on "Production techniques (propagation, intercultivation, moisture conservation, nutrition and pruning)" was chaired by Dr. I. Irulappan. Dr. N. Kumar, Dean HC & RI, Coimbatore, delivered his invited lecture in which he discussed cashew production techniques (propagation, intercultivation, moisture conservation, nutrition and pruning). After a brief review of the current status and future thrust of cashew nut given by Dr. N. Kumar,

Conveners receiving ISHS medal award for meritorious service to the Society.

the talk focused on an overview of ultra high density planting, recovery of cashew trees, commercial multiplication of cashew through soft wood grafting and time and level of pruning on flowering.

Session four on "Crop improvement including biotechnology" started with a talk on the implications of cashew biotechnologies for crop improvement presented by Dr. Gale McGranahan from University of California, USA. This talk raised the interest of not only scientists but also participants from the cashew industry in India. Exploration of plant biotechnology has led to many advances in the field of cashew production, including breeding and cultivar development, resistance to pests and diseases, quality improvement, and product diversity. Modern biotechnology techniques such as tissue culture, genetic transformation and molecular marker techniques offer great potential for future advances in crop improvement and germplasm conservation.

Session five on "Physiology and biochemistry" started with a talk by Dr. K. Hari Babu, Dean Dr.YSR Horticultural University, Andhra Pradesh, India, reporting on the firm focus on cashew nut antioxidants, which attracted the attention of participants. After a brief overview of cashew nut growth and development, the talk focused on an overview of quick tests to determine viability. Further, growth regulators, sex expression and improved seed germination by seed soaking were explored in depth.

The sixth session on "Organic production" started with a talk by Dr. Varanashi Krishna Moorthy, who delivered information on mixed farming models for organic cashew cultivation. After that all scientists briefly explained their own experience in inorganic cultivation of cashew.

Opening ceremony. From left to right: Dr. K. Vairavan, Dean and Symposium Convener, AC & RI, Madurai, Dr. Pino Calcagni, representative from INC, S. Sambandamurthy, Chief guest for the symposium, Dr. Gale McGranahan, Vice Chair ISHS Section Nuts and Mediterranean Climate Fruits, Thiru. Venkatesh N. Hubballi, Director & Transparency Officer, DCCD, Cochin, Dr. I. Irulappan, former Dean, HC & RI, Coimbatore, Dr. V. Ponnuswami, Dean, HC & RI, Periyakulam, Dr. N. Kumar, Dean, HC & RI, Coimbatore, Dr. P. Banumathi, Dean, HC & RI, Madurai, Dr. C. Ravindran (Symposium Convener).

The seventh session on "Post harvest, processing and value addition" nicely started with a talk by Dr. A.B. Patil, Professor and Registrar of the University of Horticultural Science, Bagalkot, Karnataka, India, and shared post harvest strategies and value addition, new technologies and value added products. The research work emphasized cashew apple utilization for nutritional security.

The eighth and last session on "Crop protection" started with a talk by Dr. Jean Nguya K. Maniania (Kenya). He delivered information on integrated management of major insect pests and diseases, after which all scientists briefly presented their own cashew pest and disease problems and management.

On the fourth day of the symposium, a tour to Kodaikanal was arranged. The name refers to the "Princess of Hill Station" and has a long history as a retreat and popular tourist destination. The participants were taken into various features of Kodai Hill like Bryant Park, Kodaikanal Lake, Bear Shola Falls, Shembaganur Museum of Natural History, Pillar Rocks, Silver Cascade and Horticultural Research Station.

On the last day during the discussion meeting two potential candidates to organize the Second International Symposium on Cashew Nut in 2015 showed their interest: Sri Lanka, the country from which many delegates participated in the 1st ISCN, and Kenya.

Overall, the symposium was quite successful and the organization was well appreciated by the attendees. This symposium was indeed a good opportunity for those involved in cashew nut to (i) share their experience and knowledge, (ii) connect with the scientific community working on cashew nut, and (iii) develop the cashew nut industry further by involving policy and decision making.

K. Vairavan and C. Ravindran

Acknowledgements

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Section Nuts and Mediterranean Climate Fruits - Section Pome and Stone Fruits
Fifteenth Int'l Symposium on Apricot Breeding and Culture

The Fifteenth International Symposium on Apricot Breeding and Culture took place on June 20-24, 2011, in the capital of the Republic of Armenia – Yerevan city.

The symposium brought together more than 130 researchers, producers, students, farmers and policy makers from 24 countries, providing them with an excellent opportunity to exchange a wide range of symposium topics reflected in the sessions of the scientific programme, to discuss and share research results and to debate future targets.

Thirty abstracts among 123 submitted scientific papers were selected by the Scientific Committee of the symposium for oral presentation.

The accomplishments, challenges and perspectives in apricot production as well as a historical overview of apricot culture and breeding were presented by informative talks made by representatives from Armenia, Russia, Turkey and Iran during the first session moderated by Prof. Daniele Bassi, Chairperson of the ISHS Working Group on Apricot Breeding and Culture.

The state of apricot genetic resources and the main problems in the area of conservation and evaluation of genetic resources to promote their

Group photo during the field visit to Armavir region of Armenia.

utilization in breeding programmes were highlighted by participants from Russia, France and Slovak Republic in the course of the second session chaired by Dr. Craig Ledbetter from USA.

The third session was devoted to apricot biology and physiology and was moderated by Prof. Guglielmo Costa, Chairperson of the ISHS Section Pome and Stone Fruits. Many interesting and attractive presentations illustrating the latest achievements in apricot physiology, tools for physiological study of apricot fruits and predicting flowering, inheritance of phenological traits in apricot progeny and many other issues were introduced by researchers from Spain, Czech Republic, Hungary, France and Serbia.

The priority issues in the field of apricot fruit processing and post-harvest management, modern methods to asses fruit quality, possible ways to reduce inputs and preserve the soil resource in apricot orchards, production of apricot saplings in conditions of open-air hydroponics, systems of soil surface maintenance and weed control methods, prediction of pre and postharvest apricot quality as well as novel approaches to solving specific problems and market development were discussed and introduced to the audience by representatives from Italy, USA, Armenia, Iran, and Bulgaria during the fourth session of the scientific programme led by Prof. Cristos Xiloyannis from Italy.

The results of apricot rootstock trials, characteristics of some clonal rootstocks, evaluation data on late blooming apricot genotypes, polymorphism levels in cultivars of different geographical origin, molecular aspects of a selection of frost resistant cultivars, late flowering-cold tolerant genotypes, breeding aimed at obtaining pest resistant cultivars, description of newly selected apricot cultivars and many other related issues were presented by 9 oral and 9 poster presentations made by participants from Russia, Iran, France, Hungary and Spain during

Poster presentation.

Round table discussions. Speaker: Dr. Cristos Xiloyannis (Italy), Session chairs – Dr. G. Costa (Italy) (left) and Convener Dr. A. Avagyan (Armenia) (right).

Closing session of the symposium. From left to right: Drs. J.M. Audergon (France), D. Avanzato (Italy), D. Bassi (Italy) and Sezai Ercişli (Turkey).

Post symposium consultations in Bagratashen village of Armenia.

the last session of the symposium moderated by Dr. Maria Badenes from Spain.

The scientific programme was followed by a field visit to an apricot growing area in Ararat valley to see the traditional apricot orchards and local cultivars.

A business forum involving the symposium delegates, as well as processors, traders and exporters of apricot produce took place on the last day of the symposium and provided the opportunity for organizations involved in apricot production to exchange information concerning processing technologies, requirements of domestic and foreign markets, and cooperation strategies between growers, processors and exporters.

The symposium programme included an open-air fair of apricots and related products. Dried apricots, apricot juice, sweets, and also souvenirs made from apricot wood were demonstrated to symposium participants.

The symposium was of great interest to local farmers growing apricot. Thanks to IFAD (International fund for agricultural development) support, 50 Armenian farmers were given the opportunity to participate in the scientific event and learn about new developments in the field. They actively sought technical recommendations on pruning, fertilizing and irrigation technologies and other related issues. After the official closure of the symposium, eight participants were invited by the organizers to stay for another two days in selected villages of Armenia, to live in farmer's houses, to communicate and share their knowledge and skills with the villagers. We already have evidence that many farmers still continue to get advice and recommendations from invited scientists through electronic means of communication.

At future symposia, it is planned to particularly focus on agricultural policy and research that encourage sustainable agricultural development, especially in fragile ecosystems and densely populated areas. Such discussions could contribute to further policy recommendations with respect to this crop.

Alvina Avagyan and Aleksandr Kalantaryan

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Section Pome and Stone Fruits

Thirteenth Eucarpia Symposium on Fruit Breeding and Genetics

Warsaw, the capital of Poland, was the venue of the XIII Eucarpia Symposium on Fruit Breeding and Genetics, which was held on September 11-15, 2011. The Symposium was organized by the Department of Pomology of the Warsaw University of Life Sciences (WULS – SGGW), in collaboration with the Committee of Horticultural Sciences of the Polish Academy of Sciences and under the auspices of the International Society for Horticultural Science (ISHS) and the European Association for Plant Breeding Research (Eucarpia). The Symposium was held in the Cristal Hall, located in the old campus of the University, and was opened by Professor Kazimierz Banasik, Attorney of the Rector of WULS for International Relations. ISHS was represented by Professor Silviero Sansavini, former President of the Society. The Fruit Section of Eucarpia was represented by Dr. R. Socias i Company, Convener of the previous Symposium in Zaragoza (Spain).

The general goal of the Symposium was the exchange of information on up-to-date achievements in fruit genetics and breeding. Most of the presentations emphasized the role of biotechnology and new breeding techniques arising from implementation of new biotechnological and molecular methods. Special attention was given to the fast breeding method developed at the Julius Kühn-Institute in Dresden, Germany, as well as to FruitBreedomics – a new EU-project, aimed at improving fruit breeding efficiency, developed at INRA Angers-Nantes Genetics and Horticulture, France. The importance of this Symposium was manifested by the massive attendance of about 150 researchers

Participants at the Eucarpia Symposium.

Visit to the intensive pear orchard.

View of delegates participating in the Oral Session.

from 30 countries, representing 5 continents and the most important fruit breeding centres of the world. Although the overall attendance at our Symposium was slightly smaller than that of similar symposia organized in the past in France and Spain, nevertheless more participants came from countries such as Lithuania, Latvia and especially from Iran and China.

A total of 39 oral presentations and more than 120 posters were presented. Presentations were divided into 9 topics: breeding programmes and development of new cultivars; management and research on genetic resources; fruit crop physiology – reproductive biology; fruit crop physiology – vegetative properties; genetic and genomic studies of fruit quality; biotechnology and molecular breeding; genetic and genomic studies of resistance; biotechnology, marker development and molecular breeding; genetic and genomic studies of biotic stress. Four main topics were introduced by the invited speakers: Prof. Dr. S. Sansavini from Bologna University (Italy), Dr. K. Evans from Washington State University (USA), Prof. Dr. M.-V. Hanke from the Julius Kühn-Institute in Dresden (Germany) and Dr. F. Laurens from INRA Angers-Nantes Genetics and Horticulture (France).

The mid-symposium, whole-day field trip included visits to 7 different sites located in the largest fruit growing region near Grójec, south of Warsaw, as well as in the micro-region near Wilga, south-east of Warsaw. The participants visited intensive apple and pear orchards, a blueberry plantation and modern cold storage and packing centres. A brief description of each site was prepared and handed to the participants. Additional information was delivered by the hosts – leading farmers or managers, most of whom were graduates of the Faculty of Horticulture of WULS. Nice, sunny weather contributed to a pleasant atmosphere. The "field dinner" organized at the Experimental Station of the Department of Pomology in the outskirts of Warsaw in the late evening, contributed to the full integration of the participants.

At the closing session, it was decided that the next Eucarpia Symposium on Fruit Breeding and Genetics will be organized by the University of Bologna in 2015. Dr. Stefano Tartarini of this University agreed to take the responsibility of Symposium Convener.

Emilian Pitera and Edward Żurawicz

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First Int'l Symposium on Sustainable Vegetable Production in South East Asia

VegSEA2011 participants at the symposium venue.

The 1st International ISHS Symposium on "Sustainable Vegetable Production in South East Asia" (VegSEA2011) was held from 14-17 March, 2011, in Salatiga, Central Java, Indonesia. The organisation of this symposium was very timely for a number of reasons. Vegetable production in South East Asia is an economically very important sector that generates an income for millions of smallholder farmers and larger scale agricultural companies. Because of the large added value, vegetable production is often characterized by a very intensive input of both on-farm (organic manures) and off-farm (agrochemicals) agricultural inputs. On the other hand, few scientifically based regimes for fertilization and crop protection exist, which often leads to over-application of these agricultural inputs. This has resulted in a reduction in general soil quality and excessive losses of nutrients to the environment, which has led to problems such as eutrophication of natural waters. Over-application of pesticides has had direct impacts on farmers and affects consumer's health, but also leads to resistance in plague organisms and a general decline in soil and water quality. There is an urgent need for more sustainable strategies of intensive vegetable production.

Therefore, the aim of this symposium was to bring together knowledge on sustainable techniques of vegetable production, with an emphasis on South East Asia. The emphasis of the symposium was on nutrient supply, fertiliza-

The highly successful and interactive poster sessions during the symposium.

Participants during field excursion near the local vegetable market.

tion, organic matter management and soil quality, but other aspects of sustainable vegetable production including crop protection were also dealt with. The symposium was intended for researchers, graduate and doctoral students, agricultural agencies and extension officers, policy makers, and environmental agencies with a link to vegetable production. The symposium was supported by the ISHS Section Vegetables, the ISHS Commission Sustainability through Integrated and Organic Horticulture, the ISHS Commission Education, Research Training and Consultancy, the ISHS Commission Plant Protection, the ISHS Commission Plant Substrates and Soilless Culture, and the ISHS Working Group on Vegetable Nutrition and Fertilization.

The venue of this symposium was the extremely hospitable Universitas Kristen Satya Wacana (UKSW), which provided excellent facilities for this event. The symposium was attended by about 100 participants, representing 21 different nationalities mainly from South East Asia and the Pacific. The following themes were discussed during the plenary sessions: Farming Systems & Vegetable Rotations, Nutrient Management & Fertilization, Crop Production, Crop Protection, Plant Breeding, Alternative Vegetable Production Systems, Soil Quality & Carbon Footprint. The poster sessions were organised in such a way that maximum interaction with poster presenters was achieved, which was particularly appreciated by all participants.

A field excursion took the participants to the intensive highland vegetable production area of Kopeng (at altitudes of 1400 m a.s.l. and higher) where we could observe cultivation practices and constraints faced by the smallholder farmers, including a visit to a vegetable market. The last half day of the symposium was dedicated to voluntary presentations of ongoing research projects related to sustainable vegetable production by symposium participants. This allowed us to get an overview of research activities in the region and to identify research gaps or overlap, with a view to finding suitable consortia for future project applications.

The symposium highlighted the massive amount of research and extension work that still needs to be done to improve sustainability of intensive vegetable production systems, particularly in South East Asia. One of the important outcomes of this symposium was recognition that trying to solve one problem in isolation will not improve the overall sustainability of these production systems, because of the complexity and strong interaction of the problems confronted in the region. One of the possibilities that was also discussed during the meeting, and was also the topic of several oral presentations, was organic vegetable production, because it is an integrated way to tackle many of the environmental problems of the sector.

Given the enthusiastic reactions and feedback from participants and organisers, the high quality of the presentations and the excellent local organisation, we considered this symposium to be a success. There were many suggestions to have a follow-up symposium, but no concrete plans have been made yet. The pictures can hopefully give a feel of the wonderful atmosphere during the symposium, and once again we thank the UKSW staff and students for all their help in making this event a success.

Stefaan De Neve

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Commission Horticultural Engineering
– Commission Protected Cultivation

First Int'l High Tunnel Horticultural Crop Production Symposium

The first International High Tunnel Horticultural Crop Production Symposium was held at the Ramada Inn and Conference Center, State College, PA, USA on October 17-19, 2011. The Symposium was attended by 42 participants from 5 different countries and throughout the United States. There were 7 invited keynote lectures, 14 oral presentations and 7 posters during the 3-day Symposium including a one-half day tour of the Penn State Center for Plasticulture's High Tunnel Research and Education Facility at the Horticulture Research Farm, Rock Springs, PA. Dr. Matt Kleinhenz from Ohio State University welcomed the participants on behalf of ISHS and Dr. Rich Marini, Department Head in Horticulture, welcomed the group on behalf of the College of Agricultural Sciences and University.

The history of vegetable forcing (season extension) in the United States began with the use of hotbeds by the pioneer gardeners. Hotbeds were employed mainly for the starting of the early plants, although growers found it profitable to mature some crops, especially lettuce and radishes, in hotbeds heated by manure. Vegetable forcing, however, was not of great importance until after 1890, and the industry had made its greatest and most rapid development after 1900. There were five rather distinct types of vegetable forcing: 1) Manure-heated hotbeds were the oldest type used in the United States; 2) Growing crops in frames heated by steam or hot water, or merely covered with glass or protecting cloth; 3) Production of vegetables in glass greenhouses, but on a limited scale because of costs; 4) Erection of small greenhouses, primarily for starting early vegetables for outdoor planting, which were large enough to yield a profit in the forcing of vegetables when the space was not otherwise in demand; and 5) The construction of very large greenhouse ranges for the sole purpose of growing and maturing vegetables out of season.

For centuries a wide variety of techniques have been used to extend the growing season of horticultural crops: glass jars, glass cloches, hotcaps, cold frames, hotbeds, and greenhouses of various types have all contributed to season extension. Dr. Otho Wells, University of New Hampshire, was a pioneer in promoting the use of high tunnels in the northeastern United

Joe Pietrowicz and Joe Russo from ZedX, Inc., Bellefonte, Pennsylvania discussed climate change. Photo by Bob Ferguson.

States in the early 90s and developed the New Hampshire design and system of production that involved covering the entire soil surface inside the tunnel with a solid sheet of 6 mm thick plastic. More recently high tunnels have become popular with growers because of their simplicity and effectiveness in protecting crops from low temperatures, wind, and moisture stress in both spring and fall.

High tunnels do not offer the precision of conventional greenhouses for environmental control, but they do sufficiently modify the environment to enhance crop growth, yield, and quality. Although they provide some frost protection, their primary function is to elevate temperatures a few degrees each day over a period of several weeks. In addition to temperature control, there are also the benefits of wind and rain protection, soil warming, and in some instances, control of insects, diseases, and predators such as rodents and birds. Overall, this growing system should be considered a protected growing system that enhances earliness and promotes higher yields, improves quality and shelf life, and reduces the use of pesticides.

The Keynote presentations covered the Current and Future Status of Protected Techniques in Europe by Dr. Esteban Baeza, IFAPA, Granada, Spain; Current and Future Status of Protected Techniques in Asia by Dr. Mengmeng Gu, Mississippi State University; and Current and Future Status of High Tunnels in North America by Dr. Mike Orzolek, Horticulture Dept., The Pennsylvania State University. Other Keynote presentations included: High Tunnel Construction and Production in Large Metropolitan Cities – Dr. William Lamont, Horticulture Dept., The Pennsylvania State University; Small Fruit Production in High Tunnels – Kathy Demchak, Horticulture Dept., The Pennsylvania State University; and Tree Fruit Production in High Tunnels – Dr. Greg Lang, Horticulture Dept., Michigan State University. During the 3-day Symposium, participant discussion was very vigorous and productive related to high tunnel research in the future.

Symposium participants touring the PSU High Tunnel Facility at Rock Springs, PA.

Movable high tunnel from Four Seasons with three growing positions: blueberries, tomatoes, and apricots. Photo by Bob Ferguson.

The Convener would like to thank ISHS and the Organizing Committee for their support of a successful Symposium.

Mike Orzolek

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II International Symposium on Horticulture in Europe (SHE2012)

July 1-5, 2012

Angers, France

colloque.inra.fr/she2012

ISHS

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Int'l Symposium on Organic Matter Management and Compost Use in Horticulture

Commission Plant Substrates and Soilless Culture – Commission Sustainability through Integrated and Organic Horticulture

Delegates at Adelaide Zoo, where the conference dinner ('Dining with Tigers') took place.

A highly successful International Symposium on Organic Matter Management and Compost Use in Horticulture was held at the National Wine Centre of Australia in Adelaide, Australia, from 4 to 7 April, 2011. The Symposium, which was supported by the Commission Sustainability through Integrated and Organic Horticulture, the Commission Plant Substrates and Soilless Culture and also the Working Group Composting for Horticultural Applications, brought together more than 170 leading researchers and practitioners from around the world, who had the opportunity to listen to 69 oral presentations and see 17 poster presentations.

The program focused on the role of compost and other organic soil amendments in building and maintaining soil organic matter, and hence soil fertility, to improve productivity and safeguard future food production. Presentations and plenary sessions over three days covered not only aspects of producing high quality, enriched compost products, but primarily the effects various organic soil amendments (compost, mulch, biochar) have in a wide range of crops and applications, including potting and growing media.

The extensive number of technical presentations addressed the Symposium objectives established by the Organising Committee, which were:

- characterisation of fit-for-purpose organic soil amendments and growing media;
- potential uses for compost products as horticultural soil amendments and mulch;
- managing organic matter in conventional, integrated and organic production systems;
- identifying and quantifying the agronomic, environmental and social benefits of using composted and un-composted organic soil amendments and mulches;
- the economics of managing organic matter; and
- translating R&D outcomes into farm practice.

BREAKING NEW GROUND

Typically, most ISHS Symposia are organised by universities, research centres, government departments or industry organisations with considerable administrative and financial resources. This International Symposium however, was organised and staged by a group of dedicated individuals. Hence, the Symposium went ahead only thanks to the trust Dr. Michael Raviv (Chair, Working Group Composting for Horticultural Applications) and his colleagues at ISHS had shown in the Convener and the Organising Committee. It was good to demonstrate that it is possible for dedicated individuals and small groups to organise large events, although it does come at a considerable personal cost and financial risk for individuals.

Although the Symposium was an international scientific conference, it worked as well as it did because it also had national and local significance. Without that, it would not have been possible to obtain industry support for an event that offered relatively little direct commercial gain for sponsors and exhibitors. However, the topic of 'Organic Matter Management in Horticulture' was certainly very topical in Australia at the time of the Symposium, as the Australian Government was in the process of

The two main drivers for the Symposium: Johannes Biala (left) and Peter Wadewitz (right).

Always much to see and discuss at field trips (here protected cropping of capsicum grown with compost).

developing its carbon-trading scheme, including soil carbon sequestration as an option for abating GHG emissions. Therefore, it was entirely appropriate for a politician to give the opening keynote speech. Rob Oakeshott (Independent Member of Parliament) as a member of the Multi-Party Climate Change Committee provided valuable insights into the workings of the committee, outlined how future climate change regulations might affect the agricultural and composting industries, and encouraged both industries to engage with him and other politicians. Since the symposium, the Australian Parliament has passed its carbon pricing legislation, which includes a Land Sector Package (http://www.daff.gov.au/climatechange/) that will provide $429 million to ensure that advances in emissions reduction technologies and techniques will continue the evolution of management practices in the land sector towards emissions reduction and improved productivity.

The opening keynote address by Rob Oakeshott, Member of Parliament, advised on the forthcoming Carbon Farming Initiative, which is part of Australia's carbon trading scheme.

KEYNOTE SPEAKERS

In line with this overarching theme, two keynote speakers focused on the opportunities and limitations for soil carbon sequestration. Dr. Elke Schulz from the Helmholtz Environmental Research Centre in Germany talked about the lessons learned from long-term field trials (50-150 yrs) and what they can teach us about managing organic matter in agricultural production systems, and the potential for soil carbon sequestration. Dr. Schulz also presented a 'humus balance' toolbox for farmers as a means of translating research into farm practice. In his lecture about soil carbon in the Australian environment, Dr. Jeff Baldock (CSIRO Land and Water, Australia) provided an excellent insight into soil carbon fractions, and the potentials and limitations that exist for sequestering soil carbon.

In her 'Two Views on Compost', Dr. Sally Brown from the University of Washington (USA) considered not only the effects of diverting organic residues from landfill on greenhouse gas emissions, but also the transformation of these residues into organic soil amendments and their use for land management purposes. In doing so, she compared soil characteristics of amended and unamended soils, as well as life cycle assessment.

Dr. David Crohn from the University of California Riverside tackled a topic that was equally challenging: 'Managing Nitrogen from Mulches, Composts and Manures'. David developed a Nitrogen Budgeting Optimization Tool (NBOT) that aims at predicting nitrogen release for different types of organic soil amendments in different environmental conditions. Capturing the complex microbiological processes following application of organic soil amendments combined with plant nutrient uptake and various nitrogen loss pathways, is not an easy feat, which is why David sees NBOT as the starting point, not the end point.

Being more on the practical side, Dr. Peter Stoffella (University of Florida, USA) provided varied examples of using compost in subtropical horticultural cropping systems, to be more precise in the sandy soils of Florida. Apart from presenting different composting technologies and commercial compost application equipment, Peter also spoke about (i) using compost as an alternative to polyethylene mulch and methyl bromide fumigant, (ii) using immature compost as biological weed control agent in vegetable crop alleys, (iii) using composted sugarcane filtercake in a tomato production system, and (iv) using compost as a partial peat substitute for containerized ornamentals.

While speakers presented many examples of organic soil amendments delivering agronomic and environmental benefits, use of non-pasteurised organic residues also carries a risk for consumers of fresh fruit and vegetables. Dr. Patricia Millner, Beltsville Agricultural Research Centre, USA, addressed the risks of using organic soil amendments and how to minimise them in her presentation on 'Contemporary Perspectives on Pathogen Disinfection Technologies and Regulations for Recycled Organics Used in Horticulture'. Patricia provided not only an overview of common pathogens in organic soil amendments and examples of food borne illness outbreaks, but she also spelled out current USA regulations that govern use of organic soil amendments as far as pathogen risks are concerned. Probably most importantly, Patricia advised compost manufacturers that proper quality management procedures that include critical control points (HACCP) are the best way of minimising pathogen contamination risks in compost products.

The use of compost in growing media was addressed in detail by Dr. Michael Raviv, Newe Ya'ar Research Centre, Israel and Kevin Handreck, Netherwood Horticultural Consultants, Australia. In his talk on 'Composts in Growing Media: Feedstocks, Composting Methods and Potential Applications', Michael gave an overview of compost use in growing media, focusing on (i) the ability of composts to suppress soil-borne diseases, and (ii) quality requirements composts have to meet so they

Panel discussion: 'Shaping the Future'.

can be used in growing media. Michael also postulated future research needs in this area, and offered advice on what needs to change so that compost products can be used more frequently in growing media. Kevin Handreck offered an Australian perspective on 'Composts in the Production and Performance of Container Growing Media', including the various problems (e.g. P toxicity, Fe-P interactions, N supply) that were encountered and how they were solved. Kevin talked also about the Australian Standard for Potting Mixes, and the various quality criteria it contains.

FIELD EXCURSIONS AND INTERSTATE PROGRAM

The three day presentation and plenary program was augmented by field excursions that offered options to look at the principal horticultural industries around Adelaide covering vegetable, viticulture and fruit production, and also to see two commercial composting operations.

During the following week, some keynote speakers participated in four interstate programs, aimed at promoting symposium outcomes to wider and in particular, commercial producer audiences. These programs included (i) local stakeholder seminars and field visits to commercial properties where aspects of compost application, fit-for-purpose quality, and use of enriched compost products could be discussed within commercial settings, and (ii) talks and seminars for specific target groups.

OUR COMMON RESPONSIBILITY

Considering the presentations, discussions and outcomes of the Symposium, as well as its 'spirit', the Organising Committee drafted a Symposium Declaration, called 'Our Common Responsibility'. All keynote speakers supported the declaration and put their names to it, as did Dr. Robert Prange, Chair of the ISHS Commission Sustainability through Integrated and Organic Horticulture and also Dr. Michael Raviv, Chair of the ISHS Working Group Composting for Horticultural Applications. The declaration is included in the box beside.

Our Common Responsibility

The International Symposium on Organic Matter Management and Compost Use in Horticulture, held recently in Adelaide, brought together more than 150 leading researchers and practitioners from all around the world. Those attending recognised that soil organic matter is vitally important to building long-term soil fertility and improving productivity, and hence safeguarding our future food production.

However, despite overwhelming scientific evidence that demonstrates the multiple benefits of soil organic matter and farming practices that enhance organic carbon levels in soil, sustaining and building soil organic matter is not often recognised as a major component of maintaining and improving horticultural productivity.

Recognising this connection, two broad goals were identified by the group:

1. Integrate the proper care and management of organic matter into existing agricultural enterprises
2. Maximise the agronomic, economic and environmental benefits from building and maintaining optimum soil organic matter levels.

In line with this, conference attendees iden-tified the following key objectives and measures as conditional for achieving the above goals:

- provide political and economic (value chain) support that encourages proper management of soil and soil organic matter and ensures our long-term horticultural food production capacity
- develop and deliver mainstream soil organic matter management education and training programs for farmers, advisors and extension staff
- lift organic matter management and compost use into mainstream horticultural and agricultural practices
- build and maintain soil organic matter levels that provide optimum soil fertility and productivity
- quantify soil carbon sequestration benefits from use of external organic residues as soil amendments
- manufacture fit-for-purpose compost and organic soil amendment products that deliver anticipated agronomic outcomes and economic benefits
- minimise human health and environmental risks associated with the use of organic soil amendments
- encourage and foster the production and use of certified and quality-assured recycled organic products
- understand the nutrient dynamics resulting from use of organic soil amendments, and account for organic nutrient inputs in local and regional nutrient budgets
- make best possible environmental and economic use of industrial, commercial and municipal organic residues and guide their recovery, processing and beneficial use through wise regulations.

FUTURE EVENTS

A significant outcome was the universal support for similar future events and the pledge to establish a biennial international conference series. It was widely acknowledged that the format covered all requirements for developing the use of compost in horticulture and its important role in managing soil organic matter and hence soil performance/health. The 2nd International Symposium on Organic Matter Management and Compost Use in Horticulture will be held 20-25 October, 2013, in Valparaiso, Chile.

Johannes Biala

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2-5 September 2013 at Cranfield University, UK

Technical innovations for maintaining fresh produce quality are often done in isolation, without a full appreciation of how they might impact or be affected by supply chain management. The VI International Conference on Managing Quality in Chains (MQUIC 2013) to be held at Cranfield University between 2-5th September, 2013, in association with the ISHS Commission on Quality and Post Harvest Horticulture, aims to readdress this problem and provide a forum in which academics, industrialists and students may interact to provide real world solutions for the fresh produce industry. The conference will cover the entire fresh produce postharvest supply chain and include the following topics, *viz.* reducing waste and resource mapping, consumer-centred technological advances, integrating supply chain management with novel postharvest technologies, and improving knowledge transfer between the academic community and industry. The conference will look forward to the challenges that will face the industry in the coming decade and how these might be overcome in the developed and developing world and in the emerging markets.

We look forward to welcoming you to England in 2013 for the first major international postharvest conference to take place in the United Kingdom for nearly 25 years.

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For further information visit: www.cranfield.ac.uk/health/MQUIC2013

From the Secretariat

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Argentina: Prof. Ricardo del Barrio, Prof. Nidia Leiva; **Armenia:** Nanar Kalantaryan; **Australia:** Mark Adams, Richard Benyon, Mr. Marshall Haritos, Dr. Marie Keatley, Mr. Leslie Krake, Mr. Hinga Marsh, Mr. Peter Masasso, Mr. Van Nguyen, Mr. Brian Nightingale, Mr. Robert Strugnell, Mr. Brad Wells, Mr. Julian White; **Austria:** Heidi Halbwirth; **Belgium:** Raphael Bequet, Dr. Nicolas Dassonville, Tom De Swaef, Vandegehuchte Maurits; **Bosnia and Herzegovina:** Mr. Admir Grahic; **Brazil:** Mr. Sérgio Barbosa, Rodrigo Marcelli Boaretto, Rafael Silva Oliveira, Thais Regina De Souza, Bruno Rosado; **Burundi:** Cyrille Mbonihankuye; **Canada:** Mr. Walter Cramerstetter, Prof. Dr. Alain Cuerrier, Mr. Robert Hansen, Mr. Chris Hiebert, Michel Larose, Mr. Mark Roop, Aiming Wang, Doug Waterer; **Chile:** Rafael Lopéz-Olivari, Mr. Sergio Munoz, Assist. Prof. Alonso Pérez, Carlos Poblete - Echeverría; **China:** Prof. Dr. Yike Gao; **Croatia:** Domagoj Majic; **Czech Republic:** Jiri Kucera, Romana Slipkova, Ivana Tomaskova; **Egypt:** Prof. Dr. Sayed Said Shaaban Eisa, Dr. Emad El-Din Hassanein Abd El-Samad, Mr. Karim Hendi; **Ethiopia:** Ms. Meaza Melkamu, Atsede Retta; **Finland:** kyösti Konttinen; **France:** Jacques d'Anthenaise, Dr. Gaelle Leroy, Ilja M Reiter, Nicolas Saurin; **Germany:** Prof. Dr. Barbara Elers, Mr. Ralph Heinrich, Dr. Wulf Menzel, Lena Neumann, Simon Thomsen, Adelheid Wolter, Mr. Dirk Zabel; **Ghana:** Emelia Oberye Monney; **Greece:** Mr. Vangelis karaindros; **Hungary:** Prof. Dr. László Fenyvesi; **India:** Mr. Vimal Chawda, Mr. Mahesh Damodare, Mr. Rajendran G, Dr. Sandip Mukhopadhyay, Mr. Manoj Nigam, Dr. Sunil Sharma; **Indonesia:** Dr. Ibrahim Hasan, Dr. Yohanes Aris Purwanto, Mr. Ronald Serhalawan; **Ireland:** Mr. Matthew Drew, Mr. Andrew Kelly, Mr. Kevin Mc Cabe, Mr. Stephen O'Driscoll; **Israel:** Or Sperling; **Italy:** Andrea Ariani, Mr. Kushtrim Bresilla, Claudia Cocozza, Dr. Nicola Del Ministro, Daniela Di Baccio, Bartolomeo Dichio, Dr. Roberto Fratini, Massimiliano Mameli, Simone Mereu, Gaia Monteforti, Rita Papa, Daniel Papi, Giai Petit, Dr. Massimo Pugliese, Stefania Romeo, Luca Sebastiani, Francesca Ugolini; **Japan:** Mr. Irvine Choolo, Dr. Keiko Matsumoto, Mr. Stephen Thomas, Ms. Li Zhao; **Kenya:** Ms. Annah Indeche, Njeri Njau; **Liechtenstein:** Dr. Hans Vettiger; **Malaysia:** Dr. Rosnah Shamsudin, Mr. Chin Ann Yap; **Malta:** Mr. Malcolm Borg, Dr. Marion Zammit-Mangion; **Mexico:** Mr. Mario Cabezas, Carmen Gutiérrez Castorena, Prof. Dr. Manuel Sandoval-Villa; **Netherlands:** Frits Jonk, Mr. Ron Schoutsen, Delphine Souillat; **New Zealand:** Mr. Graham Milne; **Nigeria:** Oluyemisi Adebisi-Adelani, Dr. Olutayo Adedokun, Dr. Babasola Ayodel Adelaja, Iyabo Adeoye, Catherine Arinpelu, Prof. Jacob Bobunde, Olufunke Abiola Oke, Dr. Olutola Oyedele; **Romania:** Alexandru Fira, Remus Flutur, Assist. Prof. George Adrian Peticila; **Russian Federation:** Mr. Valery Zhuravlev; **South Africa:** Mr. Peter Evans, Ms. Suzette Smalberger; **Spain:** Jordi Martinez-Vilalta, Rafael Poyatos, Rafael Romero Vicente, Kosana Suvocarev; **Swaziland:** Dr. Michel Masarirambi; **Sweden:** Dr. Tessa Pocock; **Switzerland:** Dr. Frank Liebisch, Raphael Mainiero, Mr. Jimmy Mariethoz; **Thailand:** Dr. Mantana Buanong; **Trinidad and Tobago:** Mr. Simon Bedasie; **Turkey:** Mr. Tolga Izgu, Mr. Yasin Tellioglu; **United Kingdom:** Mr. Rhydian Beynon-Davies, Mr. Ali Khas, Mr. Konrad Legg, Dr. Jose Juan Ordaz Ortiz, Mr. Luke Roeder, Sam Wingfield; **United States of America:** Anthony R. Ambrose, Mr. Jim Bagdasarian, Natalie Bumgarner, San Juana Chavez, Kyle Clark, Laszlo Csuti, Mr. Mark Curtice, Shawna Daley, Corrine Daniels, David Dumaresq, Ms. Elizabeth Elwood Ponce, Mr. Kenneth Elwood, Michael Fahner, Mr. Mel Fernandez, Ms. Polyxeni Filios, Josh Freeman, Virginia Hernandez - Santana, Dr. Shyun-Shyun Hoffmann-Tsay, Prof. Dr. Chuanxue Hong, Sameer Israni, Mr. Randy Ito, LMK Johnson, Yun-Hui Lai, William Lamont, Mr. Richard Langan, Ms. Anne Lee, Dr. Holly Little, Dr. Kevin Lombard, Mr. Tate Lounsbery, James Meyers, David Mills, William Mitchell, Dr. Boris Nemzer, Mr. Garrett Owen, Dr. Gregory Peterson, Douglas Picanso, Roy Pittman, Mr. Farley postgate, Mr. Alfred Ramirez, Mack Ramsay, Rod Reed, Zac Reicher, Vilma Mateos Remigio, Mr. Joseph Rovito, Jochen H. Schenk, Mr. R. Scott Scholer, Michael Seagraves, travis seay, Andrew Semotiuk, Ms. Jami Simmons, Mr. Thomas Sinton, Cynthia Trembley, Mr. William Urbanowicz, Douglass Yadon, Thomas Yeager.

In Memoriam

ERIC GERMAIN (1938-2011)

Eric exploring the walnut germplasm forest in Iran, in 1994.

Eric Germain passed away 14 December, 2011. A world expert on walnuts and hazelnuts, he is missed by the many researchers who consider him the father of walnut studies, an excellent resource, and a good friend. He leaves behind his beloved wife Rosen and three children, Isabelle, Jean and Pierre.

Eric Germain was born in Algeria in 1938. He was introduced to agriculture early, his father being a producer of grapes and citrus. After his *baccalaureate*, he studied at *l'Ecole nationale d'agriculture* of Grignon in France where he earned his degree of 'Ingenieure' in 1961. After military service and many job offers, he was recruited in 1963 by INRA (National Institute of Agricultural Research) in Bordeaux, France. In 1996 he became assistant director of UREFV (Unity of research on fruits and grapes) in INRA and worked on walnuts and chestnuts.

In 1970 the directors of INRA decided to renovate the program on walnuts and Eric took charge of the new program of genetic improvement of walnuts and hazelnuts. In 1976 he spent three invigorating months at the University of California, Davis. Rich from this experience he began a program of hybridization of walnuts, which over twenty years released walnut cultivars with the important traits of lateral bud fruitfulness, late flowering to avoid frost, and good taste. Some of his selections are still being evaluated, especially by Jean-Pierre Prunet and his colleagues of CTIFL (Interprofessional technical center for fruits and vegetables) at the experiment station in Creysse, France. Eric Germain retired from INRA in 2002 when INRA appeared to lose interest in genetic improvement of walnut. But before he retired he organized the 4th ISHS International Walnut Symposium in Bordeaux in 1999.

An international researcher, he freely exchanged germplasm and information with colleagues in many different countries. He also collected walnut germplasm, the most interesting and variable being from a trip to Iran in 1994. The collection may be endangered now even though it is a resource for walnut breeders all over the world.

He published many reports and several books, the most important being "Le Noyer" (two editions), and the "Inventory of Walnut Research, Germplasm and References" funded by FAO. He also cooperated on the "Descriptor list for walnuts", which is used worldwide to describe the traits of walnut.

He has many friends and many miss him deeply, both for his expertise and his kindness. Emails have arrived from countries far and wide including Chile, Spain, Iran, Turkey, Italy, US and France. All express an appreciation for the man, his expertise, his cooperation and his enthusiasm for walnuts. Here are the feelings expressed in some of the emails received:

"Personally, I am lucky that I had a chance to meet him" (V. Erdogan, Turkey)

"Dr. E. Germain was a nice person and great researcher, and we are all sad because of his loss" (D. Hassani, Iran)

"He was a true friend, inspiring quietness and transmitting easily his great expertise" (C. Fideghelli, Italy)

"Like most of us I was one of his students" (N. Aleta, Spain)

"Eric was not only a good colleague but also a good friend and I shall not forget the good time we spent together during common travels and meetings" (J.C. Mauget, France)

"I remember his visit to Romania in the forests of walnuts: an experience that has enriched me humanly and culturally" (M. Bothu, Romania)

Jean-Pierre Prunet, Ctifl Walnut Program, Station de Creysse
Gale McGranahan, Walnut breeder and Vice Chair ISHS Section Nuts and Mediterranean Climate Fruits
Kourosh Vahdati, Chair ISHS Working Group on Walnuts
Damiano Avanzato, Chair ISHS Section Nuts and Mediterranean Climate Fruits

Calendar of ISHS Events

For updates and more logon to www.ishs.org/calendar. To claim the reduced registration for ISHS members make sure to mention your membership number when registering and ensure your ISHS membership is current. If in doubt: check your membership status online at www.ishs.org/directory/

YEAR 2012

NEW ■ March 19-22, 2012, Temuco City (Chile): **VIII International Congress on Hazelnut.** Info: Dr. Pablo Grau Beretta, INIA, Avda. Vicente Mendez 515, Chillan, Chile. Phone: (56)42 209707, Fax: (56)42 209720, E-mail: pgrau@inia.cl or Miguel Ellena Dellinguer, INIA, Instituto De Investigaciones Agropeciarias, Km 10, Camino Cajon Vilcun, Temuco, Chile. Phone: (56)45 215 706, Fax: (56)45 216 112, E-mail: fellena@inia.cl E-mail symposium: mdiaz@inia.cl Web: http://www.hazelnut2012.cl/

■ March 22-24, 2012, Djerba (Tunisia): **IV International Symposium on Medicinal and Aromatic Plants SIPAM2012.** Info: Dr. Houcine Khatteli, Institut des Régions Arides, Route de Djouf, Km 22,5, 4119 Médenine, Tunisia. Phone: (216)75633121, Fax: (216)75633006, E-mail: h.khatteli@ira.rnrt.tn or Dr. Mohamed Neffati, Institut des Regions Arides (IRA), Route de Djorf Km 22,5, 4119 Medenine, Tunisia. Phone: (216)75633839, Fax: (216)75633006, E-mail: neffati.mohamed@ira.rnrt.tn E-mail symposium: sipam@ira.rnrt.tn Web: http://www.sipam.ira.rnrt.tn/

NEW ■ March 26-30, 2012, Nelson (New Zealand): **II International Symposium on Biotechnology of Fruit Species.** Info: Dr. Roger

Hellens, Plant & Food Research, 120 Mt Albert Road, Auckland, New Zealand. Phone: (64)98154200, E-mail: roger.hellens@plantandfood.co.nz or Dr. Susan Elizabeth Gardiner, Plant & Food Research, Tennant Drive Private Bag 11030, Palmerston North, New Zealand. E-mail: sue.gardiner@plantandfood.co.nz E-mail symposium: yvonne.mcdiarmid@plantandfood.co.nz Web: http://www.biotechfruit2012.com/

- March 28 - April 1, 2012, Antalya (Turkey): **XI International Symposium on Flower Bulbs and Herbaceous Perennials.** Info: Prof. Dr. Ibrahim Baktir, Akdeniz University, Faculty of Agriculture, Department of Horticulture, Campus, 07058 Antalya, Turkey. Phone: (90)2423102468, Fax: (90)2422274564, E-mail: ibrahim.baktir@gmail.com E-mail symposium: flowerbulbs2012@gmail.com Web: http://flowerbulbs2012.org/

- NEW April 2-4, 2012, Lake Alfred, FL (United States of America): **International Symposium on Mechanical Harvesting and Handling Systems of Fruits and Nuts.** Info: Prof. Dr. Jim Syvertsen, University of Florida, IFAS, CREC, 700 Exp. Stn. Rd., Lake Alfred FL, 33850, United States of America. Phone: (1)8639561151, Fax: (1)8639564631, E-mail: jmsn@ufl.edu Web: http://conference.ifas.ufl.edu/harvest/

- April 10-13, 2012, Viterbo (Italy): **VIII International Symposium on Artichoke, Cardoon and their Wild Relatives.** Info: Prof. Mario-Augusto Pagnotta, Dipt. di AgroBiologia e AgroChimica, Universita' della Tuscia, Via S.C. de Lellis, 01100 Viterbo, Italy. Phone: (39)0761357242, Fax: (39)0761357423, E-mail: pagnotta@unitus.it or Prof. Dr. Francesco Saccardo, Dip.di Produzione Vegetale, University of Tuscia, Via S. Camillo de Lellis, 01100 Viterbo VT, Italy. Phone: (39)0761357554, Fax: (39)0761357558, E-mail: saccardo@unitus.it Web: http://www.symposium2012.cynares.com/

- Because of a low number of registrations the organizing committee decided to cancel this symposium - contact conveners for further details April 18-22, 2012, Antalya (Turkey): **IV International Symposium on Improving the Performance of Supply Chains in the Transitional Economies.** Info: Prof. Dr. Burhan Ozkan, Department of Agricultural Economics, Faculty of Agriculture, University of Akdeniz, 07070 Antalya, Turkey. Phone: (90)2423102475, Fax: (90)2422274564, E-mail: bozkan@akdeniz.edu.tr or Dr. Peter J. Batt, Horticulture, Curtin University of Technology, GPO box U1987, Perth, WA 6845, Australia. Phone: (61)8 9266 7596, Fax: (61)8 9266 3063, E-mail: p.batt@curtin.edu.au Web: http://www.supplychains2012.org/

- April 23-25, 2012, Petrolina, Pernambuco (Brazil): **III International Symposium on Guava and other Myrtaceae.** Info: Dr. Natoniel Franklin de Melo, EMBRAPA-CPATSA, Cx.Postal 23, Lab. de Biotecnologia, CEP 56302-970 Petrolina -PE, Brazil. or Dr. Carlos Antonio Fernandes Santos, EMBRAPA CPATSA, Km 152, Zona Rural, Caixa Postal 23, 56302-970 Petrolina, Brazil. Phone: (55)08738621711, Fax: (55)08738621744, E-mail: casantos@cpatsa.embrapa.br E-mail symposium: 3rdsygom@cpatsa.embrapa.br Web: http://www.cpatsa.embrapa.br/sygom/

- April 23-26, 2012, Santiago (Chile): **XI International Protea Research Symposium.** Info: Mr. Eduardo Olate, P. Universidad Catolica De Chile, Avenida Vicuna Mackenna 4860, Fac.de Agronomia, Santiago RM, Chile. Phone: (56)23544112, Fax: (56)25520780, E-mail: eolate@uc.cl or Mrs. Flavia Schiappacasse, Universidad de Talca, Facultad de Ciencias Agrarias, Casilla 747, Talca, Chile. Phone: (56)71200214, Fax: (56)71200212, E-mail: fschiap@utalca.cl E-mail symposium: robyn.mcconchie@sydney.edu.au Web: http://www.proteas2012.cl/

- April 29 - May 2, 2012, Antalya (Turkey): **International Symposium on Biotechnology and other Omics in Vegetable Science.** Info: Prof. Dr. Ahmet Naci Onus, Department of Horticulture, Faculty of Agriculture, Akdeniz University, 07059 Antalya, Turkey. Phone: (90) 242-3102441, Fax: (90) 242- 2274564, E-mail: onus@akdeniz.edu.tr Web: http://www.biotech-omics.org/web/

- May 15-17, 2012, Tel Aviv (Israel): **The International CIPA Conference 2012: Plasticulture for a Green Planet.** Info: Mr. Itzhak Esquira, Ministry of Agriculture, 34 Burla Street, Apt. 2, 69364 Tel Aviv, Israel. E-mail: esquirai@gmail.com E-mail symposium: Pzilberman@kenes.com Web: http://www2.kenes.com/agritech2012/conference/Pages/Conference.aspx

- May 19-25, 2012, Chanthaburi (Thailand): **VII International Symposium on Mineral Nutrition of Fruit Crops.** Info: Dr. Sumitra Poovarodom, King Mongkut's Inst. of Tech., Landkrabang, Faculty of Agric. Technology, 10520 Bangkok, Thailand. Phone: (66)262341001, Fax: (66)232641001, E-mail: kpsumitr@kmitl.ac.th E-mail symposium: mnutrition7@kmitl.ac.th Web: http://www.mnutrition7.kmitl.ac.th/

- NEW May 20-26, 2012, Davis, CA (United States of America): **X International Symposium on Plum and Prune Genetics, Breeding and Technology.** Info: Prof. Ted M. DeJong, University of California, Department of Plant Sciences, Wickson Hall, 1 Shields Ave, Davis, CA 95616-8683, United States of America. Phone: (1)530-752-1843, Fax: (1)530-752-8502, E-mail: tmdejong@ucdavis.edu or Carolyn DeBuse, University of California, Cooperative Extension, 501 Texas Street, Fairfield, CA 94533, United States of America. Phone: (1)707-784-1320, E-mail: cjdebuse@ucdavis.edu Web: http://ishs-ucdplum-prunesymposium2012.ucdavis.edu/

- May 21-24, 2012, Fukuoka (Japan): **VI International Symposium on Edible Alliaceae.** Info: Prof. Dr. Masayoshi Shigyo, Faculty of Agriculture, Yamaguchi University, Yoshida 1677-1, Yamaguchi 753-8515, Japan. Phone: (81)839335842, Fax: (81)839335842, E-mail: shigyo@yamaguchi-u.ac.jp E-mail symposium: isea2011@convention.co.jp Web: http://www2.convention.co.jp/isea2011/

- May 22-25, 2012, Shanghai (China): **International Symposium on Soilless Cultivation.** Info: Mr. Weimin Zhu, Hort.Inst. of Shanghai Academy of Agr. Sci., Beidi Road 2901, Shanghai Shanghai 201106, China. Phone: (86)21-62206683, E-mail: wmzhu69@hotmail.com E-mail symposium: wtzp05@163.com Web: http://www.icesc-2012.com/

- June 9-11, 2012, Beijing (China): **XII International Symposium on the Processing Tomato - X World Congress on Processing Tomato.** Info: Dr. Guitong Li, China Agricultural University, CAU, West Road of Yuanmingyuan, Beijing, China. Phone: (86)1062732963, Fax: (86)1062733596, E-mail: lgtong@cau.edu.cn or Prof. Dr. Montaña Cámara, Dpto. Nutrición y Bromatología II, Facultad Farmacia. UCM, Plaza Ramón y Cajal sn, 28040 Madrid, Spain. Phone: (34) 913941808, Fax: (34) 913941799, E-mail: mcamara@farm.ucm.es Web: http://www.worldtomatocongress.com/

- NEW June 14-17, 2012, (Turkey): **I International Mulberry Symposium.** Info: Prof. Dr. Sezai Ercisli, Ataturk University Agricultural Faculty, Department of Horticulture, 25240 Erzurum, Turkey. Phone: (90) 442-2312599, Fax: (90) 442 2360958, E-mail: sercisli@atauni.edu.tr E-mail symposium: sercisli@hotmail.com Web: http://www.mulberry2012.org

- June 17-22, 2012, Maastricht (Netherlands): **X International Symposium on Vaccinium and Other Superfruits.** Info: Prof. Dr. Fred Brouns, Maastricht University, NUTRIM, PO Box 616, 6200 MD Maastricht, Netherlands. Phone: (31)433881466, Fax: (31)433670976, E-mail: fred.brouns@maastrichtuniversity.nl E-mail symposium: i.vermeeren@pauwelspco.nl Web: http://www.vaccinium2012.com/

- June 18-22, 2012, Guangzhou (China): **V International Symposium on Tropical and Subtropical Fruits.** Info: Prof. Dr. Jiang Zongyong, Guangdong Academy of Agric. Sci., Guangzhou, Guangdong, 610640, China. Phone: (86)2087596262, Fax: (86)2087503358, E-mail: jiangz38@hotmail.com or Prof. Dr. Ganjun Yi, Fruit Tree Research Institute, Guangdong Academy of Agricultural Sciences, Wushan, Guangzhou Guangdong 510640, China. Phone: (86)2038765869 or 13302200898, Fax: (86)2038765626, E-mail: yiganjun@vip.163.com Web: http://www.istsf2012.com/

- June 18-21, 2012, Leavenworth, WA (United States of America): **II International Organic Fruit Symposium.** Info: David Granatstein, Sustainable Agriculture Specialist, Ctr. for Sust. Agric. & Natural Res., WSU, 1100 N. Western Ave., Wenatchee, WA 98801, United States of America. Phone: (1)509-663-8181x.222, Fax: (1)509-662-8714, E-mail: granats@wsu.edu or Prof. Dr. Preston K. Andrews, Department of Horticulture, Landscape Architecture, Washington State University, Pulmann, WA 99164-6414, United States of America. Phone: (1)509-335-3603, Fax: (1)509-335-8690, E-mail: andrewsp@wsu.edu Web: http://www.tfrec.wsu.edu/pages/organicfruit2012/
- June 24-29, 2012, Ski and Grimstad (Norway): **XIII International Symposium on Virus Diseases of Ornamental Plants - ISVDOP13.** Info: Dr. Dag-Ragnar Blystad, The Norwegian Crop Research Institute, Plant Protection Center, Høgskoleveien 7, N-1432 Aas, Norway. Phone: (47)6494 9261, Fax: (47)6494 9226, E-mail: dag-ragnar.blystad@bioforsk.no E-mail symposium: isvdop13@bioforsk.no Web: http://www.bioforsk.no/ISVDOP13
- NEW June 25-29, 2012, Kuala Lumpur (Malaysia): **VII International Postharvest Symposium.** Info: Mr. Abdullah Bin Hassan, Horticulture Research Centre, MARDI, GPO Box 12301, 50774 Kuala Lumpur, Malaysia. Phone: (60)389437810, Fax: (60)389422906, E-mail: abhassan@mardi.gov.my E-mail symposium: abhassan53@gmail.com Web: http://postharvest2012.mardi.gov.my/
- June 27-29, 2012, Piacenza (Italy): **I International Workshop on Vineyard Mechanization and Grape and Wine Quality.** Info: Prof. Stefano Poni, Director Istituto di Frutti-Viticoltura, Università Cattolica del Sacro Cuore Piacenza, via Emilia Parmense 84, Piacenza, Italy. Phone: (39)0523599271, Fax: (39)0523599268, E-mail: stefano.poni@unicatt.it Web: http://meetings.unicatt.it/ishs/
- July 1-5, 2012, Angers (France): **II International Symposium on Horticulture in Europe - SHE2012.** Info: Prof. Jean-Claude Mauget, AGROCAMPUS OUEST - Centre d'Angers (INHP), Dept. STPH, 2, rue Le Nôtre, 49045 Angers, France. Phone: (33)241225428, Fax: (33)241225515, E-mail: jean-claude.mauget@agrocampus-ouest.fr Web: https://colloque.inra.fr/she2012
- NEW July 1-5, 2012, Brasilia (Brazil): **VI International Symposium on Seed, Transplant and Stand Establishment - SEST2012.** Info: Dr. Warley Marcos Nascimento, EMBRAPA - Vegetables, C. Postal 218, Brasilia - DF 70359-970, Brazil. Phone: (55)6133859125, Fax: (55)6135565744, E-mail: wmn@cnph.embrapa.br E-mail symposium: sest2012@cnph.embrapa.br Web: http://www.sest2012.com/english/sest2012-home.html
- July 1-4, 2012, Ghent (Belgium): **II International Symposium on Woody Ornamentals of the Temperate Zone.** Info: Dr. Johan Van Huylenbroeck, ILVIO- Plant Unit, Applied genetics & breeding, Caritasstraat 21, 9090 Melle, Belgium. Phone: (32) 9-2722862, Fax: (32) 9-2722901, E-mail: johan.vanhuylenbroeck@ilvo.vlaanderen.be E-mail symposium: woodyornamentals@ilvo.vlaanderen.be Web: http://www.ilvo.vlaanderen.be/woodyornamentals2012
- NEW July 4-7, 2012, Cebu (Philippines): **IV International Symposium on Improving the Performance of Supply Chains in the Transitional Economies.** Info: Dr. Peter J. Batt, Horticulture, Curtin University of Technology, GPO box U1987, Perth, WA 6845, Australia. Phone: (61)8 9266 7596, Fax: (61)8 9266 3063, E-mail: p.batt@curtin.edu.au or Dr. Sylvia B. Concepcion, University of the Philippines, Mindanao, Davao City, Mindanao, Philippines. Fax: (6382) 2270750, E-mail: sbconcepcion@yahoo.com Web: http://www.business.curtin.edu.au/business/ISHSsymposium
- July 9-12, 2012, Valencia (Spain): **I International Symposium on Computational Fluid Dynamics (CFD) Applications in Agriculture.** Info: Dr. Florentino Juste, IVIA, Ctra. Moncada-Náquera, Km. 4, Moncada, 46113 Valencia, Spain. Phone: (34)963424000, Fax: (34)963424001, E-mail: juste_flo@gva.es or Dr. Ricardo Suay Cortés, Ctra Moncada-Náquera, Km 4,5, Centro de Agroingenieria - IVIA, 46113 Valencia Moncada, Spain. Phone: (34) 96 3424000, Fax: (34) 96 3424001, E-mail: rsuay@ivia.es Web: http://cigr.ageng2012.org/
- NEW July 16-20, 2012, Beijing (China): **International Conference on Germplasm of Ornamentals.** Info: Prof. Qi Xiang Zhang, College of Landscape Architecture, Beijing Forestry University, No.35, Qinghua East Road-Haidian Dist., Beijing 100083, China. Phone: (86)1062338005, Fax: (86)1062336126, E-mail: zqx@bjfu.edu.cn or Dr. Guijun Yan, School of Plant Biology MO84, The University of Western Australia, 35 Stirling Hwy, Crawley WA 6009, Australia. Phone: (61) 8 6488 1240, Fax: (61) 8 6488 1108, E-mail: guijun.yan@uwa.edu.au Web: http://www.flora2012.org/
- July 16-20, 2012, Geisenheim (Germany): **VII International Symposium on Irrigation of Horticultural Crops.** Info: Prof. Dr. Peter Braun, Research Centre Geisenheim, Dept. of Pomology, Von Lade Str. 1, D-65366 Geisenheim, Germany. Phone: (49)6722502566, Fax: (49)6722502561, E-mail: braun@fa-gm.de Web: http://www.irrigation2012.de
- September 2-5, 2012, Warsaw (Poland): **XXIV Eucarpia Symposium on Ornamentals - Ornamental Breeding Worldwide.** Info: Dr. Teresa Orlikowska, Research Institute of Horticulture, Konstytucji 3 Maja 1/3, 96-100 Skierniewice, Poland. Phone: (48)468332041, Fax: (48)468333228, E-mail: teresa.orlikowska@insad.pl E-mail symposium: dariusz.sochacki@insad.pl Web: http://www.ornamentalbreeding2012.pl/
- NEW September 4-8, 2012, Shepherdstown, WV (United States of America): **V International Chestnut Symposium.** Info: William MacDonald, 1090 Ag. Science Building, West Virginia University, Morgantown, WV 26506-6108, United States of America. Phone: (1)304 293 8818, Fax: (1)304 293 2960, E-mail: macd@wvu.edu Web: http://chestnutsymposium.wvu.edu/
- September 6-8, 2012, Venlo (Netherlands): **XI International People Plant Symposium.** Info: Ms. Annette Beerens, Oude Graafseweg 50, 6543 PS Nijmegen, Netherlands. Phone: (31)615647097, E-mail: hozhq.foundation@gmail.com
- September 9-14, 2012, Zatec (Czech Republic): **III International Humulus Symposium.** Info: Dr. Josef Patzak, Hop Research Institute Co, Ltd., Kadanska 2525, Zatec, 434 46, Czech Republic. E-mail: j.patzak@telecom.cz or Dr. Anthony Koutoulis, he University of Tasmania, Private Bag 55, Hobart TAS, 7001, Australia. E-mail: anthony.koutoulis@utas.edu.au Web: http://www.chizatec.cz/ishs.htm
- September 18-20, 2012, Bogor (Indonesia): **II Asia Pacific Symposium on Postharvest Research Education and Extension: APS2012.** Info: Prof. Dr. Hadi K. Purwadaria, Faculty of Agricultural Engineering, Bogor Agricultural University, PO Box 220, 16002 Bogor, Indonesia. Phone: (62)8129579098, Fax: (62)2518623026, E-mail: tpphp@indo.net.id E-mail symposium: aps2012@ipb.ac.id Web: http://aps2012.ipb.ac.id
- September 25-29, 2012, San Juan (Argentina): **VII International Symposium on Olive Growing.** Info: Dr. Carlos Alberto Parera, INTA, Acc. Sur y Aráoz, Luján de Cuyo, Mendoza 5507, Argentina. Phone: (54)2614963500, Fax: (54)2614963500, E-mail: parera@correo.inta.gov.ar or Prof. Facundo Vita Serman, Coordinador Proyecto Regional Olivo, EEA San Juan del INTA, Calle 11 y Vidart, Pocito, 5427, San Juan, Argentina. Phone: (54)2644921079, Fax: (54)2644921191, E-mail: fvita@sanjuan.inta.gov.ar E-mail symposium: oliveargentina2012@sanjuan.inta.gov.ar Web: http://www.olivesymposium2012.com.ar/

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Chronica Horticulturae
Author Information

Chronica Horticulturae is the quarterly publication of the International Society for Horticultural Science (ISHS) and is received by all members of the Society and numerous libraries throughout the world. Members and non-members are urged to contribute articles for consideration. However, it needs to be understood that *Chronica* is not to be construed as a scientific journal that publishes original research. Research articles appropriate for *Acta Horticulturae* or horticultural science journals are usually inappropriate for *Chronica*. We seek horticultural articles of interest to a broad audience composed of ISHS members and the horticultural, scientific, and academic communities.

Chronica Horticulturae is currently made up of as many as eight sections as follows:

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Issues. Articles of a broad focus that often involve controversial topics related to horticulture, including broad social issues and economic development, are appropriate for this section. These articles are intended to stimulate discussion. Often, guest writers are asked to contribute articles.

Horticultural Science Focus. This section is intended for in-depth articles on a topic of horticulture, generally, but not always, scientific in nature. Many articles are mini-reviews, and bring current topics of interest to the horticultural community up to date. We encourage these articles to be illustrated.

Horticultural Science News. Shorter current articles about particular topics including horticultural commodities and disciplines are welcome.

History. This section includes articles on the history of horticulture, horticultural crops, and ISHS.

The World of Horticulture. This section highlights articles on horticultural industries and research institutions of particular countries or geographic regions throughout the world. They are meant to be profusely illustrated with figures and tables. This section also includes book reviews, which are requested by the Science Editor. Members who wish to recommend a book review should arrange for a copy of the book to reach the Secretariat.

Symposia and Workshops. Meetings under the auspices of ISHS are summarized, usually by a participant of the meeting. These articles are delegated by the symposium organizers.

News from the ISHS Secretariat. This section contains information on membership, memorials for deceased ISHS members, and a calendar of ISHS events. Brief memorials (up to 500 words) should be sent to the Secretariat.

Authors who wish to contribute articles for *Chronica* should contact headquarters and their request will be transmitted to the Science Editor or another appropriate editor. Authors should be aware that most articles should have a broad international focus. Thus, articles of strictly local interest are generally unsuited to *Chronica*. Illustrated articles are usually 1500 to 5000 words. There are no page charges for *Chronica Horticulturae*. Photographs submitted should be of high resolution. We encourage electronic submission. Send articles or ideas for articles to:

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