Chronica Horticulturae

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ISHS

Horticultural Highlights

The Sociology of Authorship Sequence • Florigen Unmasked: Exciting Prospects for Horticulture • Genetic Diversity in Pineapple • Emergence of Blackberry as a World Crop • Pitless Plum: Reality or Fantasy • The Poinsettia: History and Transformation • *Prunus mume:* History and Culture in China

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CHRONICA HORTICULTURAE

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Cover photograph: Brussels in Bloom: This beautiful Carpet of Flowers is created every year in the Grand-Place, Brussels, Belgium. Close to a million begonia flowers were used to create the 300 m^2 carpet. The pattern is based on a medieval carpet design. Craftsmen arranged the carpet by hand, directly onto the square's cobblestones, without any soil. Grass and tree bark were also used to provide colour. The first Carpet of Flowers was created in 1971 as a way to promote begonias. Each m^2 of ground contains more than 300 flowers.

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.

ISHS

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Adding Value by Building Bridges

Georg J. Noga, ISHS Treasurer

Georg J. Noga

Thanks to a growing membership, hundreds of successful Symposia, a high production rate of impressive publications, and excellent financial management with disciplined spending, ISHS has finally reached its long-term goal of having the equivalent of one year's turnover in reserves, thus meeting the ISHS Council request and Belgian legal requirements. What a wonderful and comfortable situation for our Society! But it took a long time to meet this goal, and it was the result of continuous efforts and sound financial management whereby past treasurers, ISHS Board and Council have made wise decisions of setting some money aside each year instead of spending it. In order to maintain this healthy, financially prudent situation in the future, the Society, the Treasurer and the Internal Auditors are obliged to continue to control spending. They must ensure that the Society pays only for needed items while avoiding impulse driven expenditures with limited likelihood of beneficial returns.

With money on hand, temptations are growing for the Society to invest at least some of the reserves in new activities. This consideration is quite legitimate. But what priorities must ISHS use in deciding where to make such new expenditure? The Treasurer as well as the other Board members received requests from individuals of our Society to allocate some of this reserve money on fellowships and awards dedicated to outstanding young scientists.

The idea, if attractive at first, may be very difficult to implement by our Society. For instance, how many grants should be made available, at what amount, to whom and for how long? Should there be a regional quota, e.g. members from less developed countries preferred? What would be the specific eligibility requirements? What would the nomination and selection processes involve? Who would make the interim and final decisions? Should we install additional committees to evaluate applications? Many questions are arising from the original simple request; whatever, such a system would be quite a challenge with the potential for additional work and resources.

However, the main question is: Will we be offering a service that other institutions and funding agencies are better prepared and qualified to offer? So far, it has not been part of the ISHS mandate to provide grants or fellowships to researchers. I must admit that there are – at least from the financial perspective – good reasons not to do so. There are many other prestigious institutions who's primary objectives and task are to provide funding. It might actually be more productive for ISHS to seek out opportunities for cooperation with such institutions instead of adding another topic of responsibility and financial engagement to our long list of already existing ISHS duties and services. As far as research grants are concerned, in most countries there are funding institutions providing support to members of our horticultural discipline. Would there be opportunities for cooperation of mutual benefit with such institutions? In other words, what could we offer as a prosperous, highly visible and acknowledged International Society to make collaboration mutually attractive?

I am very fortunate to have been selected as host for Humboldtians. Over the years I have accommodated several young postdocs from different countries and continents as researchers in my lab at Bonn University. In doing so I have made good friendships with the research fellows, and I also established a trusting cooperation with the Alexander von Humboldt (AvH) Foundation and its highly respected officials. AvH is a prestigious institution representing one of the most acknowledged foundations worldwide providing postdoctoral research fellowships and research awards for highly qualified scientists from all disciplines and all countries (www.humboldt-foundation.de). The sole selection criterion is academic excellence. There are no quotas for countries or subjects. At present the Humboldt Network of Knowledge Elite comprises 24,000 scientists and scholars from all disciplines in more than 130 countries around the world, among them 44 Nobel Prize winners. Within the last 5 years AvH has awarded close to 3000 postdoc fellowships, of which 65% were granted to applicants of Natural Sciences. A high percentage of the applicants are from Europe (37%) and Asia (36%), a significant proportion are from North America (14%), but from Africa, Latin America and New Zealand there are only 6%, 4% and 2% of the candidates, respectively.

The Humboldt Foundation welcomes excellent applications from all countries equally. Like any other international granting institution the Humboldt Foundation has a great interest in making its programs visible worldwide and selecting the top postdocs. This objective could become the basis for a close cooperation with ISHS. But what kind of service could ISHS offer that AvH or other granting institutions would benefit from? Our Society could help to make the AvH funding programs visible worldwide. ISHS is an excellent, extremely strong organization to do this with its international network of Working Groups, Sections and Commissions. We are in the fantastic situation now to sanction and publish about 50 International Symposia per year! This is amazing! In other words, every week on average ISHS organizes an International Symposium somewhere in the world! Our ISHS website records more than 28,500 page views per day! We can all be very proud! These are incredible achievements, and we really should take advantage of this opportunity to spread the attractive message for institutional cooperation of mutual benefit!

Therefore, with the agreement and mandate of our Board, the Treasurer and the Executive Director, Jozef Van Assche, made an initial visit to explore the opportunity and willingness for cooperation with Alexander von Humboldt Foundation. This first meeting was held on December 3, 2010, in Bonn. The outcome was very encouraging, and it opened up new possibilities for supporting young researchers in their professional career by getting access to funding programs that will benefit the successful individuals, ISHS and cooperating Institutions.

For example, ISHS:

- could assist in spreading material on AvH 'Georg Forster Research Fellowship Program' to ISHS members;
- will provide information on its website outlining central activities of AvH and will establish a link to the AvH website
  - to explain the procedure for AvH applications
  - to act as a go between for applicants and groups of excellence to host AvH awardees and
  - to facilitate interdisciplinary involvement in projects for the benefit of horticulture(ists);
- support AvH in gaining visibility at the Regional ISHS Congresses in Africa, South-East Asia and Latin America in the year 2012 and this way also inform ISHS members on funding opportunities;

- enlarge the ISHS Award and Fellowship Portfolio with fellowships and awards provided by AvH.

This would be a major step forward: Adding value to our ISHS membership by building bridges. This strategy would be completely in line with one of our central missions, to facilitate global networking. If our expectations regarding ISHS – AvH cooperation come to fruition, and, I have no doubt on that they will, this could serve as a model for other liaisons that may follow where ISHS is highly visible in international arenas. Success will allow plant sciences in general and horticultural science in particular to have a significant impact on the health and wellbeing of human-kind, at the same time adding value for our members by exploiting rewarding opportunities with other prestigious institutions.

New Science Editor for *Chronica Horticulturae*

Jules Janick

Yves Desjardins

This issue of *Chronica* is the last one under the aegis of Dr. Jules Janick who has served as Science Editor since his election to the ISHS Board in 2002. Although his term ended in August, 2010, Dr. Janick was prevailed on to serve an additional year during the transition of a new Board. During these 9 years many agree that *Chronica* has been transformed into a dynamic publication of the Society. Dr. Yves Desjardins, current Board Member responsible for Publications, will assume the position of Science Editor starting with the December issue 51(4). Kelly Van Dijck will continue as Associate Editor with special responsibility for Symposia and Workshops and Peter Vanderborght will continue as Associate Editor in charge of Production and Circulation.

Letter to the Editor

Carrot History

It has been pointed out to us that there is an inaccuracy in the article entitled "Carrot: History and Iconography" (*Chronica Horticulturae* 51(2):13-18). The sentence "Carrot arrived in America with the Pilgrims in 1609 and soon became part of the staple diet." is obviously incorrect since the English Dissenters who founded Plymouth Colony did not arrive in North America until 1620. The sentence should have referred to the English settlers, part of the Virginia Company, who arrived in the Chesapeake region of the New World in 1607 and founded Jamestown.

John Stolarczyk and Jules Janick

The Sociology of Authorship Sequence

Jules Janick

Laboratory activity [is] the organization of persuasion through literary inscription
(Latour and Woolgar, 1986)

INTRODUCTION

The driving force for science long has been considered to be curiosity of the natural world. However, at present, there are other mundane issues that are also involved such as earning a living since most scientists now are involved in salaried jobs either in academia, government, or industry. Another continuing driving force in science, often not openly mentioned, is the recognition and fame that come with advances and discoveries. In science as in many other pursuits, credit and acclaim is often based on priority, i.e. who is the first. In fact, priority may be the most important component in which the rewards of science are allocated and special prizes, such as the Nobel, are based on this issue. Priority in science is now determined in a special way, the date of first publication in a recognized scientific journal, where the editors, the gatekeepers of science, have developed special procedures (a series of anonymous peer reviews) to determine if the new discovery and the experimental data to back it up are considered legitimate. Similar rules exist in sports, where priority for achieving a certain event such as speed over a certain distance, must be achieved in a sanctioned, competitive event. For example, photographic evidence for an event run in a non-sanctioned meet does not count.

At present, unlike the great scientific works of Copernicus, Newton, Linnaeus, and Darwin, research results are seldom published by an individual in a very large paper or book where the results are essentially complete. It is also unusual that great scientific papers such as those of Mendel or Einstein have a single author. Present day research papers are typically multi-authored and reported in a series of discrete units. There is a certain tension since scientists are loath to delay publication of individual definitive experiments because of the fear of being scooped, as well as the need to provide evidence of progress for their job or grant, while research journals are averse to publish individual experiments. Thus, determining priority over a particular series of publications is not straightforward but complicated. Since authorship is listed sequentially, one might expect that sequence is critical but the issue is more complex. This essay on the sociology of authorship sequence has a narrow objective: how does the scientific community determine and evaluate authorship sequence.

AUTHORSHIP SEQUENCE

The unit of scientific information is the research paper. One of the curious developments in scientific publications is the changing attitudes toward authorship sequence. What might seem to be a simple easily resolvable issue turns out to be fraught with complication and difficulties. Let us review the various issues of this phenomenon.

No Author At All

A number of books and articles are authorless. In this case it must be presumed that either the author chooses to remain anonymous, or that the report is merely a matter of a complex committee without a single author. In newspaper writing, the author is usually not listed, and getting a byline is considered a great coup. Articles without authors are usually cited as "Anonymous" abbreviated as "Anon." Complications arise when the author is finally revealed. Jane Austen's famous novel *Pride and Prejudice* was originally published as "written by the author of *Sense and Sensibility*" – which was also anonymous. In some cases the anonymous author provides another name (nom de plume, penname, pseudonym). Famous pseudonyms in literature include George Sand for Amantine Luicile Dupin and Mark Twain for Samuel Clemens. In science, the most famous case is the statistician W.S. Gossard (1876-1937) who published under the name Student. All biologists are familiar with the Student t-test.

Single Author

This would seem to be uncomplicated but may not be. Check the "acknowledgement" section. Effusive acknowledgements lead the reader (and often the person acknowledged) to wonder why authorship was not shared.

Two Authors

The co-authorship of an article would seem straight forward but one wonders, why the sequence. The first author is usually considered the senior author (not older, but presumably more important) and the second author, the junior author. With equal participation in the work it is often a problem of determining who gets senior status. One way to resolve this issue, besides flipping a coin, is to use alphabetization of the names. Thus, only when the sequence is non-alphabetical does it become absolutely clear that the first author is non-ambiguously positioned as the senior author, with major responsibility for the work. Playing second fiddle in authorship is a very unpleasant situation for some and often the cause of deep resentment among colleagues. Senior authorship is valued in academia and the lack of senior authorship in CVs is a signal that the person is a follower and not a leader. When multiple publications evolve from the work, this problem can be neutralized by the two authors shifting position. The sequence of names has important effects. Thus, we refer to Watson-Crick base pairing of nucleotides in DNA, and Murashige-Skoog culture medium. (It is said that Henry Royce told Charles Stewart Rolls when discussing the name of their firm that Royce-Rolls had a nice ring to it!)

There have been differences in determining sequence. In the 19th and early 20th century the professor and not the student assumed senior authorship. In departments of Mathematics and English authorship between professor and student is seldom shared, with authorship reserved for the student. This has enormous consequences in the professor-student relationship. In the biological and medical sciences, having graduate students is extremely important to increase the potential bibliography of the professor. One would think that a professor's publication record would be divided by the number of authors but this does not seem to be the case.

There is another complication in science. When the co-worker in a project is a graduate student, the graduate student usually receives the honor of senior author. However, when the co-worker is an employee such as a laboratory assistant, authorship is not universally endowed under the dubious claim that the technician was simply paid to follow instructions. The surest way to get to be senior author in a scientific paper is to write the first draft, which is often the main work.

There are strong cultural factors in authorship sequence. In Italy for example, it is said that the "Professor" who sometimes does not write even a line or otherwise contribute to the work is often the main author. A common complaint is that "slave" students, contract workers, or assistant professors do the work while the professor takes the credit.

Three Authors

Ah, here we have a problem: there are now three places: first or senior author, middle author, and last or junior author. The most important position is the first authorship, but strangely enough

the second authorship is considered to have different importance in different cultures. In the United States, the power position by custom is relegated to the last author. Many scientists will agree to be only first or last author distaining the middle position. Thus, the contribution of the poor middle author is stuck in ambiguity. One resolution of assuming equal participation is alphabetization. But with three authors there are 6 possible arrangements (ABC, ACB, BAC, BCA, CAB, CBA). With randomness, one sixth of the time authors will be in alphabetical order anyway.

Multiple Authors

In this case the first and last author are given power positions in scientific publications. Usually the last author is the laboratory director or senior professor. The sequence of middle authors now assumes critical importance. Thus with 6 authors, being third rather than fourth seems to say something about the contribution of each. The second author may often feel especially put out assuming that person has contributed substantially. There is a tendency to resolve this issue with a footnote that usually runs as follows: *Each author has contributed equally to this work*. However, this statement is fraught with ambiguity, but who cares? The short answer is the second author. Another complication is identification of the "contributing author," the one who sends in the paper and presumably is the one to whom requests for reprints are sent. For some reason contributing author retains some panache. I do not know why.

Interdisciplinary Multi-Authored Papers

Modern science is often done in large interdisciplinary teams and often the entire group shares authorship with the assumption that each has contributed in some way or another. As many as 100 authors have been involved in some papers. Now in some journals when these articles are cited often only the first three authors are listed and the rest are indicated by the humiliating term either "etc." or "et al." Thus in this situation it is considered important to be at least the third author in a multiple authored paper. I told you this was not easy.

In the past five years there has been a sea of changes developing in identifying each authors' contribution in multi-authored papers by influential journals such as the *Proceedings of the National Academy of Science (USA)*. This has come about as a result of author disputes as well as charges of scientific misconduct. Funding agencies are now requiring statements on which authors received funding while journals require declarations on the contributions of each author such as conceptualization and design, performance of specific experiments, data analysis, and writing. This trend will certainly filter down to all journals.

In multi-authored papers there have been differences on whether technicians or paid laboratories (such as sequencing firms) deserve authorship. The payment of large publishing fees, especially color, has also been a factor in consigning authorship. With larger and larger interdisciplinary teams, acknowledgement of authorship is becoming of increasing importance and issues still remain to be resolved.

CONCLUSIONS

Authorship sequence in the last analysis is a way to determine the share of participation of a particular work. It is part of a complex system of determining rewards in science. These rewards are now based on an integration of a number of factors such as authorship sequence, the number of publications, the importance of the journal that publishes the paper and its impact, the number of citations of the results, and above all priority. Modern science is now based on multi-authored works in which complicated rules and traditions have been developed to determine authorship contribution in each paper. The system is evolving. Unfortunately the present system is not uniform with different fields and has encountered many problems and as for most complex problems there is no simple solution.

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Florigen Unmasked: Exciting Prospects for Horticulture

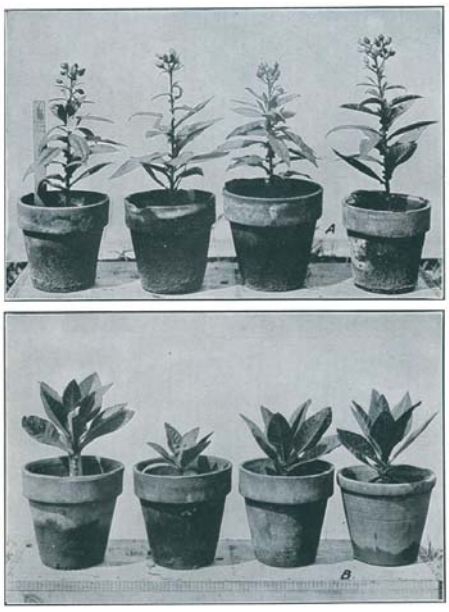
Michael Reid and Cai-Zhong Jiang

The pioneer work of Garner and Allard, who coined the term "photoperiod" to describe the dramatic effects of day length on flowering of many plants, led to the widespread commercial use of photoperiod modification to control flowering in plants, particularly ornamentals. M.K. Chailakhyan suggested that the flowering stimulus was transmitted from the leaves to the shoot apex by a phloem-transmitted mobile stimulus he named "florigen." This hypothesis spurred seven decades of research to identify the elusive "hormone." Analysis of the flowering mutants of *Arabidopsis thaliana*, a facultative long-day plant, led to the identification of a photoperiodic pathway that results in flower induction. Now one component of that pathway, *Flowering Locus T (FT)*, has been identified as the gene encoding the mobile flowering stimulus, florigen. The 20 kDa FT protein has been detected in phloem sap of cucurbits, and over-expression of *FT* overcomes the photoperiodic requirement in a short-day cucurbit, *Cucurbita moschata*. Similarly over-expression of *FT* or its orthologs results in precocious flowering in tobacco and tomato, tuberization in potato, complements flowering mutants, and induces flowering of transgenic chrysanthemums in vitro. Horticulturists can look forward to new strategies for controlling flowering, tuberization, dormancy and plant architecture stemming from this exciting discovery.

FLOWERING IS CONTROLLED BY PHOTOPERIOD

The seasonality of flowering in plants has been noted since the dawn of civilization. *"These then"*, wrote the Greek philosopher Theophrastus in the 4th century BCE, *"are the periods and seasons at which the various flowers are produced." "In that country"* [Egypt], he further reported, *"it is said that roses, carnations, and other flowers are as much as two months ahead of those in our country"* [Greece]. In 1852, Arthur Hensley, an English botanist, described the different distribution of plants in Europe, and suggested that summer day length might be the determinant of distribution of different species. It was another 50 years before Julien Tournois tested this hypothesis experimentally in France, showing early flowering of hops and cannabis plants held in a greenhouse with supplementary light. Concurrently, a German researcher, Georg A. Klebs, demonstrated that it was length of photoperiod, not light integral, that was the key factor. Conclusive evidence demonstrating the role of the photoperiod came from the work of USDA scientists Garner and Allard (1920, 1931) who showed that *"the length of day exercises a remarkable regulatory action in initiating or inhibiting sexual reproduction in plants."* They used a dark chamber to alter what they termed "the photoperiod," and noted that some species respond to relatively long days, others to short days (Fig. 1), and that some showed no photoperiodic response.

Figure 1. The classic experiment from Garner and Allard's first paper (1920) showing the effect of short photoperiods (top) on flowering in the short-day tobacco cultivar 'Maryland Mammoth'.



Photoperiodic responses were either obligate (short or long photoperiods were required for flowering) or facultative (short or long photoperiods accelerated flowering). Garner and Allard's work is the foundation for practical uses of photoperiods for controlling flowering in many horticultural crops that are still in widespread use today (Fig. 2).

Figure 2. Overhead lamps used in San Diego to induce early spring flowering in long-day Shasta daisies (*Leucanthemum* x *superbum*). Photo courtesy M. Reid.

A SIGNAL, FLORIGEN, MOVES FROM THE LEAVES TO THE FLOWERS

In Russia, Chailakhyan (1936) conducted numerous experiments to understand these exciting results, making grafts between the induced and non-induced plants of the same and different species, girdling stems and branches, and so forth. His data, published in 1936, in his classic paper *"New facts in support of the hormonal theory of plant development"* sustained the hypothesis that a flowering hormone, which he named florigen, is produced in the leaves, moves over long distances in both directions through the phloem, and is neither species- nor photoperiod-specific. His data even provided an estimate for the speed of florigen movement. Chailakhyan's observations generated enormous interest, and resulted in an extensive literature describing the details of photoperiod/environment interactions for numerous model and crop plant species. The probability that florigen was a universal flowering hormone was suggested by grafting experiments, which showed that one induced leaf could be grafted to a non-induced plant and would induce flowering. In *Perilla*, this remarkable result was repeated numerous times with the same leaf! Moreover, florigen appeared to be species and flowering-type independent. Grafts of induced leaves of one species would induce flowering in

plants of another graft-compatible species. Even more remarkably, induced leaves of short- or long-day plants would induce flowering when grafted onto non-induced plants with the opposite photoperiodic response.

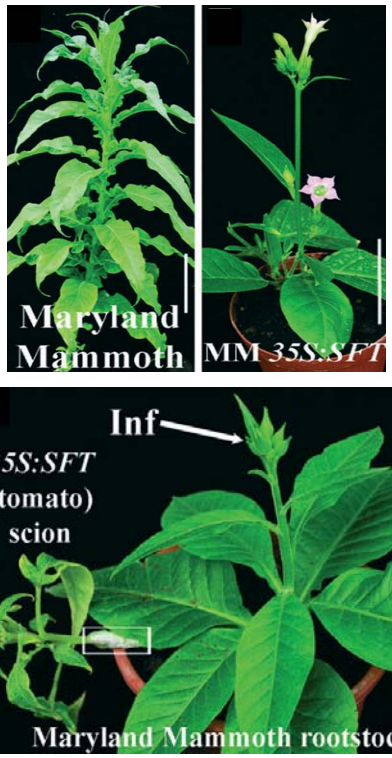
For more than 60 years biochemists, physiologists, and horticulturists attempted unsuccessfully to identify the flowering hormone, following the classical wet chemical and biochemical methods that had proved successful with cytokinins and gibberellins. Although the application of molecular strategies to classic model flowering systems provided information on genes that were up-regulated in response to inductive photoperiods, the nature of the inducing 'hormone' remained unknown.

FLOWERING MUTANTS IN *ARABIDOPSIS*, THE KEY TO IDENTIFYING FLORIGEN

The breakthrough in the hunt for florigen came from study of flowering mutants in *Arabidopsis*, a facultative long-day plant. Researchers described a number of mutants, including *co (constans), gi (gigantea), cry2 (cryptochrome), fd (flowering locus d), ft (flowering locus t), fe*, and *fwa* that were proposed as components of a single photoperiodic pathway leading to flower induction. The complex interactions among the various elements of this pathway allow an explanation of the physiological observations that have been made over the years since Gardner and Allard's first identification of the photoperiodic response. The key components of signal transduction that led to the discovery of the nature of florigen are CO and FT. CO mRNA is transcribed in a diurnal manner, but CO protein is rapidly degraded except when protected by products of genes that are under photoperiodic control. CO protein is therefore only present in the cells during an inductive photoperiod. When CO protein is present, it induces the transcription of FT mRNA in the companion cells of the phloem in the leaf veins. The first reports suggested that it was this mRNA that was the mobile flowering stimulus, but careful experiments in tomato and squash showed this to be an error.

Lifschitz et al. (2006) studied flowering in a tomato plant in which the *FT* homolog (*SFT* - single flower truss) was mutated. They demonstrated that the developmental and flowering anomalies caused by the *sft* mutation were prevented if a mutant shoot was grafted onto a tomato plant over-expressing *SFT* under the control of the 35S promoter. Over-expression of *SFT* also caused premature flowering in tomato, and in tobacco. In the delayed flowering mutant tobacco, 'Maryland Mammoth' (used by Allard and Garner in the first demonstration of the photoperiodic effect), grafting a tomato shoot expressing *35S:SFT* resulted in precocious flowering (Fig. 3). However, these researchers could find no trace of the SFT mRNA in the scions of

Figure 3. Overexpressing *SFT*, the tomato ortholog of *FT*, in 'Maryland Mammoth' tobacco, or grafting a branch of an *SFT* over-expressing tomato plant onto a tobacco plant results in precocious flowering under long days. Photo from Lifschitz et al. (2006).

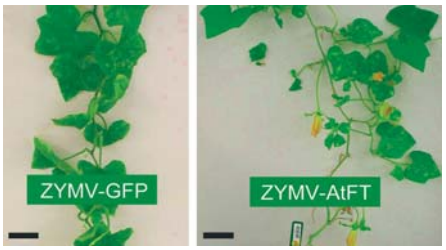


grafted plants, suggesting that the mobile stimulus was not mRNA.

FLORIGEN IS A SMALL PROTEIN ENCODED BY THE *FT* GENE

Cucurbits are particularly well-suited to examining the contents of phloem, in which the flowering signal is known to be transported, so Lin et al. (2007) screened 69 *Cucurbita* species and identified *C. moschata* as a model system for studying changes in phloem composition during floral induction. This species did not flower under long photoperiods, but did flower when grafted onto a flowering pumpkin plant (*C. maxima*). Expression of the *Arabidopsis FT* gene using a *Zucchini yellows mosaic virus* (ZYMV) vector in plants of *C. moschata* caused them to flower in long days (Fig. 4). The researchers were unable to detect RNA transcripts of the cucumber FT homolog in phloem sap isolated from *C. moschata* plants that had been induced to flower in short days. In contrast, liquid chromatography/mass spectrometric analysis of trypsin-digested proteins in the phloem sap showed the presence of fragments of proteins encoded by the two *C. moschata FT* genes. These data demonstrate conclusively that it is FT proteins, not *FT* mRNAs that are the mobile flowering stimulus in cucurbits.

Figure 4. Overexpression of the *FT* gene from *Arabidopsis* using a ZYMV vector results in flowering of short-day *C. moschata* in long days. Control (left) shows no effect from over-expression of *GFP*. Photo from Lin et al. (2007).



It is now well-established that florigen is not a small molecule hormone, but is in fact a small (20 kDa) protein. The protein is transported in the phloem sieve tubes to the shoot apex, where it is thought to bind to the protein encoded by the b-ZIP transcription factor FD - the combined protein is hypothesized to induce the expression of APETALA1, a MADS-box protein that is known to be required for formation of the first floral bud.

Since the identification of FT as the mobile flowering signal in *Arabidopsis*, a number of papers have appeared showing that homologous molecules are involved in flowering in rice (Tamaki et al., 2007), in vernalization in wheat (Yan et al., 2006), and in tuberization in potato (Rodriguez-Falcon et al., 2006). Over-expression of the *FT* ortholog *PtFTl* in aspen trees shortened the time to flowering in transgenic trees from several years to 6 months (Bohlenius et al., 2006). Such reports indicate the universality of FT action, and suggest that modulation of the production of FT might be an immensely useful tool in horticultural science, allowing control of flowering and other terminal events using molecular strategies.

IMPLICATIONS FOR HORTICULTURE

Surprisingly, the horticultural research community seems to have paid little attention to the potential importance of this discovery. One study (Jiang et al., 2010) shows that upregulation of FT in *Chrysanthemum* (a short-day plant) results in precocious flowering of transformed plants, under the long days of the incubation chamber (Fig. 5).

In our laboratory we're testing the effectiveness of a construct combining FT and inducible systems, including an alcohol-inducible promoter, in controlling flowering. It seems probable that in the near future the flowering of horticultural crops, initially ornamentals, will be controlled by simple spray application of an inducing chemical instead of the expensive blackout systems presently employed. In the more distant future, we can imagine that the identification of florigen, and the compo-

Figure 5. Overexpression of *Arabidopsis FT* in chrysanthemum under the control of the 35S promoter results in precocious flowering of *Chrysanthemum morifolium*. Photo courtesy L.-J. Zhao, China Agricultural University.

nents of the photoperiodic pathway that precede, follow, or interact with it, will suggest strategies for controlling flowering in many horticultural crops. Certainly horticulturists will be excited to test the possibilities of inducing precocious flowering in woody species, overcoming vernalization requirements, and modifying the timing of flower induction in geophytes, all through up- or down-regulation of a small protein transported in the vascular system.

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Genetic Diversity in Pineapple

Garth M. Sanewski

Pineapple (*Ananas comosus, Bromeliaceae*) is one of the many crops to emerge from the New World since its discovery by Europeans in 1492. While the plant was found to be widely cultivated or utilised throughout Central and South America and the Caribbean at the time of Columbus, the centre of origin is generally considered to be northern Brazil, Colombia, Venezuela, Paraguay and northern Argentina. It is thought domestication principally occurred in eastern French Guiana with site specific selection occurring in many regions including the lower Andes (Coppens d'Eeckenbrugge and Duval, 2009; Clement et al., 2010).

The genus *Ananas* is represented by only two species, *A. macrodontes* and *A. comosus*. While *A. macrodontes* is a highly monotypical, primitive morphotype, there is considerable diversity within the main species, *A. comosus*, to which the domestic and wild pineapple both belong. This genetic diversity is driven by a system of out-crossing and a high frequency of somaclonal variation.

Germplasm collecting expeditions and DNA molecular studies indicate the botanical variety *A. comosus* var. *ananassoides* (Fig. 1) as the wild progenitor of domesticated pineapple *A. comosus* var. *comosus*. While considerable differences exist between varieties of *A. comosus* var. *ananassoides*, most are very primitive compared to the domesticated varieties in existence when Europeans first arrived in South America. The process of domestication by indigenous Ameri-

Figure 1. A pre-Colombian domestic variety *A. comosus* var. *comosus* (left) and *A. comosus* var. *ananassoides*, the wild ancestor of domestic pineapple (right).

cans most likely commenced 6,000 to 10,000 years ago (Coppens d'Eeckenbrugge and Duval, 2009; Clement et al., 2010). This probably occurred through a process of selecting wild types with desirable traits and replanting in village environs although the amalgamation of many desirable traits into single cultivars and the substantial difference between these and the wild morphotype suggest sexual recombination might also have been used.

Breeding for modern supply chains using modern strategies started in the 1940s. Since then, despite over 80 years of breeding effort, only one universally successful cultivar, 'MD-2', has been commercialised worldwide. This Hawaiian cultivar has transformed world markets for fresh pineapple since its release in 1996 (Greig, 2004). Consumption of fresh pineapple quadrupled in the North American and EU markets in the ensuing 13 years (Loeillet and Paqui, 2009). Figure 2 shows the volume of pineapple imports for the United States of America and the European Union for the period since 1996.

'MD-2' represented a major step away from the dual-purpose processing and fresh market 'Smooth Cayenne', which dominated pineapple production in most countries (Fig. 3). The fruit of 'MD-2' develops a glossy, green-golden shell colour, a uniform and attractive cylindrical shape, a flesh that is less acid, sweeter, more yellow, more aromatic, slightly firmer, stores better and contains 5-6 times the vitamin C level. Together these changes summated to a radical change in the fresh product and represented a new fruit category called "gold pineapples" (Janick, 2003).

Most modern pineapple breeding programs, including the one that eventually developed 'MD-2', are based on five pre-Colombian cultivars: 'Perola', 'Perolera' (and the similar 'Monte Lirio' and 'Manzana'), 'Queen', 'Red Spanish' and 'Cayenne' (Fig. 4). Between them, these cultivars exhibit a wide variety of diverse and useful traits. Unfortunately, due to a high heterozygosity in the pineapple genotype and a low frequency of desirable genes in pre-Colombian types, it is difficult to quickly incorporate a large number of useful traits into a single commercial cultivar using these parents. A more strategic approach is to use more advanced Hawaiian bred cultivars such as 'MD-2' as parental stock. These cultivars are usually 4-5 generations later than the pre-Colombian ones and hence have a higher frequency of desirable genes and impart a greater breeding efficiency.

As with most crops, traits of interest to producers are usually related to yield, fruit quality, or production efficiency. Increasingly, world production is moving towards efficient large scale mechanised operations with highly regimented

Figure 2. Fresh pineapple imports to the USA and EU for a period covering the introduction of 'MD-2'. Source: Loeillet and Paqui, 2009; US International Trade Commission website http://www.dataweb.usitc.gov/ and National Agricultural Statistics Service website http://www.nass.usda.gov/.

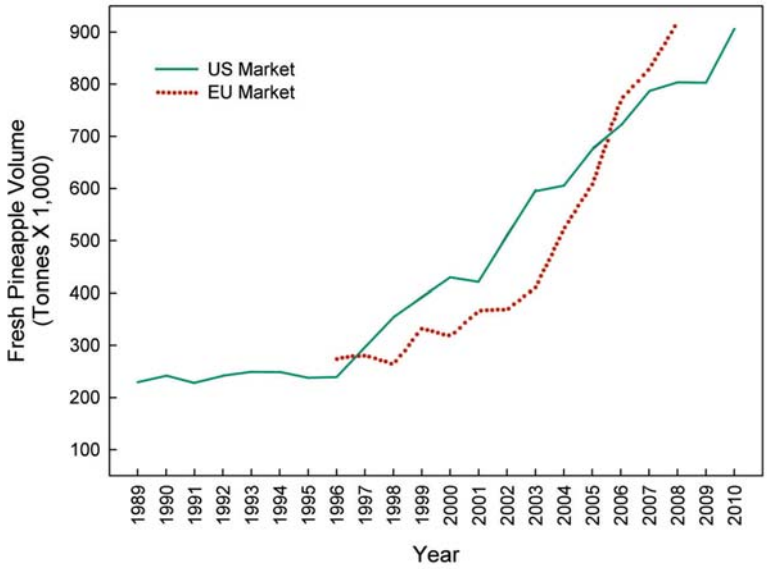
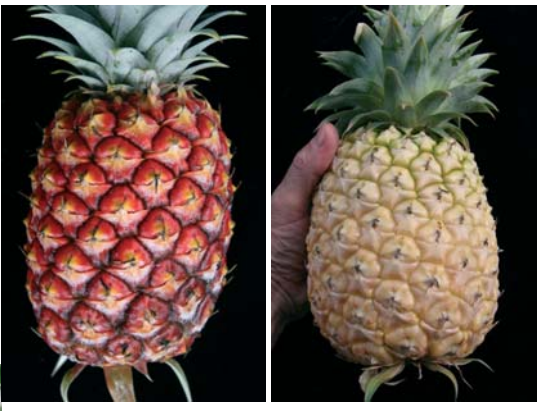


Figure 3. The two most successful domestic pineapple cultivars: 'Smooth Cayenne' (A) developed by Amerindians and 'MD-2' (B) developed in The Hawaii Pineapple Research Institute.

Figure 4. The 5 most common pre-Colombian cultivars: 'Perola' (A), 'Queen' (B), 'Manzana' (C), 'Red Spanish' (D) and 'Cayenne' (E).

Figure 5. Red and cream skinned experimental varieties.



and scheduled production systems. Market and production requirements have become so specialised that one cultivar, 'MD-2', dominates world fresh markets. However, considerable variability exists within *A. comosus* varieties for most traits of interest and new fruit types, not seen on world markets, are possible.

IMPORTANT TRAITS

Yield

The pineapple fruit is a syncarp or composite of many berry-like fruitlets. Fruit size is therefore determined by fruitlet size and fruitlet number both with a relatively high heritability. Fruit size in pineapple can vary from less than 100 g to over 7 kg (Wells et al., 1928). However, despite this genetic potential, market preference is usually for a moderate size fruit of approximately 1400-1600 g.

Skin Colour

Fruit quality attributes of interest to consumers and marketers include skin colour, acidity, sweetness, volatile profile, flesh colour and content of bioactives. Most pineapples seen in world markets possess a yellow to orange skin at maturity, sometimes with some green remaining, but cream, pink and red skinned types also exist (Fig. 5). The more usual yellow skin colour is derived from carotenoids with more yellow varieties containing a higher level (Brat et al., 2004). Green is due to chlorophyll that has not degraded (Dull, 1971). The red colour is derived from high levels of anthocyanins, principally cyanidin glycosides (Brat et al., 2004). Many varieties have a high level of carotenoids and a low level of anthocyanins giving a yellow to gold colour. By varying the levels of the different pigments, green, yellow, gold, pink and red skin types are possible. Red skin is present in several varieties but one with a good complement of other useful characters is the pre-Colombian cultivar 'Manzana'. The cream skin character (reduced chlorophyll, carotenoids and anthocyanins) is present in the primitive *A. comosus* var. *bracteatus* but is easily transferred to more commercial types within 3 generations. While consumer tests with green to gold coloured fruit indicate preference for a gold skin colour (Ramsaroop and Saulo, 2007), novel skin colour might be a way of differentiating new varieties in an increasingly commodity orientated marketing system.

Flavour

Sweetness in pineapple is predominately attributed to sucrose and while heritable, its content is, to some extent, negatively correlated with fruit size. Total soluble solids (TSS) of 13-15% is usually seen in market fruit but TSS >20% is genetically possible, especially at a smaller fruit size, presenting the possibility for super-sweet varieties.

Acidity varies in pineapple from <0.2% to >2% (citric acid equivalent). Consumers generally prefer pineapple acidity in the 0.3-0.7% range. The ratio of TSS to acidity is also important with a high ratio preferred (Ramsaroop and Saulo, 2007). To achieve a high TSS to acidity ratio in a non-equatorial, sub-tropical production region requires a low acid cultivar. The optimum TSS:acid ratio is most quickly achieved through breeding by selecting for low acidity as acidity can be more than halved in a single generation.

Flesh and skin volatile compounds give fruit its characteristic aroma and flavour. Although 280 volatile compounds have been identified in pineapple flesh (Tokitomo et al., 2005), only a few of these are usually found in a concentration above their aroma detection threshold. There are substantial cultivar differences in the concentration of the main volatiles (Elss et al., 2003; Brat et al., 2004; Ito et al., 2006; Soler et al., 2006; Montero-Calderon et al., 2010). Descriptions of flavour for different cultivars include fruity, floral, citrus, and coconut. Table 1 lists the main volatiles considered as active flavour contributors in pineapple fruit analysed so far. The development of new varieties with unique and distinctive flavours is therefore possible by developing varieties with unique combinations of volatile compounds, sugars and acids.

Flesh Colour

As in the skin, the yellow colour of pineapple flesh is attributed to carotenoids (Dull, 1971) and these differ by 2-3-fold between the common 'Smooth Cayenne' and the 'MD-2' (Ramsaroop and Saulo, 2007; Brat et al., 2004). While bright yellow flesh is preferred by consumers, dark yellow to white fleshed pineapples are also possible (Fig. 6). The white flesh character is found in several cultivars including 'Perola' and 'Monte Lirio'. White flesh could be used to further differentiate cultivars with another unique character such as coconut flavour.

Figure 6. White and dark yellow flesh.

Table 1. Compounds identified as possible key odorants in fresh pineapple flavour (Source: Flath, 1980; Teai et al., 2001; Elss et al., 2003; Brat et al., 2004; Tokitomo et al., 2005; Ito et al., 2006; Soler et al., 2006; Montero-Calderon et al., 2010). Aroma descriptions as per http://www.thegoodscentscompany.com.

Volatile compound	Aroma
4-hydroxy-2,5-dimethyl-3(2H)-furanone	Sweet, caramel, fruity, burnt. Strawberry & pineapple at low conc.
4-methoxy-2,5-dimethyl-3(2H)-furanone	Sweet, caramel, fruity, musty, savoury
ethyl 2-methyl butanoate	Green, apple, fruity
methyl 2-methyl butanoate	Fruity, apple
methyl butanoate	Fruity, apple
ethyl 3-(methyl thio) propanoate	Pineapple
methyl 3-(methyl thio) propanoate	Sulfurous, pineapple
ethyl 2-methyl propanoate	Sweet, fruity
methyl 3-propanoate	Fruity, pineapple
methyl propanoate	Fruity, rum-like, apple, banana & strawberry
octalactone	Creamy, coconut
decalactone	Sweet, coconut, peachy
hexalactone	Sweet, creamy, coconut, herbaceous
vanillin	Vanilla
1-(E,Z)-3,5-undecatriene	Fresh, green, pineapple
octanol	Citrus
methyl hexanoate	Fruity, pineapple
ethyl hexanoate	Fruity, pineapple
3-methylbutyl acetate	Fresh, fruity. Banana & pear at low conc.

Bioactives

Vitamin C content and antioxidant capacity in general are often quoted for fruits with citrus fruits commonly perceived as a benchmark. Oranges contain 35-50 mg vitamin C/100 ml of juice. The common 'Smooth Cayenne' pineapple has relatively low vitamin C content at around 10-15 mg/100 ml juice but other cultivars such as 'MD-2' can be as high as 91 mg/100 ml (Johannessen and Kerns, 1964; Ramsaroop and Saulo, 2007). In addition to vitamin C, other compounds including phenolics and carotenoids also contribute to antioxidant capacity. New methods of assessing the total antioxidant efficiency such as the peroxyl radical trapping efficiency (PRTE) have indicated a single serve of pineapple equivalent to a glass of red wine (Vanzani et al., 2011).

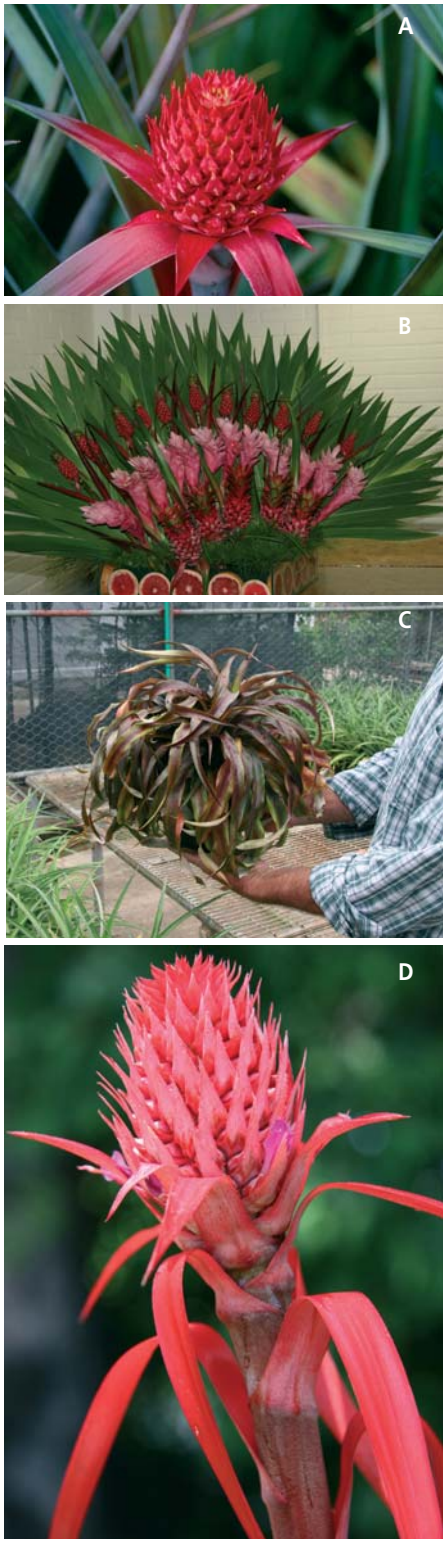
Pineapple is also the source of the medicinal drug, bromelain, a complex of compounds including proteinases and other bioactives. Its medicinal uses include as a digestive aid, in the relief of arthritis, for vaccine formation and skin debridement of burns. It also demonstrated antitumour, fibrolytic and antimetastic activity (Maurer, 2001; Baez et al., 2007). *Ananas comosus* var. *comosus* contains at least four proteinases: stem bromelain, fruit bromelain, comosain and ananain (Heinicke and Gortner, 1957; Rowan et al., 1988). Two additional proteinases, macrodontains I and II, have been extracted from *A. macrodontes* (Lopez et al., 2001). The many varieties of pineapple are yet to be explored for additional medicinal compounds.

OTHER USES

Part of the early domestication process of pineapple included selection for fibre characteristics. The variety *A. comosus* var. *erectifolious* that produces particularly long, light weight but strong fibres was traditionally used by indigenous tribes of South America for its leaf fibre, which was used to make multipurpose twine and cloth (Leal and Amaya, 1991). While these traditional uses have now mostly been lost to synthetic fibres, new uses include the production of biocomposites for the automotive industries (Zah et al., 2007; Ashori, 2008).

The *Bromeliaceae* is well recognised for its extraordinary diversity of species with ornamental appeal. This ornamental appeal extends into the pineapple genus. The primitive varieties *A. comosus* var. *erectifolious, A. comosus* var. *ananassoides* and *A. comosus* var. *bracteatus* and their hybrids possess many characteristics with ornamental appeal. Characteristics include a brightly (usually red) coloured flower head on a long stalk, small decorative fruit on a long stalk, dark red foliage and a small clumping habit suited to pot culture (Sanewski, 2009; Souza et al., 2006) (Figs. 7 and 8). The ornamental appeal of miniature pineapples and their colourful flower heads is now being recognised with small commercial industries developing around the world.

Figure 7. Ornamental pineapple products including colourful flower heads (A and D), decorative miniature fruits (B) and small, potted plant (C). Flower/fruit arrangement in B by F.V. Souza, EMBRAPA, Brazil.



Good germplasm collections of primitive *Ananas* have been established in Brazil, Venezuela and France. These collections are yet to be fully explored for genetic potential.

Figure 8. Leaf colours within *Ananas comosus* var. *comosus*.

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Horticultural Science News

Emergence of Blackberry as a World Crop

Chad E. Finn and John R. Clark

Once thought of as a berry consumed only from wild plants, blackberries (*Rubus* subgenus *Rubus* Watson) have now become a common fruit choice in marketing outlets, particularly in North America and the European Union. Termed the "fourth" berry by some, after the more common strawberry (*Fragaria* × *ananassa* Duch.), blueberry (*Vaccinium* spp.), and red raspberry (*R. idaeus* L.), blackberries have enjoyed expansion due to a combination of factors including improved cultivars, expanded marketing efforts and fruit availability, and an overall increase in berry consumption, especially as fresh fruit, in many areas of the world. It is estimated that cultivated blackberries are grown in excess of 25,000 ha.

HISTORICAL

Blackberries are native across much of Eurasia and North America. This presence combined with their tendency to colonize disturbed areas has made them a food source for humans for thousands of years. The various members of the genus have had a multitude of uses throughout human history as documented in archaeological studies, as well as in art and herbals (Hummer and Janick, 2007; Hummer, 2010). For most of their history, they were a fruit to be gathered from the wild. It wasn't until the mid to late 1800s that people started to select for better or, more typically in the early stages, novel characteristics in plants that were brought into cultivation (Clark et al., 2007). Fresh fruit production began to be more common for local sales in the 1900s. The development of the raspberry/blackberry hybrid 'Logan' in the 1880s served as the basis for a substantial canning industry in the Pacific Northwest. This industry expanded with the development of freezing technology. The growing conditions in the Pacific Northwest and California were ideal for the newly discovered raspberry/blackberry hybrid 'Boysen' and for the first trailing blackberry cultivars developed by the USDA-ARS's George Waldo in the 1930s-1950s. While the fresh blackberry industry slowly grew as a locally produced product, the processed blackberry flourished with the release of 'Marion' in 1956 and the invention of viable machine harvesters, the first commercial machine being from the Iron Wino Co. (Oregon), in the late 1950s.

The success of the fresh red raspberry industry in some ways paved the way or provided an example of how blackberry could become an important fresh market crop. The fresh red raspberry industry grew rapidly from the 1970s to the 1990s with the development of cultivars, primarily developed initially by Driscoll Strawberry Associates in Watsonville, California that could be shipped internationally from California. Blackberries have many similar horticultural characteristics to raspberries but have lower production costs than raspberries

Blackberry is becoming the fourth most important berry after strawberry, blueberry, and red raspberry.

due to their more vigorous nature, greater disease tolerance and therefore longer-lived plantings. California growers looked to blackberries as a profitable way to meet consumer's desires for new products. Blackberry consumers in the south and in the Pacific states had wild blackberries growing in their backyards and developed a preference for "their" blackberries. While vastly simplified, the southern species tended to be sweet with a slightly grassy, and occasionally quite bitter flavor along with somewhat crunchy seeds while the main species in the west tended to have an intense, aromatic flavor with a sweet/acid balance that when right leads to the intense flavor but when too acid leads to a tart berry and they had less noticeable seeds. Cultivars developed for the fresh market tend to blend these characteristics being well balanced but with a strong sweetness and seeds that don't predominate your chewing experience. As these cultivars were combined with the horticultural and economic factors, blackberries have become much more desirable to consumers. Perceived health benefits of highly colored fruit due to their anthocyanin or antioxidant content have also helped drive increased customer demand. Thus, blackberries complemented other berries in the expanded consumer interest.

Blackberry in bloom.

RECENT CROP EXPANSION

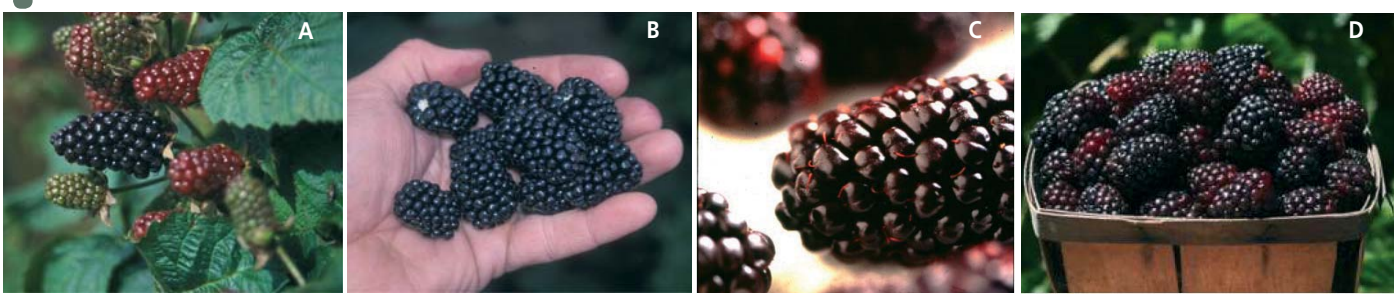
North America

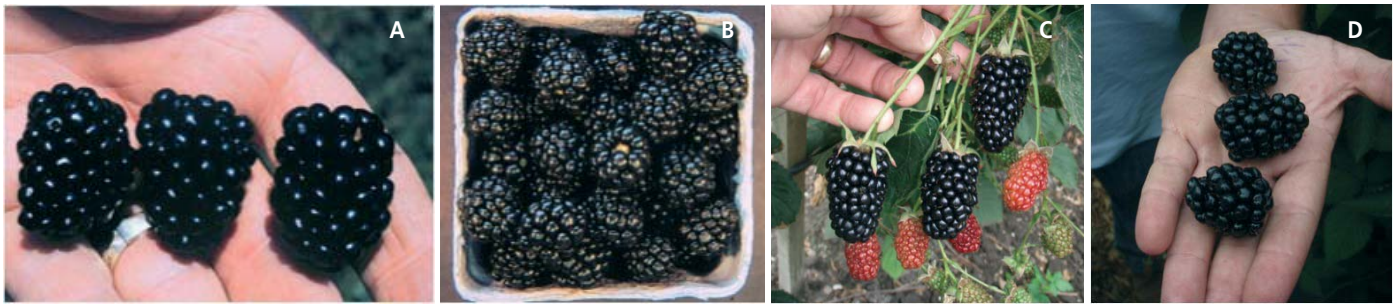
The greatest recent expansion in blackberry production has been in North America, especially California and Mexico, for fresh consumption across the U.S. and Europe (Strik et al., 2007). This expansion has been driven by factors including a stable blackberry supply in most or all months of the year made up of cultivars that allow shipping to distant markets. While the fresh blackberry industry expanded rapidly in California in the 1990s, it exploded in Mexico in the 2000s. The Pacific Northwest, while primarily a processed industry, had a significant expansion of their fresh market during the same time. The most exciting production area for blackberries that has developed in recent years is Central Mexico, in the states of Michoacan and Jalisco. Most blackberries produce vegetative primocanes the first year and after these canes go through a dormant period they become floricanes that bear the crop. In the 1980s, cultural manipulations were developed to allow floricane-fruiting blackberries to be forced into fruiting without a dormancy period. This production system is cultivar dependent and was first developed on the thorny 'Brazos' (developed by Texas A & M University, USA), which had an estimated chilling requirement of approximately 300 hr. Production of 'Brazos' was the basis of the development of the Mexican blackberry industry in the 1990s. In 1990, the Brazilian cultivar 'Tupy' was brought to Mexico (developed by EMBRAPA, Pelotas, Brazil) and was estimated to have similar chilling requirement as that of 'Brazos'. Although initial efforts to manage 'Tupy' with the same practices used on 'Brazos' were not fully successful, adjustments were tried and fine-tuned to provide for dependable production of 'Tupy' (Jorge Rodriguez, personal communication). The substantially increased quality of 'Tupy' over 'Brazos' led to expanded market development and tremendous expansion in production area. Fruit production in Mexico spans the months of October to June using these specialized management methods. It is estimated that 'Tupy' is produced on 6,500-8,000 ha in Central Mexico as of 2011. This production has provided for a dependable fruit supply during the "off" season in the US and Europe.

With the expansion of blackberry marketing in the winter and spring in the US and Europe, US domestic production for fresh market was encouraged to increase. Crop area expanded further in the western states, particularly California, and production for commercial shipping began in the South. Georgia, North Carolina, Arkansas, and Texas initiated acres for retail-market sales. Current production in the US is at an all time high with the development of these additional areas. Fig. 1 provides a view of shipping to terminal markets in the USA for 2000-2010. This figure includes data for only California for the US, but with increases in other states in the US, particularly from 2005 onward, one can see a strong upward trend in production. The production in the US is dwarfed by that of Mexico, however. Therefore, although not all production for shipping is included, one can see that blackberries shipped increased from just above 4,500 kg in 2000 to approximately 54,545 kg in 2010. While the tonnage of Mexican fruit going to processing is much less than the tonnage going fresh, with the tremendous expansion of the industry, there now is a processing industry where there was not one in the past.

The Pacific Northwest in the US, with over 3,500 ha, and Serbia in Europe, with over 5,000 ha, have remained as the leading producers in the world for the processed market. The Pacific Northwest, primarily Oregon, also has a substantial fresh market industry but this is dwarfed by their processing industry. 'Marion', marketed as "Marionberry", is a trailing blackberry that has been the most important cultivar in this region since the 1960s. While renowned for its flavor and processing characteristics, it is thorny,

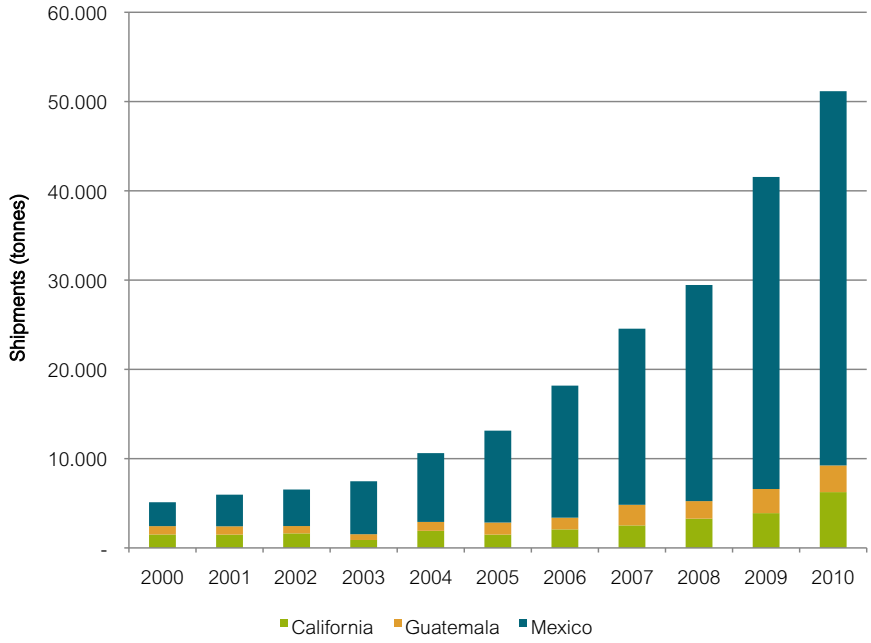
Popular trailing blackberry cultivars recently released by USDA-ARS in Oregon: A. 'Black Diamond', B. 'Obsidian', C. 'Black Butte' (courtesy of USDA-ARS) **and D. 'Newberry', a 'Boysen' like blackberry** (courtesy of Mark Crosse, Fresno Bee).





Popular erect blackberry cultivars recently released by the University of Arkansas: A. 'Apache', B. 'Arapaho', C. 'Natchez' and D. 'Ouachita'. See also Prime-Ark® 45 figure.

Figure 1. Growth in U.S. fresh market blackberry shipments 2000-2010 by major production regions. These are not total shipments because not all regions report to USDA including the southern USA, however, data are indicative of the trend. Source: USDA Agricultural Marketing Service.



which is a legal liability especially in a machine harvested crop, and it is too soft to ship fresh. New high quality, thornless trailing cultivars that are suited for machine harvesting and processing have been developed and are being widely planted. In addition, trailing cultivars that have firm fruit and can be shipped have been developed and are being planted in this region for the fresh market. While the fresh blackberry industry has rapidly expanded, the processing industry has remained relatively stagnant with only a small increase in acreage worldwide.

South America - Primarily Chile

While Chile had become a major supplier of fresh berries for off season consumption in the northern hemisphere, the cost of air freighting fruit from Chile was high and led to a search for new production areas. As a result Chile went from a major fresh red raspberry and blackberry producer in the 1990s and early 2000s to very little fresh production for export by the mid 2000s while in a similar time frame, Mexican production rapidly increased. Chile still is a significant producer for the processed market. Their industry is fairly unique in that most of the growers have less than 1 ha under cultivation and over 50% of the crop is harvested from wild

'Marion' (aka "Marionberry") field in Oregon.

'Metolius' field in Oregon.

Blackberry production: A. 'Tupy' production in central Mexico. Different cropping cycles with crop in bloom (left) and ripening fruit (right). B. Blackberry field in Serbia (courtesy of Brankica Tanovic, Institut za pesticide i zastitu zivotne sredine). **C. Semi-erect blackberry production in China** (courtesy of Zhang Qinghua, Chinese Academy of Forestry).

plants. 'Boysenberry' continues to fill an important niche market for processing in Chile and Uruguay.

Europe - Primarily Serbia

Serbia has been an important raspberry and blackberry producer for several decades and most of their fruit has gone to the processed market. During the wartime periods in the 1990s, production plummeted as the infrastructure was not in place to handle processing and storing fruit. Now in better times, production has resumed and expanded and there are 4,500-5,200 ha of blackberries. Locally developed cultivars, particularly 'Čačanska Bestrna', have played a major role in supporting acreage expansion.

China

While a clear picture of the Chinese industry is difficult to obtain, there is no doubt that there was substantial increase in the production area in the late 1990s and 2000s. A number of cultivars were trialed in the mid 1990s throughout China. Based on results from these trials, most of the production has been concentrated along the Yangzi River and is largely in semi-erect cultivars that are harvested for fresh and processed markets. A concern that pesticides may have been used illegally causing a collapse in internal consumption led to thousands of acres being removed in 2009. Currently, China is believed to have about 3,500 ha.

New plantings in Spain, South Africa, and Australia have all further helped drive the worldwide expansion in blackberry production.

PRODUCTION INNOVATIONS

Production practices and cultivars that bring a higher quality, year-round product to the consumer, and that are profitable for growers, packers, and processors have been an integral part of this fresh market expansion.

Tunnel Production

Traditional, open-field, floricane production has been, and continues to predominate in worldwide production even in the more moderate climates such as California. However, after high tunnel production systems that were developed in Europe for a number of horticultural crops began to move to the US, they were found to be very useful for blackberry production. Precipitation, most typically in the fall, is detrimental to the quality of fall ripening fruit and greatly reduces shipping ability and shelf life. With tunnels, northern producers in mild climates can have excellent fruit nearly until winter although they typically shut down when cheaper fruit begins to arrive from Mexico in the fall.

The development of Mexican blackberry production has involved development of unique production practices that when combined with the mild, high elevation environment of central Mexico and use of the 'Tupy', allows for year round production of fruit. Individual blackberry fields can be manipulated to flower and ripen fruit at nearly any time of the year. The primocanes are grown and trained using typical management practices but then they are defoliated and treated with growth regulators to bring the canes into bloom. In addition, the just-fruited floricanes can be pruned to induce a second flower bud break. Mexican production is usually tailored so there is little production in the main production season of the US as this is the hot-

Evaluation of machine harvestability of blackberry selections at Enfield Farms (Lynden, Wash.).

'Chester Thornless' with rain protection tunnels in place for use in fall in Oregon.

'Black Diamond' field in Oregon.

Prime-Ark® 45 with ripe primocane fruit. Courtesy of Kathy Demchak (top) and Ellen Thompson (bottom).

ter and rainier season and as the crop has more competition from US produced fruit.

New Cultivars

Improved cultivars such as 'Tupy' have propelled the expansion of the fruit industry. Semi-erect types were developed by USDA-ARS scientists such as with Drs. Jack Hull in southern Illinois and Gene Galletta in Beltsville, MD. The semi-erect 'Chester Thornless' is probably the most widely grown fresh market blackberry, although 'Tupy' has no doubt surpassed it in total acreage. Renowned for its productivity, firmness, and retention of its black color during shipping, 'Chester Thornless' has begun to fall from favor due to its fair fruit flavor in the face of new competitive cultivars with better fruit quality. In the erect types, Drs. Jim Moore and John R. Clark at the University of Arkansas developed cultivars with the tribal name theme that could be shipped with good quality, 'Cherokee' served as a mainstay of the industry until the 1990s but was replaced by the thornless 'Navaho', which in turn is being complemented by the thornless 'Ouachita' and the more recent release 'Natchez'. Drs. Francis J. Lawrence and Chad Finn with the USDA-ARS in Oregon have released a series of trailing types in the past 15 years that are suited for fresh and processing applications. While the western trailing types have generally been too soft for shipping, 'Siskiyou' released in the 1990s and more recently 'Obsidian' are exceptions that are very early ripening, filling a unique niche, and are just firm enough to ship. The trailing 'Onyx' and 'Newberry', which is a 'Boysen'-looking blackberry, are poised to be important fresh market cultivars for the west coast of the U.S. The thornless USDA-ARS (Oregon) release 'Black Diamond' rapidly became the most commonly planted cultivar for processing after its release in 2005.

Reversion of color post harvest; fruit appeared fully black when harvested. This is a genetic and environmental problem.

Processing frozen blackberries and strawberries for evaluation (courtesy of Stephen Ausmus, USDA-ARS).

Introduction of Primocane Fruiting Cultivars

The University of Arkansas recently released the first commercially viable, primocane fruiting blackberry, 'APF-45' (marketed as Prime-Ark® 45). While it is too early to tell the impact of this cultivar, it is expected that a substantial portion of the industry will be growing primocane fruiting types in the future. For example, primocane-fruiting red raspberries served a critical role in the expansion of the fresh-market raspberry industry. The primocane habit allowed growers to grow the crop in areas of low or no chill and also more fully manipulate cropping time. This has resulted in red raspberries being grown in a short-term perennial production system where yield, fruit size, and fruit quality were maximized. As improved cultivars of primocane-fruiting blackberries are developed, it is expected they will have the same sort of impact on fresh production.

THE FUTURE

The rapid expansion of the blackberry industry has been remarkable. New, higher quality, cultivars, modified production practices and new production regions have all combined to make this crop one that consumers expect to be available fresh year-round in their grocery stores. As new cultivars are developed that combine the industry's need for high quality arrivals with consumers demand for luscious fruit we only expect demand to further increase.

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Pitless Plum: Reality or Fantasy

Ann Callahan, Chris Dardick and Ralph Scorza

The wall between Reality and Fantasy
Is sometimes so small and not so tall.
Raphael Gualazzi, *Reality or Fantasy*.

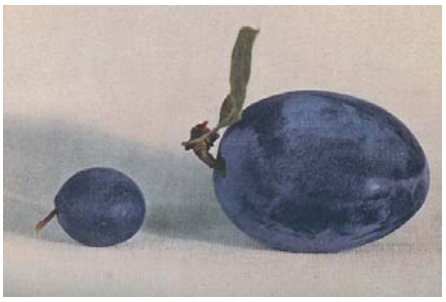
Luther Burbank began a breeding program to produce stoneless plums (*Prunus domestica*) over 100 years ago. He released two plums, 'Miracle' and 'Conquest', whose fruit contained only a very small part of the stone. These plums are no longer available. In today's world of convenience a plum that does not contain either the stone or the seed might be very welcome. Is it possible to again produce plum cultivars that are completely stoneless and seedless? A combination of gained knowledge in genetics and breeding, molecular technology and remnants of stoneless germplasm, probably from Burbank's program, suggest that it is possible to now produce a pitless plum.

INTRODUCTION

A number of seedless fruit and vegetable products have found tremendous market appeal. This is especially true for banana, grape, orange, and watermelon for which consumers have come to expect seedlessness. In grapes, only one out of the top 14 California table grapes still contains seeds (http://www.freshcaliforniagrapes.com/topvarieties.php). Seedless watermelon, although smaller, are the most popular type (Bentley, 2010), and market demand for seedless citrus such as mandarin oranges is reflected in the higher prices commanded for those products (http://www.growingproduce.com/varieties/citrus/varietynews/?storyid=3682; http://westernfarmpress.com/markets/market-prices-separating-mandarins). Whether consumers desire seedless fruit for the personal preference of not having to dispose of seeds or concern for choking hazards, there is clearly a strong market for these genetic improvements.

Satisfying consumer preference for seedlessness has thus far been limited to particular crops as seedless traits are currently unavailable for many fruits, especially those that contain a hard protective covering that surrounds the seed (called the stone). Fruits that contain a hardened stone are classified as drupes and include all the stone fruits (*Prunus* species) such as peach, plum, apricot, and cherry, other fruits such as coffee, olive, and date, many of the nuts, as well as raspberry and blackberry. In drupes, it would be necessary to eliminate both the stone and seed, a task that has to date been elusive. But

Fruit from the original stoneless plum, 'Sans Noyau', next to fruit resulting from successive hybridizations with high quality fruit (Burbank, 1914a).



in addition to consumer attitudes, there are several other economic reasons, both for the plant and for the fruit processing industries to not form the stone and seed (together referred to as the pit). The plant expends precious resources into not only forming the seed but into the protective barriers surrounding it, which in drupes consist of energy intense lignin/cellulose complexes (Ryugo, 1961, 1963; Nakano and Nakamura, 2002; Dardick et al., 2010). Pits must be removed when processing fruits and considerable innovation has taken place to designing "pitting" machines. A search for fruit pitting patents resulted in over 3000 types of machines. In addition to pitting, the industries have to guarantee as a protection to consumers that all the pits are removed and in addition that no fragments remain (to the tolerance level of 1 in 400 fruits for plums or 1 in 400 ounces or more for sour cherries). This requires expensive detection equipment. All in all, the convenience, the energy expense to the plant, and the cost to processors of pits are collectively burdensome.

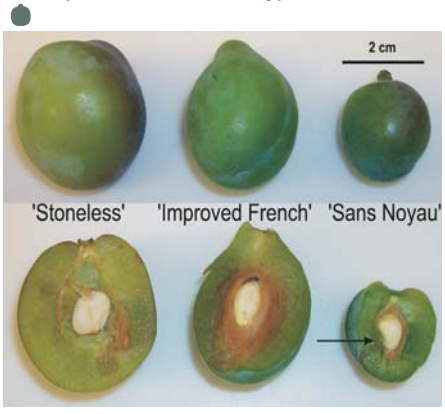
STONELESS HISTORY

Luther Burbank was a prolific breeder who over his career was responsible for over 800 releases including the 'Burbank' potato (the source of 'Russet Burbank'), the 'Shasta' daisy, the red California poppy, the 'Santa Rosa' plum, and two stoneless plums, 'Miracle' and 'Conquest' (Burbank, 1914a; Stansfield, 2006). Burbank was recognized in his time as one of the leading breeders of horticultural crops (New York Times articles 1906, 1912). His notoriety continues today as many of his creations still predominate in numerous crop and ornamental industries. Many of the goals of Luther Burbank's breeding programs involved making the plant more efficient and convenient for both growers and consumers, for example, spineless cactus that could be eaten by grazing animals or thornless blackberries (Stansfield, 2006). In the late 1800s, Burbank began a program to produce stoneless plums that he titled "an experiment in teaching a plant economy" (Burbank, 1914b). His thought was that the stone was not needed for cultivated trees that were propagated through cuttings. "….But a moment's reflection makes it clear that the plum stone serves man no useful purpose, while the inconvenience it gives us is obvious." …(Burbank, 1914b).

Burbank became aware of a stoneless plum, 'Sans Noyau', that had been known for centuries, and obtained shoots for grafting from the Transom Frères' Nurseries, France sometime around 1890. These were grafted onto mature trees and after a number of years produced fruit that were very small, sour, and most importantly, partially stoneless. They had approximately half of the stone covering the seed. Burbank proceeded to initiate a series of crosses to obtain higher fruit quality with less stone. After several more generations of crossing stoneless progeny to high fruit quality he obtained an acceptable quality seedling from a cross of stoneless by 'Agen' pollen. In 1903, Burbank sold this stoneless plum, 'Miracle', to the Oregon Nursery Company where it became available for purchase in 1906 (Burbank, 1903, 1914b).

An acquisition of 'Sans Noyau' growing in the fields at the Appalachian Fruit Research Station, ARS-USDA, Kearneysville, West Virginia. The bush-like stature of the five-year-old tree is clearly seen in contrast to the two plum trees behind it.

A fruit from 'Stoneless' plum, 'Improved French' and 'Sans Noyau' collected in 2011 from the ARS orchard, Kearneysville, West Virginia. 'Stoneless' has only minimal fragments of stone, while 'Sans Noyau' has a partial stone (see arrow) that is thin enough to easily cut through with a knife. 'Improved French' has a typical stone.



Burbank improved upon 'Miracle' with a new selection he named 'Conquest'. Where 'Miracle' had a small sliver of stone, 'Conquest' had only a grain or as Burbank put it 1/1000 of the weight of the fruit rather than the standard 3-6% of a normal fruit. Burbank considered this one of his four best plums and nearly perfect. He thought that he could do better than 'Conquest' because he had over 100,000 seedlings that were stoneless amongst which were selections that were completely stoneless and some that were even completely stoneless and seedless – pitless. Unfortunately none of those had adequate fruit quality. "…the most strenuous series of experimental efforts that I ever undertook – a quest that occupied a considerable

Fruit from 'Stoneless' plum (on the left) with only a small piece of stone tissue and fruit from a normal stone cultivar, 'Cacanska Lepotica' (on the right).

share of my time for a period of fifteen years, and which even now is not altogether complete." (Burbank, 1914c). He believed that with additional crosses he could incorporate high quality fruit characteristics with the complete absence of stone and seed.

Burbank's stoneless cultivars were not successful in the market. It could have been because they weren't stoneless enough, or that they did not have high enough fruit quality, or it could have been for the very simple fact that plum growers were paid by the weight of the product and the fruit with no stone weighed less, thus earning less money for the same number of fruit (L.J. Rombough, pers. commun.).

KNOWLEDGE ON STONES AND SEEDS

Stones

Fruit are classified as either being dry fruits or soft fleshy fruits depending on the consistency of the mesocarp or alternative "flesh" layers (Seymour et al., 2008). The tissue layers that make up either dry or fleshy fruit are derived from the ovary and are collectively called the pericarp and consist of endocarp, mesocarp and exocarp layers. The endocarp becomes the hardened layer like the stone in the fleshy *Prunus* species fruit or the enb layer in the dry fruit of *Arabidopsis*; the mesocarp becomes the flesh and the exocarp becomes the skin (Labrecque et al., 1985; Ognjanova et al., 1995). The endocarp layer in drupes hardens as the fruit mature through a process that involves cell wall formation and lignification resulting in woody endocarp layers.

Much of what is known about the genetic control of endocarp formation and lignification comes from studies in the model plant *Arabidopsis* (Roeder and Yanofsky, 2006). *Arabidopsis* produces a dry, dehiscent fruit but it also forms a hardened lignified endocarp that forces the seedpod to shatter when the seeds are mature. Through mutant screens a number of transcription factor genes have been identified that appear to be responsible for determining which cells will become the lignifying layer of endocarp (enb) or the cell layer that shatters (ena) (Dinneny and Yanofsky, 2004; Dinneny et al., 2005; Ferrandiz, 2002; Irish, 2010; Lewis et al., 2006). These appear to also be expressed at times of endocarp development in peach and even tomato implying that a common program of development takes place (Dardick et al., 2010; Tani et al., 2007; Tadiello et al., 2009; Vrebalov et al., 2009).

In addition to the discoveries in the regulation of the lignifying endocarp, an enormous amount of work has been conducted on understanding the basic process of lignification (Boerjan et al., 2003). Lignin pathway genes have been identified and manipulated to determine if properties of wood and forage crops can be modified to make them more amenable for desired products. Transcription factors have been identified that are responsible for the initiation of the lignin pathway and some of these are responsible for the lignification of the fruit endocarp tissue in *Arabidopsis* (Demura and Fukuda, 2006; Nilsson et al., 2008; Mitsuda et al., 2007, Mitsuda and Ohme-Takagi, 2008). The genes for lignification and the responsible transcription factors are also expressed during endocarp formation in peach and plum (Dardick et al., 2010).

Seeds

Seedless fruit are formed by parthenocarpy where the ovule is not fertilized or stenospermocarpy where fertilization is required but the embryo is unable to develop properly. Applications of growth regulators such as gibberellic acid (GA) induce parthenocarpy in a number of crops (Vivian-Smith and Koltunow, 1999; Pandolfini, 2009). There are also plants with mutations in the GA pathway that result in seedless fruit. Stenospermocarpy is the more common case in the commercial seedless fruit such as 'Thompson Seedless' ('Sultanina') grapes that leave a seed trace. The fact that fruit development can continue in seedless fruits indicates that full seed development is not required for normal fruit development.

Seedless *Prunus*

In *Prunus* there has been only a small amount of work on developing seedless fruit as there is little point if the stone is present. In *Prunus* fruit applications of GA have induced seedless fruit and even with one application of GA, normal sized seedless fruit could be obtained (Kiyokawa and Nakagawa, 1972). In plums only a combination of two different GAs was able to induce parthenocarpy (Jackson, 1968). *Prunus* did not appear to respond to exogenous auxin. Crane et al. (1961) and Crane (1963) showed that stone development was related to fruit growth, which was affected by different GA concentrations. He also found that lignification proceeded normally regardless of the ultimate growth of the stone. Zucconi and Bukovac (1978) reported that peach fruit with killed seed could be induced to produce normal sized fruit with spray applications of GA_3. They also found that the seed did not appear to play a role in fruit drop as seedless fruit whether GA treated or not has the same percentage of fruit set. Parthenocarpic peaches resulted in smaller fruit with normal stones.

Seed Development

Arabidopsis seed development has been well studied (Irish, 2010). The ovule develops from a region of the inner wall of the ovary. The integuments, inner and outer layers are formed from the outside of the ovule at a point that defines where the chalaza is formed and the opposing site becoming the funiculus that provides the pathway for nutrients for the embryo and seed. The integuments encompass the nucellus as well as the developing megasporocyte within the embryo sac. After fertilization the embryo develops and the endosperm is formed while the nucellus is depleted. Just as in endocarp development there are a number of transcription factors that control the determination of these tissues. Mutations in these genes result in defective or aborted seeds. This information has been used to generate seedless fruit through genetic engineering, by putting a cell lethality gene under an ovule specific promoter in combination with an auxin stimulating gene under a carpel specific promoter (Acciarri et al., 2002; Rotino et al., 2005). This results in an ovule that is killed in combination with a constant source of auxin from the carpel tissue (pericarp) to stimulate the expansion of pericarp tissue. This has worked quite well for crops such as eggplant or tomato (Acciarri et al., 2002; Rotino et al., 2005; Y Li, US Patent #6,268,552). It is currently under exploration in plum in our lab. Other genetic approaches for seed elimination are available through the identification of natural mutations that result in seedlessness such as that in sugar apple (Lora et al., 2011), citrus (Vardi et al., 2008) and apple (Yao et al., 2001) as well as triploidy exploited in banana (Simmonds, 1976), citrus (Ollitrault et al., 2008), watermelon (Kihara, 1951), and loquat (Liang et al., 2011).

'FasTrack' plums bearing fruit grown in the greenhouse. The trees are approximately 1 year old and will flower and fruit continually in the greenhouse.

WOULD A PITLESS PLUM BE DESIRABLE TODAY?

Convenience is becoming a driving force in marketing of fruit and a pitless plum, by providing a more convenient product, could impact marketability. Not having to remove the pit would dramatically change the way plums are processed. Pitless plums would eliminate the need for pitting machinery and its upkeep. It would eliminate the need for orienting the fruit, and the need to reshape the fruit that normally follows the pitting process. Not only would the machinery be eliminated but water use would be reduced along with fruit losses due to pit removal-associated damage. The loss of weight of the fruit due to pit-associated flesh removal would be eliminated. In addition, more diverse cultivars could be marketed as they would be free from constraints on fruit characteristics necessary to withstand the pitting process such as flesh texture and sugar content, skin properties, as well as fruit size. Highly expensive equipment such as near infrared spectroscopy (NIR) and machine vision technology, currently used in processing plants, may also be eliminated if there are no pits or fragments to detect. The lack of pits could also open new markets where normally only non-stone fruit such as blueberry, strawberry and cranberry are used such as in cereals or granola bars. The issue of the resources devoted by the tree to stone production will be interesting to explore when stoneless fruit is produced. If resources are shifted from stone production, where will these resources then be directed?

MAKING PITLESS PLUMS REALITY

Extending Burbank's Vision

Using modern molecular tools, it should be possible to more efficiently pursue Burbank's vision of a pitless plum. Recently plum lines that resemble Burbank's lost lineages of stoneless plums as well as the 'Sans Noyau' were obtained from collections at UC Davis (CA), USDA-ARS at Parlier, CA, the National Repository for *Prunus* in CA, and from a private grower who discovered stoneless plums growing along a fence row in Oregon (L. Rombough, pers. commun.). These lines of plums have exhibited very little stone development most years and a nearly complete but thinner stone in other years. Studies on the development of the stone in one of these lines, 'Stoneless', suggested that the lack of stone was due to fewer endocarp cells being formed leaving a larger cavity that would normally be filled with stone tissue (Callahan et al., 2009). Crosses with these plums have also indicated that the genetic influences on this trait may be complex. Offspring from an open-pollinated cross of 'Stoneless' show the stoneless character segregating in the seedlings (R. Scorza et al., unpubl.).

There are several reasons why a modern breeding project would be expected to successfully produce pitless plum cultivars. We now have a better understanding of the patterns of segregation of genes relative to phenotypes. We also know that the stoneless trait is an environmentally sensitive phenotype, being weaker in warm weather. Molecular markers that are linked to stoneless as well as high fruit quality traits can be used to screen seedlings so that only those with markers linked to stoneless are carried to maturity. We can accelerate the breeding cycles through 'FasTrack' breeding, a system that incorporates a *FLOWERING LOCUS T* gene from poplar, that allows the plums to bloom and fruit continuously in the greenhouse (http://ucanr.org/sites/fastrack/DriedPlum/) This allows a generation every year instead of the normal 4-7 years in the field.

What took Burbank 15 years could be reduced to 6 years in the greenhouse. Development of stoneless plums is now more promising because the fruit on the 'Stoneless' line is already of reasonable quality rather than the poor quality partially stoneless 'Sans Noyau' with which Burbank began his project.

We have also observed in stoneless germplasm that approximately 70% of the fruit have an incomplete seed represented by a dry, shriveled seed fragment (Dardick, pers. commun.). With selection we may be able to entirely eliminate the seed. We believe that the time is ripe to produce pitless plums utilizing the knowledge, techniques, and germplasm currently available including molecular markers, accelerated breeding, functional genomics and genetic engineering. The knowledge gained in the model plum system can then be applied to all the drupes bringing pitless fruit from fantasy to reality.

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The Poinsettia: History and Transformation

Judith M. Taylor, Roberto G. Lopez, Christopher J. Currey and Jules Janick

The beautiful poinsettia, known for its scarlet bracts, comes to us encrusted with myth and legend as befits a royal plant of the Aztecs. The Nahua people in Mexico called it *cuetlaxochitl; xochitl* is ancient Nahua for an ornamental flower. This plant did not flourish in their high altitude capital, Tenochtitlan (now Mexico City), but every winter the rulers imported thousands of the plants from warmer regions. Extracts of the plant were used to dye cloth and its milky sap, or latex, was used for medicinal purposes. The Spanish conquerors and missionaries attempted to erase all evidence of the preceding pagan Aztec religion but records have survived showing that the plants were used for religious ceremonies in the winter (Anderson and Tischer, 1997). Once the Spanish friars took over they adopted the brilliant red plant as part of the Christmas ritual. The Spanish-speaking Mexicans named it *flore de nochebuena*, the flower of the Holy Night (Christmas Eve), and the French later named it *etoile d'amour* (star of love). The vivid red bracts of poinsettia that emerge in mid-winter have signified the festive mood at Christmas and the joy of the season for many for over 150 years in the United States and Europe. The purpose of this article is to establish the actual story of its arrival in the United States and Europe attempting to clear away all the accumulated misinformation and cobwebs, and to review its extraordinary development as an important horticultural crop.

INTRODUCTION

The poinsettia (*Euphorbia pulcherrima* Willd.ex Klotzsch.), a member of the large and diverse family *Euphorbiaceae*, originated in southern Mexico and northern Guatemala (Fig. 1). In its native habitat this species is a winter-flowering shrub that grows over 3 m and is a common landscape plant (Fig. 2). The sap is milky and may produce dermatitis in susceptible individuals. The umbel-like cymes are subtended by many showy, red bracts but breeders have produced many different colors including white, pink, and purple. Globally, Europe accounts for about two-thirds of the poinsettia market and the United States for the remaining one-third. Poinsettia is presently the most valuable potted flowering plant in the United States with a wholesale value of $145 million in the top 15 producing states (U.S. Department of Agriculture, 2010).

Figure 1. Plants of the *Euphorbiaceae* (Meyer, 1902).

JOEL ROBERTS POINSETT AND THE POINSETTIA PLANT

The common name, poinsettia, honors the American Joel Roberts Poinsett, 1779-1851 (Fig. 3), who, legend says, observed it in Southern Mexico in 1825 (Anon., 1888). For years it has been assumed that Poinsett came across the gorgeous plant in Taxco, southern Mexico, as part of a nativity scene, and sent cuttings or plants to Charleston, South Carolina in 1828. From Charleston cuttings or plants were sent to Colonel Robert Carr, a nurseryman in Philadelphia, Pennsylvania, whose wife Ann was the granddaughter of John Bartram, the self taught American botanist of the colonial era. Carr entered the plant as "a new *Euphorbia* with bright scarlet bracts or floral leaves, presented to the Bartram Collection by Mr. Poinsett, United States Minister of Mexico" at the Pennsylvania Horticultural Society's flower show in June 1829 where it was seen and admired by hundreds of people (Fry, 1995).

Figure 2. The poinsettia is a common landscape plant in the tropics (Huang, 2007).

Almost no evidence exists to support much of this charming and delightful story. The facts are as follows. The plant is indeed endemic to Southern Mexico. Specimens were received in the United States in 1828 and by 1829 it was on display in Philadelphia and its arrival was associated with the name of Joel Roberts Poinsett. There is no evidence the plant first arrived in Charleston South Carolina before reaching Philadelphia but its movements after Philadelphia are well documented.

Figure 3. Joel Roberts Poinsett (Longacre and Herring, 1837).

The next step in its dissemination was taken by Robert Buist, a Scottish nurseryman in Philadelphia who was so enthralled by the new plant that he took cuttings to his friend James NcNabb in Edinburgh. From Scotland it reached the distinguished German botanist Karl Willdenow in Berlin who named it *Euphorbia pulcherrima* in 1834. This remains the accepted botanical name. Two years later Robert Graham in Edinburgh published his taxonomic findings and changed the name to *Poinsettia pulcherrima* but this generic name has not been accepted (Britton and Brown, 1913).

The biography of Poinsett by Fred Rippy (1935) devoted one paragraph to the poinsettia story and in a footnote the author indicated he had been unable to find any correspondence to validate the claim that Poinsett introduced the plant. Rippy dryly commented that "It is generally acknowledged in the horticultural guides that Mr. Poinsett introduced the flower." Rippy cited the only reliable document of the era, a discussion of Poinsett in the 1887 *Charleston Yearbook* by Charles Stille who had spent a day with Poinsett as a lad of 12. Together, Charles and Poinsett visited the Reverend John Bachman, a Lutheran minister and noted naturalist who once worked with Audubon. The Yearbook article states:

> "Mr. Poinsett was rewarded for the interest he took in science by having a beautiful flower named after him… There is some difference of opinion as to whether Mr. Poinsett discovered it himself or simply introduced it to this country. At all events it is always known now as being named after him."

The flower was originally called either "Mexican flame flower" or "painted leaf" in the United States, though neither of these seemed satisfactory. The occurrence of a plant acquiring an enduring common name after it received its formal name, rather than the other way around, is rare. The choice of Poinsett's name is attributed to William Hickling Prescott, the author of the classic 1843 book *The History of the Conquest of Mexico*, but this too is a myth (Fry, 1995), since Robert Graham used the name poinsettia in his taxonomic identification of 1836.

Poinsett was a very well educated, cosmopolitan Southern gentleman of Huguenot descent from Charleston, South Carolina, who spoke French, German, Italian and Spanish (Rippy, 1935). He was appointed the first American minister to the newly independent Mexico by President James Monroe in 1825 but was recalled by President Andrew Jackson in 1830. Poinsett subsequently acted as Secretary of War in President Martin van Buren's cabinet after terms in the South Carolina state legislature and the United States House of Representatives where he was a staunch foe of nullification in the 1832-1833 crisis in South Carolina. His book about his first tour of duty in Mexico, *Notes on Mexico* (Poinsett, 1824), contains no mention of the plant. Poinsett was a founder of the National Institute for the Promotion of Science, the predecessor of the Smithsonian Institute.

Poinsett never enjoyed very robust health. He started out to be a physician like his father but could not complete the course. His lifelong interest in natural science stemmed from the preliminary studies. Poinsett carried on an extensive correspondence about horticulture, exchanging seeds and cuttings with friends and colleagues in the United States. He believed that the exchange of plants and seeds helped to promote stronger ties between the United States and Mexico.

The American Philosophical Society in Philadelphia elected him to membership in 1827 (Fry, 1995). This broadened his correspondence to include members of the society and other Philadelphia savants. These connections appear to be the most likely route through which the new red-bracted plant reached the United States. There are fairly strong indications that it may have traveled directly from Mexico to Philadelphia. Four different collections of Mexican seeds and plants were dispatched to Philadelphia between 1828 and 1829. Poinsett himself remained in Mexico until 1829.

William Maclure, the president of the Academy of Natural Sciences, and Thomas Say, a descendant of John Bartram, visited Poinsett in Mexico for three months in January 1828 traveling to both Veracruz and Mexico City. Later that year Maclure again visited Poinsett and returned to Philadelphia in the fall with many seeds and plants. Say also collected more than 100 types of seeds but was not meticulous about identifying them. Number 65, a "Fine Red flower, perennial" could be poinsettia.

In November 1828 James Ronaldson, a Scottish enthusiast in Philadelphia, wrote to Poinsett that he had received a box of seeds from Veracruz and assumed it came from Poinsett. The fourth possibility was William Keating, a geologist who went to prospect in Mexico and met Poinsett. On occasion, Keating acted as a courier for Poinsett.

In summary, there is no doubt that the plant was growing in Philadelphia when Colonel Robert Carr exhibited it at the first flower show of the Pennsylvania Horticultural Society in June of 1829. Poinsett was still in Mexico but it was generally accepted he was instrumental in its transfer. Perhaps the following extract from a letter from one of Poinsett's friends in 1830 clinches the argument that these plants did not enter the United States via South Carolina:

> "Mrs Herbemont [of Charleston] has *been very vexed* with you when she learned by the papers that several northern gardeners had received seeds and plants you had sent them from that land of vegetable beauties, Mexico, and that *you had not in one instance* remembered her…" (Fry, 1995).

POINSETTIA IN MEXICO

The specimen received in Philadelphia was not a wild plant but had been cultivated and modified for many years in its native Mexico. Doña Fanny Calderon de la Barca, wife of the Spanish minister to Mexico, commented in her letters home that her church courtyard was lit by these gorgeous scarlet flowers at Christmastide (Calderon de la Barca, 1843).

For reasons which are not clear Mexican growers still believe that Poinsett himself devised a hostile mechanism to prevent them from developing or benefiting from this growth purely out of spite. Various publications in Mexico indicate that he obtained a "patent" in the United States which led to this embargo (Fuentes Mares, 1984; Miranda, 2004). An exhaustive search through old patents and treaties has failed to turn up such an instrument. While the United States patent laws began in 1795 to protect inventors against their mechanical devices being pirated, plants were not covered. The first US law that protected new cultivars of plants, the Townsend-Purnell Act of 1930, excluded seed propagated plants, tuber propagated plants (to exclude potato), and wild plants (Janick et al., 1983). At present, international protection for plants is controlled by a 1961 treaty, International Union of the Protection of New Varieties (UPOV) and seed-propagated plants in the United States are now protected by the Plant Variety Protection (PVP) Act of 1970, administered by the United States Department of Agriculture. Poinsett did negotiate a commercial treaty with Mexico as part of his ministerial duties and it was ratified by the United States but the plant was not part of the treaty.

The current animosity to Poinsett in Mexico has some basis in fact and this may have contributed to the myth of the United States patent. Poinsett tended to meddle in Mexico's internal affairs, supporting one party over another (Rippy, 1935). At one point death threats were made against him. All this contributed to his recall by the President Jackson. The term *poinsettismo* is still in use today in Mexico to express arrogance and high handedness.

POINSETTIA IN THE UNITED STATES

North American nurserymen rapidly propagated the plants and distributed them widely throughout the United States over the last part of the 19th century. The modern phase of poinsettia development took place in the early 20th century. Poinsettias have led the sales of potted plants year after year and are one of the mainstays of the commercial floriculture industry. This phenomenal growth is associated with the Eckes, a German immigrant family which settled in Southern California (Ecke et al., 2004).

Albert Ecke and his family stopped over in California in 1900 en route to Fiji where they

planned to open a health spa. They saw such an excellent opportunity in California that they settled there, remaining until the present. Albert began farming in the Eagle Rock Valley, near Los Angeles but then moved to Hollywood. They planted orchards and also large fields of chrysanthemum, gladiolus and poinsettia for the cut flower market. By 1909 they narrowed their floral crops down to poinsettia alone. Ten years later, both Albert and his eldest son Hans had died and the business was taken over by the second son, Paul Ecke (Fig. 2), who moved south to Encinitas where the company remains.

The early poinsettias were still fragile. Their leaves fell off quickly and the scarlet bracts only lasted for about a week to 10 days. Bahr (1937), author of one of the earliest texts on floriculture, complained: "Perhaps no other plant or flower we handle during Christmas week is short lived, wilts quicker or is more disappointing to those who receive it; yet, when the next Christmas comes around, there comes again the same demand for poinsettias and the disappointments of a year ago are all forgotten." Up to the 1950s it was very difficult to get them into perfect condition by Christmas and maintain their quality in the homes of consumers.

The history of the poinsettia production in the United States in the 20th century has some well defined landmarks. Major advances in flowering physiology came about with the discovery of photoperiodism in plants by Garner and Allard (1920) and photoperiod control techniques were developed in the floricultural industry to shorten the day length with black cloth and "force" floriculture crops into flower for specific market dates (Post, 1942, 1950). This was essential because poinsettia, among other floriculture crops, is a short day plant where flowering is induced with a night length of at least 11.75 hours (it is the night length not the day length that is critical). Shortening the day length with black cloth (increasing the dark period) induces flowering in poinsettia (Fig. 4). Adding photoperiodic lights to interrupt the dark period prevents flowering and keeps the plant vegetative. Management of day length permits scheduling of flowering in order to get plants to flower for the Christmas season.

Figure 4. Poinsettia production in greenhouses; note the black cloth.

Table 1. Seminal cultivars in poinsettia improvement.

Year	Cultivar	Distinguishing characteristics
1923	Oak Leaf	Dwarf, long lasting bracts
1988	Eckespoint® Lilo	Dark leaves, early flowering
1963	Paul Mikkelsen	Stiffer stem; improved bract longevity
1992	Eckespoint® Freedom	More consistent branching; withstands careless handling
1998	Eckespoint® Haddon Winter Rose Dark Red	Very dark leaves; "curly" incurving bracts and leaves

Figure 5. Paul Ecke Sr. (1895-1991).

While the ability to control flowering has had the most profound effect on poinsettia production, improvement of plant quality attributes through breeding efforts has greatly improved today's commercial cultivars (Table 1). Some of this was due to the establishment of various breeding programs across the country in the mid 1950s, including Pennsylvania State University, the USDA Research Center at Beltsville, Maryland, and the University of Maryland. However, the greatest advances have been made through the efforts of some private companies including Ecke, in California; Azalealand, in Lincoln, Nebraska; Mikkelsens in Ashtabula, Ohio; Earl J. Small, in Pinellas Park, Florida; and Yoder Brothers, in Barberton, Ohio. Considerable efforts of breeding programs have focused on improving ornamental characteristics such as color and bract size (Fig. 5). However, major efforts have also been made to improve the post-harvest quality of poinsettia including delayed leaf senescence and abscission as well as reduced ethylene sensitivity, traits which plagued poinsettias for years.

Other major innovations in the poinsettia resulted from the remarkable discovery by Gregor Gutbier, a poinsettia breeder in the 1980s, that grafting poorly branched (branching-restricted) plants to well-branched (free-branching) plants increased branching in the propagules from the restricted-branching scion (Fig. 6). This effect was demonstrated to be due to the transmission of a phytoplasma that was transmitted from an infected to a non-infected plant (Lee et al., 1997; Dole and Wilkins, 1999; Huang, 2007). The phytoplasma was shown to be caused by an infectious agent related to peach X disease and spirea stunt, but was otherwise benign in poinsettia. Once the role of the virus was recognized it became a standard procedure to induce the beneficial pathogen to new poinsettia seedlings by grafting. Vegetative propagules (cuttings) from grafted plants kept their free-branching trait.

Other innovations in poinsettia production (Fig. 7) include plant pruning (pinching) to increase branching and the use of growth regulators (PGRs) to reduce stem elongation and final plant height. By increasing branching and controlling plant height, poinsettia producers can produce compact, high-quality plants that may also be packed, shipped, and sold on a cart in retail locations. The industry height standard in the United States for plants grown in 15 cm containers is between 36 to 41 cm. Florist-quality poinsettias were originally produced from several un-pinched cuttings in a single container known as "straight ups." However, a high-quality poinsettia may be produced by planting a single cutting in the container and pinching the cutting to induce branching (a 3- to 4-cm "hard pinch" is most effective) after rooting has been established in the container (Berghage et al., 1989). This allows several branches to develop from axillary buds and produce a "full" plant.

Compact poinsettias may be produced using applications of PGRs to control stem elongation during production. There are several active ingredients currently applied to poinsettias, including ancymidol, chlormequat chloride, daminozide, ethephon, flurprimidol, paclobutrazol, and uniconazole (Ecke et al., 2004). PGR solutions may be applied by foliar sprays (chlormequat, daminozide, and ethephon) or drenching the growing substrate (Hammer and Barrett, 2001). Timing of PGR applications is important. Plant growth retardant applications made close to or during short days can reduce bract size; therefore applications are best made early in

Figure 6. Variation in modern poinsettia cultivars: Ecke 'Orange Spice', deep orange bracts with dark green leaves; Syngenta 'Carousel Dark Red', curled dark red bracts against dark foliage; Syngenta 'Sonora White Glitter', red bracts with cream speckling; Syngenta 'Whitestar', bright white bracts and medium green leaves; Ecke 'Ice Punch', bright, rosy-red bracts with a blaze of white down the middle of each bract; Syngenta 'Cinnamon Star', early flowering cultivar with cinnamon-pink bracts; Ecke 'Polly's Pink', bright, fluorescent-pink bracts with dark foliage; Ecke 'Winter Rose Dark Red', incurved dark red bracts and incurved dark green foliage; Selecta 'Pink Candy', dark-pink bracts with darker pink flecks; Dümmen 'Pink Cadillac', large pink bracts with very dark green foliage; Ecke 'Tapestry', red bracts and leaves with variegated margins; Dümmen 'Viking Red', large, rounded, medium-red bracts (photos by R.G. Lopez).

Ecke 'Orange Spice'

Syngenta 'Carousel Dark Red'

Syngenta 'Sonora White Glitter'

Syngenta 'Whitestar'

Ecke 'Ice Punch'

Syngenta 'Cinnamon Star'

Ecke 'Polly's Pink'

Ecke 'Winter Rose Dark Red'

Selecta 'Pink Candy'

Dümmen 'Pink Cadillac'

Ecke 'Tapestry'

Dümmen 'Viking Red'

production when plants are vegetative or late when bracts are nearly fully developed to minimize any negative impact on bracts (Currey and Lopez, 2011).

Poinsettia propagation has also changed over time. Seedling plants are only used in breeding programs. Poinsettias produced commercially are started from stem-tip cuttings. In the early 1900s, dormant 1- to 2-year-old plants were bare-root harvested in late winter or early spring from fields located primarily in California, Florida, and Texas and shipped to commercial growers in the eastern United States (Post, 1950). Upon receipt by producers, the bare-root plants were potted and stem-tip cuttings were harvested in April or May. Poinsettia mother plants

Figure 7. Phytoplasma-infected red poinsettia (Huang, 2007).

are no longer grown in the continental United States on a large scale. Almost all cultivation is now done in South America with its tropical climate and associated lower costs. Cuttings are air freighted into the U.S. or Europe where they are rooted and plants are then "finished" by specialty growers for sale to the consumer in supermarkets and garden centers.

In the past decade, the cost to heat greenhouses has more than doubled and thus threatens poinsettia production. For greenhouse operations in northern latitudes, energy costs for heating alone account for 10 to 30% of their total operating cost. Research at the University of New Hampshire, Clemson, and Purdue University has demonstrated that cultivars produced earlier in the season (6 to 8 week response time), have moderate vigor with naturally large bracts that are well adapted to cold finishing (late growth under cool temperatures). Under this system, growers can take advantage of naturally warm outdoor temperatures in August and September to "bulk" up the vegetative plant. When outdoor temperatures began to fall, typically in mid-October, greenhouse temperature set points (day/night) are reduced to 20 to 21°C/14 to 17°C for "cold finishing" to reduce energy consumption. In addition to energy and growth regulator savings, the timing of cold finished plants is not excessively delayed and bracts and final height are not negatively affected (Lopez and Krug, 2009).

The Paul Ecke Ranch

The Eckes began growing two cultivars of poinsettia before 1920: 'True Red' and 'Early Red'. Their neighbors in Southern California used these plants in their gardens. 'Early Red' was more useful for commercial purposes both as a cut flower and as a potted plant as it held its foliage longer.

Three new cultivars were released in the 1920s but 'Oak Leaf', introduced by a Mrs. Enteman in Jersey City, New Jersey, dominated the field for the next 40 years. It was the first cultivar suitable for growing in a pot and also retained its leaves and bracts for an

extended time. The 1920 sport 'Hollywood' had wider, more compact bracts than 'Early Red' and the 1924 'St Louis' from Louis Bourdet in St Louis, Missouri attained some popularity in its day.

Paul Ecke devoted himself to selecting and developing better cultivars based on 'Oak Leaf'. His introductions included 'Henriette Ecke', 1927, and 'Mrs. Paul Ecke', 1929. The latter, a sport of 'Oak Leaf', was shorter and had wider bracts than its parent. Poinsettias had become a commercial reality and several firms across the United States grew them successfully in greenhouses. In Indianapolis, Bauer and Steinkamp came across another sport of 'Mrs. Paul Ecke' which they named 'Indianapolis Red'. Each of these sports offered improvement in habit and bract size.

Not all the new cultivars lasted well, in spite of their undoubted novelty. 'Henriette Ecke' had "double" incurved bracts. Its offspring, which made the plant almost look like a dahlia, seemed very promising but the bracts were deemed to be too small and the plants did not perform well in the greenhouse. Many years later novelties were in great demand. 'Winter Rose Dark Red' was introduced in the 1990s and by 2004 it was available in seven different colors. Another series with curly bracts, 'Renaissance', came in at about the same time specifically for the cut flower market. These cultivars do well as cut flowers. 'Paul Mikkelsen' from the Mikkelsen nursery in Ashtabula, Ohio, had a stiffer stem and greater longevity than any preceding cultivar. Eckespoint® 'Lilo' was the first poinsettia with dark leaves and early flowering. It retained its foliage well but needed some special treatment to ensure good branching. Eckespoint® 'Freedom' had all the above good points but more consistent branching. It was also ready to be shipped a week or two before Thanksgiving, allowing for a head start on the holiday marketing season. Another excellent quality was the ability to withstand careless handling by untrained staff at large non-specialty stores. In 1998 Eckespoint® 'Winter Rose Dark Red' was the first cultivar to have "curly" incurved bracts and very dark, incurved foliage.

The public likes the traditional red poinsettia but also finds new colors and styles very exciting (Lopez et al., 2010). Breeders have to respond to these needs and accommodate the public's slightly fickle reactions. Since 2002, Ecke has introduced Eckespoint® 'Plum Pudding', with purple bracts, Eckespoint® 'Chianti' with darker wine red bracts, Eckespoint® 'Shimmer Pink', pink with white flecks, and many others (Ecke et al., 2004). Eckespoint® 'Prestige Red' has become the standard modern cultivar and it already has many variations.

POINSETTIA IN EUROPE

The poinsettia was widely distributed across Europe by the mid-19th century. It enjoyed great popularity for the same reasons it was so successful in North America but the plant had to be grown in heated greenhouses and so was an expensive luxury.

Poinsettia breeding has also been carried out in Europe. Thormod Hegg, a Norwegian breeder, introduced 'Annette Hegg Red' in 1964. This cultivar was the first in a series of multi-flowered plants produced by pinching and in a previously unknown range of colors. They could be made to produce between 5 and 8 inflorescences per stem. This cultivar was also easy to propagate and grow commercially. The Hegg cultivars were important up to 2002.

In Germany, the Zeiger Brothers in Hamburg also instituted a breeding program. Gregor Gutbier in Linz, Austria, introduced another dazzling series of colorful cultivars, including the 'V-14 Glory' Angelikas in 1979. Ten years later they reached the United States. One advantage they offered was an ability to withstand slightly cooler night temperatures.

THE FUTURE

Innovations in the breeding and production of poinsettia have made this plant the most widely produced pot plant in the United States although its premier position is currently being threatened by the increasing sales of potted orchids. As its popularity has largely been restricted to the Christmas season because of its attractive red bracts, expansion of the current market is threatened. The introduction of many different hued bracts, such as pink, cream, white, purple and flecked could lead to the plants becoming a mainstay of interior decoration. Furthermore, using cultivars with orange bracts such as 'Orange Spice' could expand marketing during the fall and especially at Halloween. The challenge will be to duplicate the vision and marketing skills of past innovators in the industry.

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Prunus mume: History and Culture in China

Yanmei Li and Qinglin Liu

Prunus mume Sieb. et Zucc., known as mei, mei flower, or Japanese apricot, is a famous traditional flowering tree in China with a cultivation history of more than 3000 years. The wild mei was used for its fruit before the Qin Dynasty (221-207 BCE), and was cultivated in the Han Dynasty (202 BCE-220 CE). Its ornamental value was appreciated in the South and North dynasties (420-581), and mei culture became prevalent in the Song (960-1279) and Yuan (1271-1368) dynasties. The collection and classification of mei cultivars had been underway since the 1940s. Breeding programs have been initiated for selection of cold-hardy cultivars and the cultivated area has moved northward to Changchun and Gongzhuling in the northeast, Chifeng in the north, and Lanzhou in the northwest. Breeding work is underway to transfer low chilling from mei to apricot. The cultivars of mei flower were divided into 11 groups and 381 cultivars are now registered internationally. At present 45 mei gardens have been established. Mei flowering shoots are very popular in flower arrangement. There are 1.30 million tonnes of mei fruits harvested from 101.64 thousand hectares. The mei fruit is rich in organic acids, and mainly used for food processing in China.

Mei (*Prunus mume*) is a native Chinese flowering tree, with wide distribution and a long history. At first mei was introduced to cultivation as food and condiment but later became important as an ornamental. After two thousands years of selection of chance seedlings, there are now nearly 400 ornamental cultivars. Mei flowers bloom at the very beginning of the new year. Because of its ornamental value, mei has become an important part of traditional Chinese culture.

HISTORY

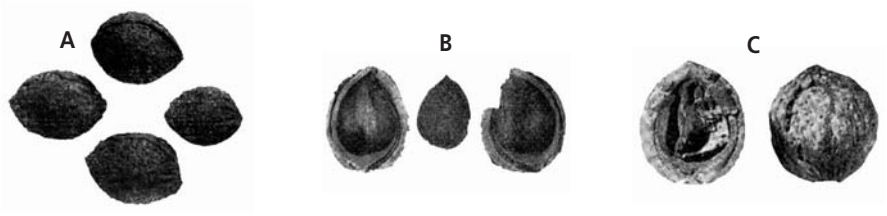
The Neolithic Age to the Pre-Qin Period (221 BCE)

Mei fruits were harvested for food or sacrificial offerings for years in the Neolithic Age. Carbonized pits of mei were discovered at the Peiligang Historical Site in Xinzheng, Henan Province in 1979 dated 7500~7000 years ago by 14C isotope assay (Henan Working Team No.1 of Institute of Archaeology, CASS, 1984; Li et al., 2007). *Shangshu*, a historical work of the Shang Dynasty (1600-1046 BCE), noted that "a thick and paste soup cannot be made without pickled mei fruits" (Chen, 1989). In 1975, carbonated mei pits of 3200 years old were found at Yin Ruin tombs in Anyang, Henan Province (Cheng, 2008).

Qin and Han Dynasties (221 BCE-220 CE)

Mei trees were first planted for fruit production. Many well-preserved mei pits and dried flesh (Fig. 1) in pottery pots were discovered in the Han Tomb No.1 of Mawangdui in Changsha (Institute of Botany, CAS, 1978). At the same time Chinese characters such as *Mei, Yuan Mei*, and *Fu Mei* were found on bamboo slips in this tomb. The latter two were products made of mei fruits (Chen, 1996), which indicates that processing technology had been developed at that time.

Figure 1. Carbonized pit of mei unearthed from the Han Tomb No.1 at Mawangdui in Changsha: (A) carbonized pits; (B) pits and kernel; (C) dried fruit.



In the Han Dynasty (202 BCE-220 CE) mei trees were planted for their flowers and cultivars for both blossoms and fruits began to appear. In the first volume of *Xijing Zaji* (*Miscellany of the Western Capital*) in the Han Dynasty it was reported that: "When the Shanglin Parkland was built in the early stage of Han Dynasty, the ministers outside consecrated famous fruits and unique trees…seven kinds of mei, including Zhu (red), Ziye (purple leaf), Zihua (purple flower), Tongxin, Lizhi, Yan and Hou" (Cheng, 2008). Most cultivars were grown for the fruit but some fruiting cultivars with striking flower or leaf color, such as 'Zihua' and 'Ziye', also appeared at that time. Mei flowers were recorded in *Shudu Fu* (*Words for Shu Capital*) by X. Yang in the Han Dynasty (Chen, 1989).

Wei, Jin, South, and North Dynasties (220-581)

The centers of population and civilization moved to the southern area of Yangzi River, which was the major cultivation area of mei (Cheng, 2008). As more and more mei trees were cultivated, their ornamental values were appreciated. The character of flowering in the early spring was praised by poets. K. Lu in the Song dynasty (420-479) described sending mei blooming branches to a friend in Longtou (Gansu Province, now). The Emperor Jianwendi of the Liang dynasty (502-557) wrote a poem named "*Meihua Fu* (*Words of Mei Flower*)", in which he mentions that the "early blossoms of mei flower know the coming of spring." X. Xie in the Chen dynasty (557-589) mentions mei blossoms welcoming spring "early and alone, unafraid of cold." Z.J. Zhang wrote *Poem to Mei Wood in Light Rain*, which suggests the planting of a mei forest (Cheng, 2008). At this time mei admiration turned from fruit to flower and cultivation solely for ornamentals value began to emerge.

Sui and Tang Dynasties (581-907)

Although cultivation of mei was still centered in Hangzhou and Chengdu, cultivation spread to the Yellow River as its popularity increased. The major cultivars in the Tang Dynasty were single flowered 'Jiang' and pink double flowered 'Gongfen', and red and cinnabar purple mei also appeared (Chen, 1989).

Mei was widely planted in both imperial and private gardens. Mei as a term was used to describe imperial gardens (Shangyuan Mei and Gong Mei) and private gardens (Mei Yuan = mei garden and Mei Guan = mei house) in poems of the Tang Dynasty (618-907) as well as in landscapes (mei flower island, mei rivulet, mei islet and mei hill), and buildings (mei pavilion and mei villa). Mei trees were planted alone, combined with bamboo, and were often near water (Cheng, 2008).

Mei flower was introduced to Japan by Japanese envoys in the middle of Tang Dynasty (710-784), and then spread to Korea (Wu, 1995). Some good fruiting cultivars were selected in Japan (Li and Liu, 2010).

Song and Yuan Dynasties (960-1368)

Mei was cultivated most widely and appreciated most fashionably in this period. About 1186, C.D. Fan authored *Mei Treatise*, the first monograph of mei flower in China. He listed 10 cultivars, including 'Jiang', 'Zao' (early), 'Xiao', 'Chongye' (double), 'Lv'e' (green calyx), 'Qianjiangbian Lv'e' (light purple margin), 'Baiye Xiang' (double, flavescens), 'Hong' (red), 'Yuanyang' (two fruits) and 'Xing' (apricot) (Chen, 1962). According to the descriptions, the Cultivar Groups (*Albo-plena*, Green Calyx, Apricot and *Flavescens*) appeared at that time. In the Yuan Dynasty, two new cultivars named 'Dan Taofen' (light pink) for both flowers and fruits and 'Honghuai Baozi' with duplicated flower centers appeared. The latter has survived for 600 years in Yunnan (Wang et al., 1995).

Z. Zhang in the Southern Song Dynasty planted some old mei trees at the Mei Garden, South Lake in Hangzhou, including more than 300 'Jiang', and dozens of 'Qianye Xiang' (full double) and 'Hong'. His book *Mei Pin* (*Appreciating Mei Flowers*, 1194), described 58 situations for high appreciation of mei flowers (Chen, 1995a, b).

B.R. Song compiled *Meihua Xishenpu* (*Portraits of Mei Flower*) in the end of the Southern Song Dynasty (reissued in 1261). The blooming process was divided into 8 phases including bud, few stamens, many stamens, ready to bloom, blooming, full bloom, withering, and bearing fruits. One hundred pictures of different flower shapes were displayed in the form of woodcuts, each of them was given a title and a poem with five characters per line. This picture-book was the first woodcut painting manual in China, and also a significant breakthrough in describing the phenology of mei flower (Chen, 2010).

Mei had become a very important subject with the further development of imperial and private gardens. There was a mei pavilion in Qionglin Yuan, an imperial garden in the Song Dynasty. There were a mei pool, a mei hill, a mei islet and Lv'e Huatang (Green calyx Palace) surrounded by thousands of mei trees in Gen Yue, an imperial garden in the Huizong period of Song Dynasty. There were mei valleys and mei slopes commonly in private gardens. A poem named *Mei Flower in Bottle* written by W.L. Yang, indicated the use of cut mei flowers for flower arrangement.

Ming and Qing Dynasties (1368-1911)

After the climax in the Song and Yuan dynasties, growing and appreciation of mei flower stabilized, but the number of cultivars increased. There were 19 cultivars in *Qunfang Pu* (*Spectrum of All Flowers*) compiled by X.J. Wang in the Ming Dynasty (1368-1644), where cultivars were classified mainly by flower colors. There were 10 white flowers such as 'Chongye Lv'e', 'Yudie', 'Shi', and 'Dong', 7 reddish flowers such as 'Qianye Hongmei', 'Heding', 'Shuangtou Hong', 'Zi', and 'Yanzhi', and 2 special ones such as 'Bing' and 'Mo'.

In the Qing Dynasty (1644-1911), mei was widely planted with abundant cultivars. There were 21 cultivars in *Hua Jing* (*Mirror of Flowers*) compiled by H.Z. Chen, including 'Qianye' (full double), 'Zhaoshui' (bending) 'Huangxiang' (*Flavescens*), 'Pinzi' (three fruits), 'Jiuying' (nine petals), 'Taige' and 'Lang'. The peduncle of 'Zhaoshui' bends downwards to the water at blooming, and the flowers of 'Yutai Zhaoshui' were fragrant. There was another flower bud at the center of 'Taige' flowers.

Since the number of mei trees kept increasing in the Ming and Qing dynasties, famous scenic spots for appreciating mei had been formed, including Dengwei in Suzhou, Zhongshan in Nanjing, and Xixi in Hangzhou. It was recorded that "there is a hill named Dengwei in Suzhou where mei flowers are in full bloom, like a sea of fragrant snow covering 15 km^2" in *Wujun Zhushan Ji* (*Records of All Mountains in Wu Prefecture*) written by H.D. Yuan (Cheng, 2008). Some mei trees planted 400 years ago in the Ming and Qing dynasties are still alive in Yunnan and Zhejiang (Fig. 2).

With the improvement of cultivation technology, potted mei flowers were produced. In the *Changwu Zhi* written by Z.H. Wen in the Ming Dynasty, advice was given to "plant mei trees in flower pots and twist them to odd shapes." It was noted that: "The monks grew and sold flowers for living in Nanjing Huayan Temple, in which mei was their favorite; they twisted the branches with wires to make them lovely."

Republic of China (1911-1949)

In 1912, there was a private mei garden in the west of Wuxi constructed by the famous

Figure 2. Existing ancient mei trees: (A) tree of the Ming Dynasty (Eryuan, Yunnan); (B) tree of the Qing Dynasty (Huangyan, Zhejiang).

Chinese businessmen, Z.J. Rong and his brother D.S. Rong. There were thousands of plants, including groups such as *Albo-plena*, Green Calyx, Pink Double and Cinnabar Purple. The number of cultivars of mei trees has been increasing since 1949, and the garden became a park now called Wuxi Mei Garden.

When Dr. Sun Yat-sen was buried at the mausoleum in 1929, the managing committee decided to set up a commemoration park, in which about 60 cultivars of mei flower were planted. The number of cultivars of mei flower increased gradually, and it became a famous scenic spot renamed Meihua Hill in 1945.

In 1942, Professor M. Tsen published a monograph, *Mei Hua, National Flower of China*. He described the genetic resources and 15 cultivars of mei flower in Chongqing (Chen, 1989), a milestone of sorting out mei cultivars. In 1945, Professor J.Y. Wang and J.Y. Chen published an article entitled "Classification of Mei Cultivars in Chengdu" in the *Journal of the Agricultural Association of China*. Twenty cultivars were recorded, which provided a foundation for cultivar classification in China (Chen, 2010). In 1947, J.Y. Chen published a book named *Meihua in Bashan and Shushui* (Sichuan). All aspects related to mei such as history, distribution, cultivar, propagation, cultivation, disease and insect control, and application were described. The 35 mei cultivars were divided into 6 groups such as cinnabar purple, red, pink double, apricot, white double and green calyx (Chen, 2010).

From Founding of PRC to Reform and Opening up of China (1949-1978)

In 1954, S.B. Zhao collected thousands of mei flower from Chongqing, and transplanted them to Mei Garden, Moshan, East Lake, Wuhan. There were some elite cultivars such as 'Jinqian Lv'e', 'Baixu Zhusha', 'Ning Xin', 'Da Yu', 'Kouban Dahong' and 'Taohong Taige'. They also collected some famous cultivars such as 'Subai Taige', 'Huqiu Wanfen' and 'Jiang Nan' from Anhui and Jiangsu. In 1962, 62 cultivars of mei flower were identified (Zhao and Liu, 1997). Since the spring of 1958, Professor J.Y. Chen has introduced and acclimatized mei flower in Beijing by directly sowing seeds from the south region of the Yangzi River, in cooperation with the Beijing Botanical Garden, CAS. They also attempted to transplant mei flower to Beijing.

Figure 3. Mei cultivars in various groups: (A) 'Jiang Mei'; (B) 'Fen Taige', note flower bud in the center of the flower; (C) 'Sanlun Yudie'; (D) 'Xiao lv'e'; (E) 'Caowang Huangxiang'; (F) 'Fuban Tiaozhi'; (G) 'Meiyuan Momei'; (H) 'Canxue Chuizhi'; (I) 'Long You'; (J) 'Yan Xing'; (K) 'Xiao Meiren'.

Table 1. The 11 cultivar groups of mei.

Group	Description	Typical cultivar
Single Flowered	The branches and twigs grow upright or slantingly upright, the twig color is green or the ground color is green, the new xylem inside twigs is greenish white. Single flowers with reddish purple calyx, and red, pink, or white petals, volatilize true mei-flower fragrance.	'Jiang Mei' (Fig. 3A)
Pink Double	Light to dark pink petals, semi-double to double flowers.	'Fen Taige' (Fig. 3B)
Albo-plena	White petals, semi-double to double flower.	'Sanlun Yudie' (Fig. 3C)
Green Calyx	Green calyx, white petals, single, semi-double or double flowers.	'Xiao lv' e'. (Fig. 3D)
Flavescens	Light yellow petals, single, semi-double or double flowers.	'Caowang Huangxiang' (Fig. 3E)
Versicolor	Flowers with bicoloured spots or speckles.	'Fuban Tiaozhi' (Fig. 3F)
Cinnabar Purple	The new xylem inside twigs is purplish-red, single to double flowers with purple calyx and purple red petals.	'Meiyuan Momei' (Fig. 3G)
Pendulous	The branches and twigs naturally pendant or slantingly pendant.	'Canxue Chuizhi' (Fig. 3H)
Tortuosa	The branches and twigs naturally contorted, or zigzog.	'Long You' (Fig. 3I)
Apricot Mei	The branches, twigs, leaves, flowers and fruits are similar to mei but not typical, the hypanthium swollen, the ripe fruits are yellow.	'Yan Xing' (Fig. 3J)
Meiren	The branches, twigs and leaves are purple-red all year round, semi-double or double flowers with slightly swollen hypanthium, the ripe fruits are purple-red.	'Xiao Meiren' (Fig. 3K)

After the Reform and Opening up of China (1978 to present)

The cooperative research group for mei flowers and wintersweet (*Chimonanthus praecox*) was set up in China Flower Association in 1987. The group was transformed to the Chinese Society for Mei Flower and Wintersweet in 1989 when the first National Exhibition of Mei Flower and Wintersweet was held. From then on, the national exhibition was carried on every two years. The next, 13th, will be held in Wuxi in the spring of 2012.

Two monographs named *Chinese Mei Flower Cultivars* and *Chinese Mei Flower* were published by Professor J.Y. Chen et al. in 1989 and 1996. Both contain information on origin, history, genetic resources, distribution, cultivar classification, propagation, cultivation, diseases and insect control, cultivar improvement and flower culture. A total of 327 cultivars were recorded. Professor J.Y. Chen and the Chinese Society for Mei Flower and Wintersweet were appointed as the International Cultivar Registration Authorities (ICRAs) of mei since 1998, the first in China (Chen, 2004). Based on the cultivar registration, a new bilingual book *Chinese Mei Flower Cultivars in Color* was published in 2010, in which 318 cultivars were recorded.

Thanks to the research on acclimatization and increase of hardy cultivars, it is possible to build mei gardens in the north of China. The first northern mei garden was built in Qingdao in 1993. The Boutique Garden for International Registered Mei Cultivars was constructed in Mt. Jiufeng, Beijing in 2004 (Li, 2004).

BOTANY AND CULTIVARS

Botanical Description

Mei is a small deciduous tree in the family *Rosaceae*, with height of 5-10 m, has brownish-purple bark and nearly rounded crown. The twigs are usually greenish or green background, glabrous. The leaves are small, alternate, narrow-ovate or nearly round-ovate, with apex acuminate, base broadly cuneate or nearly rotund, and margin finely serrate. The petioles are short and puberulous. The flowers bloom before the leaves in early spring, and are white, pink or red, sessile or nearly so and fragrant, with five purplish sepals. The stone fruits are yellow or greenish, diameter of 2-3 cm, the flesh adhering to the pitted stone.

There are a number of interspecific hybrids of mei with some species in the same genus, such as apricot mei (*P. mume* var. *bungo*), a hybrid between mei and apricot (*P. ameniaca*), having purplish-brown and thick twigs that are like apricot, long and thick petioles, and flowers that are not fragrant. Meiren mei, *Prunus* × *blirean*, a hybrid between *P. cerasifera* 'Altropurpurea' and mei, has red leaves and semi-double to double pink flowers. The hybrids of mei with plum (*P. salicina*) called Sumomo-ume have dark purplish-brown twigs, purple and long petioles, with luxuriant flowers, heavy fragrance, and purplish red fruits.

Introduction, Acclimatization and Breeding for Hardy Cultivars

Mei flower is usually cultivated in the areas of Yangzi River and Yellow River, between Yellow River in the north and the Zhujiang River in the south. To expand the cultural area, the introduction and acclimatization was started in 1957, and a number of hardy cultivars were selected through various methods. For example, cultivars such as 'Jiang', 'Sanlun Yudie', 'Mihua Jiang', 'Jiang Nan', 'Zhongshan Xing', 'Fuban Tiaozhi', 'Xiao Gongfen', 'Xiao Lv'e', 'Yin Hong', 'Zhusha Wanzhaoshui' were selected after introduction and transplantation. Some cultivars such as 'Beijing Xiao', 'Beijing Yudie', 'Yutai Zhaoshui' were selected by open pollination and chance seedlings. Other cultivars such as 'Yan Xing', 'Shantao Bai', 'Hua Hudie', 'Qiao Meiren' and 'Hei Meiren' were bred through interspecific hybridization and selection of hybrids (Chen et al., 2003).

A series of regional tests have been conducted in Lanzhou, Taiyuan, Changchun, Shenyang, Beijing and other areas in north China since 1986 to evaluate hardiness. At present, the northern boundary for mei culture is Gongzhuling, Jilin, 2000 km from its natural distribution; the western limitation is Lanzhou, Gansu.

The International Cultivar Registration of Mei

Since 1998, the international cultivar registration of mei has been conducted in China. Five volumes of *Annual/Two-years' Report of International Mei (Prunus mume) Register* were published since 1999, and 381 cultivars from both China and foreign countries were registered, including flowering mei, fruiting mei and flower-fruiting mei. The main breeders and applicants are Mei Flower Research Centre of China in Wuhan, Mei Garden of Dr. Sun Yat-Sen's Mausoleum in Nanjing, and Wuxi Mei Garden, Heilongtan Park in Kunming.

According to *International Code of Nomenclature for Cultivated Plants* (7th edition) mei cultivars are divided into 11 Groups (Chen and Chen, 2009).

MEI IN CHINESE CULTURE

The First Flowering Branch in Early Spring

Mei is beloved because of early blooming. Z. Jiang in the South and North dynasties wrote that "spring is awaked by mei flower in January and February". Mei flower is considered the symbol of vitality.

The Friend of Winter

The symbolism of mei flower derives from its biological characteristics (Liu, 2003). Mei flowers are cold hardy, and blooming in the snowy season, hence the expression "tread on snow to seek mei flowers." Their old but vigorous trunks and branches symbolize perseverance and courage. The flower color is light and elegant, signifying lofty pride.

Mei flower has been personified as an elegant beauty or a detached gentleman. Since mei flower defies frost and snow, and pine tree and bamboo are green over the winter, these three plants were considered "three friends in winter." These symbols were an important part of traditional Chinese culture, displayed in many poems, calligraphy and paintings through the ages (Fig. 4A). Mei, pine, and bamboo are often planted together in gardens to form the pavilion or trail of "three friends" (Cheng, 2008).

Mei Flowering with Five Blessings

Mei flowers have five petals, which represent five blessings: happiness, luck, longevity, smoothness, and peace. The traditional symbol of a happy wedding includes bamboo representing the husband, and mei representing the wife. The mei flower is common vignette in china (Fig. 4B), embroideries, jade carvings (Fig. 4C) and other traditional handicrafts.

Four Gentlemen

In traditional Chinese culture, orchid (quietness), bamboo (honesty), chrysanthemum (seclusion), and mei (pride) are considered the "four gentlemen." The "four gentlemen" are found in Chinese paintings over thousands of years (Fig. 4D).

National Spirits

Many historical figures, who are considered to be the soul of Chinese nationality, were closely connected with mei flower. B. Lin, a famous poet in the Northern Song Dynasty, who lived in seclusion in Gushan Hill in Hangzhou, praised mei as follows: "Over the clear and shallow water its sparse shadows horizontally slant, and under the dusky moonlight its silent fragrance floats and spread." He immersed himself in mei culture, laying the foundations for it being the symbol of noble personality.

Y. Lu, the patriotic poet in the Southern Song Dynasty, wrote more than 400 poems about mei flower. He described the landscape of mei forestry around Huanhua River in Chengdu as follows: "Riding through the west of Chengdu city those years, I used to be intoxicated like mud by mei flower. The fragrance spreading over 10 km continually from Qingyang Palace to Huanhua River".

M. Wang, the famous master of painting and poem, who lived in seclusion in Mt. Jiuli, planted thousands of mei trees and was addicted to painting mei (Chen, 2001). He wrote a poem in his painting entitled *Black Mei in White Paper*: "In the mei trees by the side of our inkstone washing pool, every flower blooms in light black on white paper; only the light fragrance overflow in the world, never mind of praise for beautiful colors" (Fig. 4E).

Chairman Mao Zedong favored mei flower. He wrote a famous poem titled *Bo Suanzi Ode Mei*: "The pretty mei flowers do not contest with other flowers in the spring, but only herald the coming of spring." (Fig. 4F).

The City Flower and the National Flower

The Republic of China approved mei as the national flower in 1929. Mei flower, cold resistant, staunch, and faithful when facing the winter, represents the spirit of "self-support and self-reliance" advocated by Dr. Sun Yat-sen. Mei is still the "national flower" in Chinese Taiwan. Eight cities (Nanjing, Wuhan, Wuxi, Taizhou (Jiangsu), Taizhou (Zhejiang), Huaibei, Meizhou and Danjiangkou) appointed mei as their city flower. In 2008, 102 academicians recommended mei flower and tree peony as the "Twin National Flowers" (Chen, 2007).

MEI GARDENS

There are many mei gardens consisting of collections of cultivars in the traditional cultivation areas, such as Meihua Hill in Nanjing, Dengwei Hill in Suzhou, Chaoshan Hill in Hangzhou, Dianshan Lake in Shanghai, Wuxi Mei Garden, and Heilongtan Park in Kunming. In recent years, some mei gardens were set up in northern China as more and more hardy cultivars were released. These include Mei Hill in Beijing Botanical Garden, Qingdao Mei Garden, Yueling Mei Valley in Zhengzhou, and the Boutique Garden for International Registered Mei Cultivars in Beijing.

Figure 4. Mei in art and crafts: (A) the painting of three friends in the winter (M.J. Zhao, Southern Song Dynasty); (B) vase with mei flower pattern; (C) jade carving with mei flower shape; (D) a scroll painting of four gentlemen; (E) the painting named "*Ink Mei*" (M. Wang, Yuan Dynasty); (F) the Commemorative Badge for Chairman Mao in 9th National Mei Flower and Wintersweet Exhibition showing flowering branch of mei.

Figure 5. Some mei gardens in China: (A) Meihua Hill in Nanjing; (B) East Lake Mei Garden in Wuhan; (C) Wuxi Mei Garden; (D) Mei Garden at Mt. Lingfeng in Hangzhou Botanical Garden; (E) Qingdao Mei Garden; (F) Mei Garden of Heilongtan Park in Kunming; (G) Mei Hill in Beijing Botanical Garden.

The Meihua Hill of Dr. Sun Yat-sen Mausoleum in Nanjing (Fig. 5A) is one of the four largest mei gardens, covering more than 100 hectares. Nanjing had a long history of planting and appreciating mei flowers, lasting six dynasties. Every spring when mei blossoms, thousands of mei plants flourish throughout the hill, with colorful petals and dense fragrance. Millions of citizens walk from Zhongshan Gate to the Meihua Hill to view the landscape.

The East Lake Mei Garden in Wuhan (Fig. 5B) is the location of both Mei Flower Research Center of China and the National Mei Flower Germplasm Conservation Garden. The garden contains more than 200 mei cultivars. The exhibition hall of mei named A Branch of Spring was constructed in a classical Chinese garden. The garden contains a science education center, a penjing hall, a flower culture hall, and a cultivar hall for display of art works (Mao, 2001).

Wuxi Mei Garden (Fig. 5C) is located on the mountains in the western suburb of Wuxi and is the earliest and the largest in China (Liu et al., 2001). There are more than 100 cultivars introduced from Japan. Mei is the theme of this irregular garden; all the stones, paths, pavilions, palaces, terraces and forestry are designed with mei.

There is a mei garden (Fig. 5D) at the foot of Mt. Lingfeng, Hangzhou Botanical Garden, north of West Lake. The Lingfeng Temple was built in the later Jin Dynasty, when mei flowers began to flourish. In the Qing Dynasty, 100 mei trees were planted in Jiaqing era and 300 mei trees were added in Xuantong era. In the spring of 1988, an addition of 27 hectares was constructed, and more than 5,000 trees of 50 cultivars were planted. The mei flowers are famous for earlier flowering and long persistence because of high attitude.

Qingdao Mei Garden (Fig. 5E) is located in Shimeian scenic spot. There are more than 100 cultivars, belonging to 10 groups, mainly introduced from Wuhan. Some new cultivars such as 'Qingdao Xinghong' and 'Danban Danfenghou' were selected through chance seedlings (Zhuang and Zhuang, 1999). The garden is consisted of valleys on the north slope with pavilions and villas.

The mei garden (Fig. 5F) in Heilongtan Park consists of over 6000 trees, nearly 90 cultivars, over 28 hectares in Kunming, Southwest China. It contains a scenic spot called Seek Mei Flower in Longquan. A 700-year-old "Tang Mei" tree is considered the most precious old mei tree in Yunnan.

Mei Hill in Beijing Botanical Garden (Fig. 5G) was built on natural terrain. Some hardy cultivars were planted, such as 'Meiren', 'Fenghou', 'Dan Fenghou', 'Xiao Lv'e', 'Xiao Gongfen',

Figure 6. Flower arrangement in vases with mei.

Figure 7. Some flowering mei penjing: (A) knot; (B) zigzag; (C) split; (D) screen; (E) straight; (F) curving; (G) horizontal; (H) "seek the spring"; (I) "three friends in the winter".

'Zhusha Wanzhaoshui', 'Sanlun Yudie' and 'Beijing Yudie'. There are also some cultivars introduced from Japan.

FLOWER ARRANGEMENT AND PENJING

Mei is a major element in traditional Chinese flower arrangement. Mei is usually displayed in vases (Wei and Zhao, 2003), to emphasize Chinese tradition, poetic feeling, and artistic imagination (Fig. 6). The rough, twisted and old branches are especially esteemed. The composition of cut flowers is usually asymmetrical to display the natural shape.

There are two kinds of Penjing for mei flower: trees only (Baisai), and trees in a landscape (Penjing) including water, stone, and grass. Container-grown mei has a history of over 600 years. There are various styles of tree shapes such as the knot (Fig. 7A), windswept, zigzag (Fig. 7B), split (Fig. 7C), screen (Fig. 7D), and bent (Chen, 1996). Methods to form shapes differ according to their styles. For example, the knot was made by knotting the young trunk to form a lump. The trunk is twisted in an S-form to make the zigzag type. The trunk is

Figure 8. Mei fruit: (A) unripe; (B) ripe; (C) red ripe fruit; (D) processed; (E) salted; (F) sweetened.

divided to form the split form. Stretching all the branches downwards in one side will produce the windswept form to imitate the shape of the tree in windy areas. All trunks and branches are trained in one dimension to form the screen. Bending all the branches achieves the bent form. There are other shapes such as ball mei, basket mei and three layer mei. Besides the traditional shapes, some natural styles are now highly appreciated, such as straight (Fig. 7E), sloping, and torturous (Fig. 7F), horizontal (Fig. 7G), downward, zigzag, naked roots, and pendent branches. For these styles extensive pruning and training is needed.

The mei penjing emphasizes beautiful composition. There are various styles such as waterless (Fig. 7H), dried sand (Fig. 7I), water and earth, water and stone, and inkstone. The dried sand style is composed of water flooded sand with minor ditches. In the water and stone styles, the mei is planted on the stone. For the inkstone style the container was replaced by flagstone, which represents the surface of water.

FRUIT PRODUCTION

There are abundant fruit mei germplasm resources in China, mainly distributed in the South of Mt. Qinling and Huaihe River. There are both large area and mass production in Guangdong, Guangxi, Fujian, Yunnan and Taiwan. According to an incomplete statistics in 1995, the growth area of mei fruit trees was 101.64 thousand hectares, the annual gross production was 1.3013 million ton (Chu, 2003), both the area and production is estimated to be rather steady these years. Mei fruit is also the most important deciduous crop in Taiwan, and its growing area was 9,166 hectares with an annual output of 45,218 tonnes in 2002.

The mei fruit (Fig. 8) contained a lot of organic acids, mainly citric acid, and had the functions of detoxifying and germicidal action. It is small and acid, so less eaten fresh, more as a processed food. The classical products are salted mei, sweetened mei, smoked mei, syrup of mei; now the preserved mei, mei wine, mei vinegar, mei juice and mei jam are common products.

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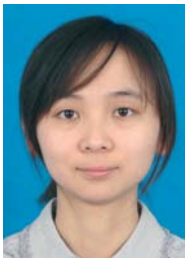

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New Research Institute of Horticulture in Poland

On January 1, 2011 the new agricultural institute, *Research Institute of Horticulture* (RIH) in Skierniewice was established based on the decision of the Ministry of Agriculture and Rural Development. RIH was formed following the integration of two research institutes, *Research Institute of Vegetable Crops* (RIVC) with *Research Institute of Pomology and Floriculture* (RIPF), both located in Skierniewice – the "Capital" of Polish horticulture. Prof. Dr. Franciszek Adamicki has been appointed as first Manager of the RIH. The new institute will bring together the collective research strengths of joined institutes and combined staff consists of 605 employees, including 44 professors and 87 doctors. It was established to strengthen the horticultural research capacity and to create an event of international significance and competitiveness, which will lead to progress of horticultural science, improvement of productivity and profitability of Polish horticulture. RIH is the main research center in Poland developing the scientific and practical base for horticultural crops production.

The priority areas of research activities in RIH include:

- Applied creative breeding of vegetable plants, fruit trees and bushes, especially tomato, cucumber, apple rootstocks, apple cultivars, blackcurrants, raspberries, strawberries and others.
- Application of biotechnology techniques to fruit tree research and vegetable plants.
- Protection of genetic resources of vegetable plants, fruit trees, bushes and ornamental plants.
- Development of technology of vegetable production in open field, under cover and mushroom growing, as well as development of integrated production of apples, strawberries, currants and ornamental plants under covers.
- Evaluation of biological and productive values of new cultivars of fruit and vegetables, improvement of processing and storage technologies.
- Control of pests and diseases in vegetable plants production and in orchards with minimum usage of pesticides.

Research Institute of Horticulture, Skierniewice, Poland.

- Bee breeding, and improvement of bee products collection, conservation and storage.
- Extension of research results among growers and horticultural societies.

RIH carries out research in four divisions: Pomology, Vegetable Crops, Floriculture and Apiculture and covers all research problems related to the horticultural production in Poland. The Institute also has Experimental Stations located in production regions. The Institute facilities in Skierniewice consist of several buildings, greenhouses, experimental vegetable fields, experimental orchards, experimental cold storage rooms, quality evaluation laboratories and specialized analytical laboratories.

New Books, Websites

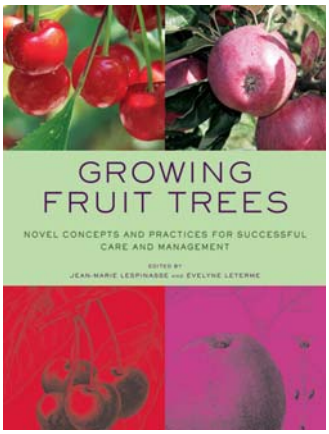
BOOK REVIEWS

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

Growing Fruit Trees. Novel Concepts and Practices for Successful Care and Management. Edited by Jean-Marie Lespinasse and Évelyne Leterme. 2011. W.W. Norton & Company, New York, London. 352p. ISBN 978-0-393-73256-6 (paperback). $49.95. http://books.wwnorton.com

The name Jean-Marie Lespinasse is synonymous with fresh, original thinking about the natural growth habits of fruit trees and how they can be optimally managed, through very selective and informed pruning and training, to come into bearing early and to produce high-quality fruit. This book is an excellent testimony to those contributions.

The book comprises chapters on many of the major temperate fruit and vine crops including: almond, apple, apricot, cherry, chestnut, fig, table grape, hazelnut, kiwifruit, olive, peach, pear, plum, quince, and walnut. There are 19 contributing authors and a further 8 collaborators. The



text is very richly illustrated with excellent coloured photographs, wonderful line drawings, and very clear tables and charts. It is a credit to the editors that they have been able to assemble such a high number of top quality images and to have retained such a consistent high quality throughout the 352 pages in the book.

Each chapter, which focuses on one fruit crop, follows a consistent content; namely, the history of the crop, botanical classification, varietal descriptions, tree morphology (including both vegetative and floral characteristics), the annual growth cycle, a description of the fruit, and detailed information about training and pruning.

The text is very easy to read – almost "chatty". The content is scientifically based but presented in a manner that is useful to all involved with temperate fruit production. It contains a very helpful glossary that explains all of the technical and scientific terms that are fully and accurately used in the text. Consequently, it should prove to be a valuable reference text for fruitgrowers, nurserymen, university students, lecturers, and extension agents. Interestingly, references are not included in the text and instead the reader is referred to a "References and Further Reading" section in the end sections of the book. For a reader wanting a more direct access to sources that justify a particular claim or statement, this is a frustration.

This book is an English translation of the French text "De La Taille à la Conduite des Arbres Fruitiers" published in 2005. For some unstated reason, it is focussed strongly on the USA and particularly on California, which is unusual given all of the other very significant and extensive temperate fruitgrowing regions in the world. It is also clear that some elements of the translation have not been adequate – for example (page 185), names are incorrect with Bruno Just being called Bruno Jus and Graham Bayliss being named Graham Bay Liss. On page 30, it is claimed that the top 10 producers of apples for export "…are Mexico, Canada, Taiwan, Dubai (UAE), China, India, Indonesia, the United Kingdom, Saudi Arabia, and Thailand" - presumably, this has become confused in the translation and it is assumed that the text was meant to state that these are the top 10 importing countries for this crop. Similarly, "kiwifruit" is correctly named in the text but called "Kiwi" in the chapter heading. Within the text, S.I. units are secondary to American units although both values are presented. Overall, however, the translation is very well done and errors are comparatively minor, even if distracting.

The basic premise of this book can be summarised as follows (page 250): "training a tree results from observing it and understanding how it functions. Techniques such as pruning, removing and bending are meant to help the tree express its own potential and not to restrict it to shapes or training methods that are poorly adapted to the species or cultivars…observation also allows us to take stock of the species' genetic diversity and to adjust accordingly…the shape of the tree has little importance…it is, however, necessary to construct a solid structure within a tree so that it may yield quality production consistently and sufficiently."

This book makes a valued contribution to our overall knowledge of temperate fruit production.

Reviewed by Ian Warrington, Massey University, New Zealand

NEW TITLES

Aliaga Mateos, José Antonio, Márquez García, Miguel Ángel and Hernández Salvador, Carmen. 2011. Almería, Calidad por Naturaleza (in Spanish). Consejería de Agricultura y Pesca, Junta de Andalucia. 75p.

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Mallet, Robert. 2011. Envisioning the Garden: Line, Scale, Distance, Form, Color, and Meaning. W.W. Norton & Company, New York, London. 144p. ISBN 978-0-393-73342-6 (paperback). $39.95. http://books.wwnorton.com

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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

IV Conference on Biomass and Energy Crops, 21-23 September 2011, Champaign, Illinois, USA. Info: Rebecca Morgan, Association of Applied Biologists, The Warwick Enterprise Park, Wellesbourne, Warwick, CV35 9EF, UK, Phone: +44 2476 575195, Fax: +44 1789 470234 Email: rebecca@aab.org.uk, Web: www.aab.org.uk

Conference on New Technologies for Early Pest and Disease Detection, 12 October 2011, Lincs, UK. Info: Rebecca Morgan, Association of Applied Biologists, The Warwick Enterprise Park, Wellesbourne, Warwick, CV35 9EF, UK, Phone: +44 2476 575195, Fax: +44 1789 470234 Email: rebecca@aab.org.uk, Web: www.aab.org.uk

International Conference on Medicinal and Aromatic Plants in Generating New Values in 21st Century, 9-12 November 2011, Sarajevo, Bosnia and Herzegovina. Info: Sulejman Redžić, Academy of Sciences and Arts of Bosnia and Herzegovina, Bistrik 7, 71 000 Sarajevo, Bosnia and Herzegovina, Phone: + 387 33 210 902, Fax: + 387 33 206 033, Email: mplants@yahoo.com or sredzic@anubih.ba, Web: www.map-sarajevo.com

International Symposium on Minor Fruits and Medicinal Plants for Health and Ecological Security (ISMF&MP), 19-22 December 2011, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India. Info: Dr. S.N. Ghosh, Professor and Dean, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur – 741252, Dist. Nadia, West Bengal, India, Fax: 03473-222659 (Office), Mobile: 0947521347, 09433224649, Email: profsnghosh@yahoo.co.in, profsnghosh@rediffmail.com, www.ismfmp.com

Advanced Course on Medicines from Plants, 16-21 January 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

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

First Int'l Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops

"Storms make the oak grow deeper roots." – George Herbert, English poet

Participants of the symposium outside the main venue at the University of California, Davis.

A seasonal, but unusually strong, storm greeted over 50 participants from 15 different countries to the Sacramento Valley. The first morning of the symposium revealed downed branches and various debris scattered throughout the town of Davis, California, USA and the site of the symposium, the campus of the University of California (UC), Davis. The storm was an appropriate reminder to participants that horticultural research is, among other things, a challenge of adjusting to the demands of nature. Participants moved forward with great optimism, enthusiasm, and focus, and would spend five days, 19-23 March 2011, in open discussion on the status of conservation, management, and sustainable utilization of wild relatives of subtropical and temperate fruit and nut crops. This was the first such meeting, co-convened by Dr. Malli Aradhya of the USDA Agricultural Research Service (ARS) National Clonal Germplasm Repository and Dr. Daniel Kluepfel of the USDA-ARS Crops Pathology and Genetic Research unit in Davis, and co-hosted by the USDA-ARS and the Plant Sciences Department of the University of California, Davis.

Crop wild relatives (CWRs) are the major sources of useful genes that are selectively maintained as co-adapted gene complexes through the delicate balance of evolutionary forces over millions of years and offer an abundant supply of functional genes and genetic variability for crop genetic improvement. Tree crop breeders generally use genetic variability in the primary gene pools and in many crops it is even restricted to a narrow range of domesticated elite germplasm. The time has now come for the tree crop researchers to look far and beyond traditional primary gene pools for useful genes to develop new scion and rootstock cultivars addressing the ever changing needs of growers, consumers, markets, and of course the imminent threats of climate change. Contributions of CWRs to human society and the threats to their very survival have been very well recognized. The loss of these invaluable resources has seriously reduced our ability to develop new crop varieties in response to current and future agricultural challenges, especially, the imminent threats of climate change. Through this symposium, we made a formal beginning to address some of these issues concerned with conservation, management and sustainable utilization of wild relatives of subtropical and temperate fruit and nut crops.

The symposium was inaugurated by Maureen Whalen, Assistant Area Director, USDA-ARS, Pacific-West Area, who introduced the National Plant Germplasm System (NPGS) of the USDA-ARS and spoke about its mission in the broader context of research within the USDA-ARS. Chris van Kessel, Plant Sciences Department, UC Dav-

Zeynal Akparov (center), Director of the Genetic Resources Unit, Baku, Azerbaijan, after accepting the vote of the 2nd meeting in 2015 to be held in Baku, standing with Gale McGranahan (right) and David Maghradze (left).

is, highlighted the fruit and nut crop industries of California's famous Central Valley, which are some of the biggest in the world and showcase the best utilization of wild relatives in sustainable production of fruit and nut crops. Nigel Maxted, School of Biosciences, University of Birmingham, United Kingdom, in his keynote address, made a compelling case for conservation of CWRs, setting the stage for further deliberations.

Twenty-three oral presentations, including seven plenary lectures, and 31 posters were presented during the meeting. The first oral session on germplasm conservation and management consisted of three plenary lectures, first by John Preece, Research Leader of the USDA germplasm repository in Davis, followed by a second lecture on community-based, participatory in situ and on-farm conservation strategies by Bhuwon Ratna Sthapit from Bioversity International's South Asia Office, and the third by Malli Aradhya highlighted the research on fruit and nut wild relatives (FNWRs) conducted at the Davis repository. Other oral and poster presentations covered extensively the FNWRs in the Transcaucasia and in South Asia.

The second day featured three plenary lectures: the first by Patrice This of INRA in France on conservation priorities and strategies for the genus *Vitis*, followed by Dan Potter, professor of Plant Sciences, UC Davis, on the phylogeny and lineage based conservation approaches to the genus *Prunus*, and a third one by Abhaya Dandekar, professor of Plant Sciences, UC Davis, on the use of genomic tools to harness functional variability in fruit and nut crop species. The participants spent the afternoon out on field tours of the Yolo Olive Press managed by Mike Madison, a family farmer and organic grower in Davis, then the Center for Land Based Learning, a non-profit organization that offers hands-on training in agriculture, environmental management, and decision-making skills for students and young farmers, and the USDA field gene bank at the Wolfskill Experimental Orchard, Winters, showcasing about 6500 accessions of subtropical and temperate fruit and nut crop species including their wild relatives.

Day three began with an oral session highlighting the need for germplasm characterization with a plenary lecture by the co-convener Dan Kluepfel in which he discussed the characterization and use of the USDA-ARS *Juglans* germplasm collection to identify novel sources of resistance to soil borne diseases and rootstock breeding programs. Other oral and poster presentations updated the status of characterization and sustainable utilization of CWRs of grapevine, pistachio, persimmon, olive, myrtle, and pecan from the Mediterranean, Asia, and North America. The fourth oral session focused on plant explorations and highlighted the plant-exchange programs and explorations organized by the NPGS. The fourth and final day of the symposium addressed the sustainable utilization of FNWRs with a final oral session discussing genetic resources information management, including a demonstration of the online USDA-ARS Genetic Resources Information Network (GRIN/GRIN-Global).

Maureen Whalen opens the symposium with a discussion of the National Plant Germplasm System (NPGS).

In the closing ceremony, Gale McGranahan, Vice-Chair of the Nuts and Mediterranean Climate Fruits Section of the ISHS, highlighted the role of ISHS in promoting the science of Horticulture through symposia and conferences, providing forums for the global horticultural research community and industries. The conference participants unanimously elected Baku, Azerbaijan as the venue for the 2nd meeting in 2014, accepted by Zeynal Akparov, Director of the Genetic Resources Unit, Baku. Malli Aradhya proposed the vote of thanks and remarked on the importance and urgency to safeguard the precious genetic resources of FNWRs for sustainable production and global food security.

Anne Koehmstedt, Dianne Velasco, Malli Aradhya and Dan Kluepfel

Field trip to the Center for Land Based Learning in Winters, California.

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First Int'l Symposium on Genetic Resources of Bamboos and Palms and Third Int'l Symposium on Ornamental Palms

SYMBAMPALM 2010 invited speakers (from left to right): Marcelo Souza – Embrapa, Brazil; Hugh Pritchard - Kew Garden, England; Fernando Tombolato – IAC – President of SYMBAMPALM 2010; Marco Zullo – IAC General Director, Brazil; Raymond Townsend - Kew Garden, England; Tito Schiva – IS Floricoltura, Italy; Newton Erbolato – Aproccamp, Campinas, Brazil; Fu Jinhe – INBAR, China; Etsuzoh Uchimura – Japan; Ricardo Marinho – landscape expert, Fortaleza, Brazil.

SYMBAMPALM 2010 was held at the Instituto Agronômico (IAC) Auditorium, from 21 to 25 November 2010. This technical and scientific meeting was promoted by the Brazilian Society for Floriculture and Ornamental Plants and the International Society for Horticultural Science – ISHS and it was partially financed by Brazilian Council for Research and Development - CNPq and São Paulo State Research Foundation – FAPESP.

This was the first technical and scientific meeting in Brazil on the subject of Bamboos and the third on Palms. The efforts of these horticultural organizations, Brazilian Universities and Institutes of Scientific Research highlighted the potential of bamboos and palms to a wider audience to increase the global awareness of bamboos and palms, to help protect natural resources and the environment, to ensure sustainable utilization, to promote new cultivation of bamboos and palms for new industries in Brazil and around the world, and to promote traditional and community uses of bamboos and palms.

View of bamboo collection and bamboo built structures at Tatuí Exp. Station, Brazil.

The importance of protection and cultivation of palms and especially of bamboos is enhanced in global concerns of ecology and environment and the threat of the global heating and the change of climate. Because of the deforestation pressure on the natural woods of the Amazon region bamboo is surely a viable wood substitute. Unlike metal and plastic, it is environmentally friendly, being not only biodegradable but also having enormous capacity to sequester carbon, because of the high speed capacity of the bamboo growth.

Bamboos and palms apart from their utility as food and medicine, tools, implements and daily utilities, they have been extensively used for fashionable handicrafts, furniture and even art. Modern architecture has been using these natural woods for building and construction especially in the Northeast of Brazil along the tropical seashores. In Eastern countries bamboo has also been developed as an energy source in the form of charcoal, activated carbon and even to generate electricity through gasification, and these are important reasons why we have invited experts from China and Japan for the SYMBAMPALM 2010 and created the motto: "Today's uses, Tomorrow's potentialities: a synergy East-West". In the Northeast of Brazil is located the largest South American bamboo industry producing high quality bamboo paper. The bamboo and palm scenario in this country will significantly improve in the coming years for the benefit of our society, and SYMBAMPALM 2010 surely contributed to these coming changes.

During SYMBAMPALM 2010, 25 talks were presented, 11 short communications, 38 posters and 5 workshops, assembling a total of 121 attendants, mostly Brazilian, including the invited speakers, members of the Organizing and Scientific Committees and students coming from different parts of Brazil, and also from Colombia, China, Japan, Italy, England, Belgium, Turkey and United States.

During SYMBAMPALM 2010, the participants briefly explored all the aspects related to these

Palm trees technical visit to Plantarum Institute at Nova Odessa, Brazil.

two important crops starting with Taxonomy, Anatomy, Distribution, passing by Conservation of Genetic Resources and Ecology, and then Propagation and Cultural Techniques, Harvesting and Conservation, to finally reach their uses and the marketing worldwide.

Antonio Fernando Tombolato

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Commission Irrigation and Plant Water Relations

Eighth Int'l Workshop on Sap Flow

Group photo of the SapFlow 8th participants.

The 8th International Workshop on Sap Flow held in Volterra, Italy, from May 8-12, 2011, was convened by Prof. Dr. Luca Sebastiani (Scuola Superiore Sant'Anna, Pisa, Italy), Prof. Dr. Roberto Tognetti (University of Molise, Pesche, Italy), and Prof. Dr. Antonio Motisi (University of Palermo, Palermo, Italy). The workshop locations were the SIAF Campus near Volterra and the Centro Studi Santa Maria Maddalena in the city centre.

The workshop gathered some 90 delegates from 17 countries to present and discuss the methodologies and applications to measure sap flow in plants. New methodological approaches, theoretical and practical improvements of existing technologies and instruments were displayed and discussed by researchers and manufacturers. In order to improve the link between researchers and manufacturers, at the beginning of the workshop a practical exhibition of new sap flow instruments was organized by the sponsors in the SIAF Campus where the delegates were accommodated. Some trees in the SIAF garden were monitored for sap flow during the whole workshop and the participants had the possibility to see and discuss the results in real time with the manufacturers of the instruments.

Scientific contributions consisted of 6 invited lectures, 43 oral presentations and 19 posters. The contributions were grouped into three different Sections: "Methodological aspects and application perspectives", chaired by Dr. Steve Green (Plant and Food Research, New Zealand) and Dr. Enrique Fernandez (Instituto de Recursos Naturales y Agrobiologia, IRNAS-CSIC, Spain); "Plant structure and water relations", chaired by Dr. Paolo Cherubini (WSL Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland) and Dr. Shabtai (Shep) Cohen (Dept. of Environmental Physics and Irrigation, Institute of Soil, Water and Environmental Sciences, ARO Volcani Center, Israel); "Stand transpiration and ecophysiological aspects", chaired by Prof. Dr. Jan Cermák and Prof. Dr. Nadezhda Nadezhdina (Dept. of Forest Botany, Dendrology and Geobiocenology, Mendel University Brno, Czech Republic). An open forum discussion took place after each Section.

Several contributions try to investigate and understand some crucial aspects of plant physiological processes relevant for sap flow measurements. Water relations, anatomical features, and hydraulic architecture of plants prove to

be crucial aspects that should deserve more studies in the next years to increase precision and reliability of sap flow sensors, especially when these are aimed to improving management practices in forestry and agriculture. Parallel to the plenary sessions was the sponsor exhibition room in which main sap flow manufacturers showed the latest advances in sap flow and related equipment.

In his lecture to open the first Section, Dr. Green gave a talk on the theoretical developments towards a new method to measure low and reverse flows in plants and highlighted computer modelling approaches to investigate salient features of the Average Gradient method. Dr. Fernandez' lecture focused on the usefulness of an indicator derived from sap flow measurements for scheduling irrigation in commercial fruit tree orchards with particular attention to olive. The rest of contributions within Section 1 gave to the audience a detailed picture of the recent advances in sap flow techniques, such as miniature sensors, calibration and verification methods, reverse flows measurements and general criteria for improving data analysis techniques. There was a general discussion on the perspectives of existing sap flow methods to quantify long-term water consumption in different horticultural and forest plant species.

SapFlow 8th welcoming address in the Centro Studi Santa Maria Maddalena. From the left: Drs. Sebastiani, Tognetti, Motisi, Fernandez, Green.

Passionate scientific discussion between young and senior sap flow researchers lasted well beyond the time of the official workshop sessions, helped by the beautiful location, local food products and by the friendly and relaxing atmosphere created by the sap flow community members.

Section 2 was opened by Dr. Cherubini, who discussed the potential of combining dendroecological methods with the hydrological research objectives and highlighted a very promising spectrum of ^{18}O isotope applications in environmental and hydrological studies. The second invited lecture was given by Dr. Cohen who talked about the radial and azimuthal (or tangential) distribution of sap velocity in tree stems, discussing in detail how to predict it with the currently available systems. The other oral contributions of the "Plant structure and water relations" Section presented data on sap flow obtained from a large range of species, such as grapevines, almond, Scots pine, *Juniperus sabina, Drimys brasiliensis*, apple, *Prunus avium, Sequoiadendron giganteum*, and *Fagus sylvatica*. The wide range of species presented proves the large applicability of sap flow techniques to several research fields. Another lecture focused on night-time sap flow and its role in removing air from plant hydraulic systems and one paper also gave an overall perspective of sap flow discussing the tapering of xylem conduits and how the water distribution network is optimized in trees. The general discussion of Section 2 was focused on how to get a better integration between plant anatomy, hydraulic structure and sap flow measurements.

In the last Section, Prof. Cermák related on the sap flow methodology and its application in relationship to tree structure focusing from the whole-tree to the stand eco-physiology, while Prof. Nadezhdina talked about the key issue of

Sap flow sensors installed on young olive trees.

water redistribution in soil and tree compartments. The rest of the contributions within this Section addressed a variety of mechanisms related to sap flow methods for the estimation of transpiration by riparian buffer trees, spatial variability in water use from crop trees and natural forests, water footprint, and automatic system to measure sap flow and canopy photosynthesis. The discussion of this Section was interesting and also summarized some general points addressed in the preceding days.

In general, the outstanding standard of most presentations created interesting discussions after each oral contribution, which continued at the end of each Section. All this scientific debate, together with the multiplicity of data storage and transmission systems, equipments and sensors shown by the sponsors attending the workshop, gave the attendants a comprehensive and very detailed picture of the state-of-the-art of sap flow systems, including some exciting advances in this technology.

The social activities during the workshop were also numerous (welcome party, slow food dinner, gospel choir, guided tour, social dinner, and piano bar). The history of Volterra, the beautiful landscape around the city, and the excellent local food products have created a perfect atmosphere among researchers stimulating a fruitful and enjoyable discussion even on complex scientific issues such as those involved in sap flow methods. So, it was not uncommon that scientific discussion lasted well beyond the time of the official workshop sessions in SIAF Campus.

On the second day of the workshop, we had a guided visit to the ancient city of Volterra rich of Etruscan, Roman and medieval constructions and famous worldwide for the extraction and processing of alabaster. After the visit, we enjoyed some specialties of the local gastronomy. The last day we had the ISHS Business Meeting and the closing ceremony and discussed about the next edition of the Workshop. It was unanimously agreed that the 9th edition of the Workshop would be organized by Prof. Dr. Kathy Steppe (Ghent University, Belgium) who accepted to be the person in charge. The expected date for this 9th edition is in June 2013.

Luca Sebastiani, Roberto Tognetti and Antonio Motisi

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Commission Plant Substrates and Soilless Culture

Second Int'l Symposium on Soilless Culture and Hydroponics

The Colegio de Postgraduados in Texcoco (Mexico), under the aegis of the International Society for Horticultural Science (ISHS), organized from May 15 to 19, 2011 for the second time in Latin America an International Symposium on Soilless Culture and Hydroponics. The Symposium was attended by 210 people, including ISHS members, non-members, students, farmers and companies related to Hydroponics and Soilless Culture.

This event was a platform for exchange of experiences among research institutes, institutions, universities, researchers, farmers, students and companies related to this industry of soilless culture. The Symposium provided a gathering of representatives from Argentina, Belgium, Brazil, China, Colombia, Costa Rica, Cuba, El Salvador, Germany, Israel, Mexico, New Zealand, Peru, South Africa, Spain, The Netherlands and the United States of America.

Five key note speakers were invited. The first was Prof. Dr. Wilfried Schnitzler from Germany

Opening ceremony. From left to right: Biol. Epitacio Robledo, Agriculture Puebla; Dr. Felix González Cossío, Principal Colegio de Postgraduados; Lic. Pedro Adalberto González Hernández, Agriculture Puebla; Dr. Erik Van Os, representing the ISHS and the Commission Plant Substrates and Soilless Culture; Dra María de las Nieves Rodríguez M., Symposium Convener.

A large group of symposium participants gathered at the entrance of the Convention Center, Puebla.

with his lecture on "Urban Hydroponics". The second invited lecture was given by Dr. Cees Sonneveld from The Netherlands and dealt with "Addition of Iron, Manganese and Zinc to the Nutrient Solutions on Tomato and Cucumber Growing in Systems with Inert Substrates". The third keynote speaker was Dr. Dietmar Schwarz, researcher at the Institute for Vegetable and Ornamental Crops (IGZ), Germany with his lecture on "Nitrogen Nutrition in Soilless Culture". The fourth lecture "Advances on Hydroponics in Latin America" was presented by Dr. Alfredo Rodríguez-Delfín from Universidad Nacional Agraria La Molina, Lima, Peru. Finally, Dr. Sonia Rodríguez from Universidad Autónoma de Chihuahua, Mexico, gave the lecture on "Hydroponic Green Fodder and Ecology".

Time allowed only a limited number of oral presentations; many others had to be in poster form. There were 69 posters that attracted the attention of the participants. The topics included "Plant Physiology and Plant Nutrition", "Organoponics", "Plant Nutrition and Pathogen Control", "Hydroponic Systems", "Nursery Plant Production", "Abiotic Stress", "Substrates" and "Nutrient Solutions".

Organizing Committee of the II International Symposium on Soilless Culture and Hydroponics.

One highlight was a field day on hydroponics where participants appreciated the hydroponic technology applied in Puebla, Mexico and how, with low-tech but well handled, it is possible to use this technique for achieving production advantages in terms of quality and productivity in Latin American countries. Participants could see the experience on tomato and lettuce production under soilless cultivation. After that, all went to lunch in a nice place named Cholula.

The symposium's convener was Dr. María de las Nieves Rodríguez Mendoza, who has organized an excellent event with the support of the staff of the Colegio de Postgraduados in Texcoco.

María de las Nieves Rodríguez Mendoza

Group of participants gathered in one of the greenhouses designed for hydroponics lettuce production. Tour presented by Federico and Daniel Fuentes.

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Fourth Int'l Conference Postharvest Unlimited 2011

Attendees observing 3D animation of "Journey to the Center of the Fruit" presented by Maarten Hertog. Backwall image is from the animation.

The Fourth International Conference Postharvest Unlimited was held May 23-26, 2011 in Leavenworth, WA, USA. Postharvest issues continue to remain a focus within the producer community as new cultivars and crops become available, existing and new markets expand and demand enhanced quality, and new technologies enabling storage life extension and quality sensing are developed. Conference attendees from 22 countries presented research results spanning a broad range of postharvest topics including fruit genomics and metabolomics, quality assessment by destructive and non-destructive techniques, procedures to extend fruit, vegetable, and ornamental crop market life, physiological responses to controlled and modified storage technologies, adaptations to postharvest stress, modeling of fruit development, and breeding for enhanced postharvest quality.

Orchard stop during the conference tour.

Use of advanced imaging and spectroscopic technologies to visualize and/or assess quality was the subject of a number of presentations. Advances in this area range from those becoming commercialized to others where feasibility of technology for assessment of specific aspects of quality was reported. Of particular note were reports of imaging studies from which 3-dimensional animations have been assembled to visualize transit into the interior of apple fruit or to non-destructively assess interior tissues for physiological and/or pathological disorders.

Genomic and metabolomic assessment of quality and disorders of a variety of postharvest topics were presented. The use of these powerful tools as a means to assist new cultivar development and to describe developmental processes of normal and aberrant ripening and senescence were the focus of a number of presentations. This is a rapidly developing area of postharvest research that is contributing to both new crop development as well as to provide insight into processes that limit marketability of horticultural crops.

The many reports describing new and/or modified procedures using existing technologies to maintain and enhance produce quality in the postharvest environment illustrated the continued progress towards enhancement of postharvest systems. Integrated technologies including refrigeration, controlled atmospheres and non-invasive sensing of physiological events in real time were described as was commercial utility of these systems.

The conference attendees enjoyed a week of springtime in central Washington State and thank the sponsors (AgroFresh, Inc., Decco, Pace International, Pear Bureau Northwest, Washington Tree Fruit Research Commission, North Central Washington Fieldmen's Association) for their generous support.

James Mattheis

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New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Argentina: Dr. Daniel Kirschbaum; **Australia:** Dr. Justin Coombs, Mr. Jay Dhungel, Dr. Silvia Estrada-Flores, Ms. Marion Lawson, Mr. Jon McCarthy, Mr. Shane McCulloch, Mr. Les Mitchell, Mr. Stuart Pettigrew, Mr. Craig Pressler, Mr. Paul Rennie, Mr. Franklin Trouw, Mr. Lloyd Wensley; **Azerbaijan:** Dr. Zeynal Akparov; **Belgium:** Dr. Juan Carlos Pérez Guerra; **Brazil:** Ms. Rívia Amaral, Mr. Yuuki Ban, Dr. Gustavo Alexand Coelho Braga, Dr. Marcelo Rezende, Mr. Jonathan Alex Wigman; **Bulgaria:** Mr. Dimitar Terziev; **Canada:** Mr. Dave Gill, Ms. Natalie Iwanycki, Lesley Longhorn, Ms. Heather Ross; **Chile:** Assist. Prof. Pamela Artacho, José Manuel Muñoz Catalán, Ms. Veronica Rodriguez, Dr. Boris Sagredo; **Colombia:** Ms. Andrea Lopez; **Denmark:** Mr. Bo Tarno; **Egypt:** Dr. Ahmed Abou El-Yazied; **Estonia:** Dr. Ulrike Plath; **Finland:** Mr. Henri Heinonen; **France:** Emilie Brandel, Dr. Vaia Sarlikioti, Anne Shah; **Germany:** Mr. Juergen Schmid; **Greece:** Mr. Constantinos Grigoriadis, Dr. George Iatrou, Mr. Ioannis Kadoglou, Mr. Ioannis Kontopoulos, Mr. Nikolaos Tsougkrianis, Dr. Nikolaos Voulgarakis; **Hungary:** Ágota Juhász; **India:** Dr. Arava Vijaya Bhaskara Rao; **Indonesia:** Dr. Irmanida Batubara, Prof. Dr. Latifah Darusman; **Iran:** Mr. Alireza Khaghani; **Ireland:** Dr. Jason Barry, Mr. Stuart Wilson; **Isle of Man:** Mr. Michael Tucker; **Israel:** Ori Ben-Herzel; **Japan:** Ms. Makiko Kitao, Prof. Takeshi Nishio; **Jordan:** Mustafa Jarrar; **Kenya:** Dr. Ruth Amata; **Korea (Republic of):** Mr. Deuk Hwan Ko, Mr. Jinseok Seong; **Lithuania:** Ms. Deimante Utaraviciute; **Mauritius:** Mr. Rajeswar Ramlugun; **Mexico:** Dr. Lizette Borges, Dr. Raúl Cárdenas Navarro, Prof. Dr. Juan Manuel Soto Parra; **Netherlands:** Maaike Baggerman, Ms. Annette Beerens, Kerstin Sobottka; **New Zealand:** Dr. Jane Adams, Mr. Rob Craig, Stella McLeod; **Nigeria:** Dr. Ademola Adeseye Idowu, Mr. Yahaya Mohammed; **Norway:** Ms. Alena Gibalova, Dr. Arne Sb; **Peru:** Ms. Lizabeth Silva; **Philippines:** Ben Bareja, Mr. Emilio Yap; **Portugal:** Rui Santos; **Qatar:** Mr. Shaik Abdul ali, Ms. Rachida Riad; **Romania:** Ionel Ianos, Dr. Elena Iuliana Ilie, Dinca Natalia; **South Africa:** Mr. Rudolf Badenhorst, Dr. Coenraad Basson, Dr. Heidi Hawkins, Ms. Luigia Kotze, Mr. Andrew Macdonald, Mr. Kyle B.R. Smith; **Spain:** Mr. Alan Craig, Mr. Alfonso Kurtz, Mr. Eitan Martin Oro; **Sweden:** Dr. Sanja Manduric; **Switzerland:** Dr. Mario Rohrer; **Thailand:** Prof. Dr. Chaiyong Eurviriyanukul; **Turkey:** Prof. Dr. Turan Karadeniz, Mr. Ozhan Simsek; **United Kingdom:** Hana Alsalih, Ms. Nuchanart Hongsanukulsant, Mr. Antonios Matas, Ms. Laetitia Moucheboeuf, Mr. Prakashkumar Narasimhamurthy, Mr. Hail Rihan, Mr. Pascal Simian, Mr. Simon Taylor; **United States of America:** Kerwin Bradley, Craig Campbell, Dr. Kedong Da, Dr. Rosanna Freyre, Mr. John Gaffney, Mr. Marc Gange, Prof. Dr. Arnold Hara, Mr. Ross Hendricks, Mr. Christopher Jackson, Robert Jones, Dr. Leo Kelly, Steven Klus, Mr. Ronald Kothera, Donald McCarty, Dr. Ebenezer Ogundiwin, Ms. Christel Osborne, Mr. Robert Payne, Mr. Mark Scott, Kimberly Smith, Dr. Roy Starr

Award

PROFESSOR IAN WARRINGTON IS AWARDED THE COMPANION OF THE NEW ZEALAND ORDER OF MERIT FOR SERVICES TO SCIENCE

Professor Ian Warrington from Palmerston North (New Zealand) was presented with his recently awarded Companion of the New Zealand Order of Merit for services to science at a ceremony at Government House in Wellington on 12 April 2011. The Order is awarded to those "who in any field of endeavour, have rendered meritorious service to the Crown and the nation or who have become distinguished by their eminence, talents, contributions, or other merits". Ian's award, announced in the 2011 New Years' honours' list, was based on his significant contribution to horticultural science and to the New Zealand horticultural industry for over 40 years.

Within his research career he became known nationally and internationally for his work on the environmental effects on plant growth and on improving the training and management methods for apples and kiwifruit. Much of Professor Warrington's scientific research has focused on plant responses to environmental factors such as temperature, light intensity, day length and carbon dioxide concentration.

Professor Warrington's work on temperature effects on apples has probably been one of the great advances in this field. His contribution in this field was acknowledged in 2000 when he received the ASHS Fruit Publication Award from the American Society for Horticultural Science for the publication "Apple fruit growth and maturity are affected by early season temperatures" by Warrington, I.J., Fulton, T.A., Halligan, E.A. and de Silva, H.N. published in 1999 in J. Amer. Soc. Hort. Sci. 124: 468-477. Although apples is one area in which he has published the most, he has made a contribution to science in a wide range of horticultural crops including various vegetable crops, grapes, kiwifruit, flower crops such as nerines and Zantedeschias, ornamental plants, forestry species and field crops such as corn and wheat, to name a few. He was also awarded the best "cross-commodity" paper for the Journal of the American Society for Horticultural Science in 1992.

He has published over 120 refereed papers primarily in the area of environmental physiology. He co-edited the books "Kiwifruit: Science and Management", and "Apples: Botany, Production and Uses", which detail research and production information on these crops from around the world.

Professor Ian Warrington and his wife Blondie, following his investiture at Government House in Wellington (photograph courtesy of Photography by Woolf, Wellington, NZ).

For over 20 years, beginning in 1969, Ian was the coordinator of the state-of-the-art controlled environment laboratory at the Department of Scientific and Industrial Research in Palmerston North, New Zealand. He was instrumental in contributing strongly to the design of this facility that provided a very wide range of precisely controlled environments in a large number of sophisticated walk-in growth rooms. In-depth research conducted alone or in cooperation with other scientists resulted in publications on a wide range of crops. The capabilities of the facilities were so unique that scientists from several countries, including many from the United States, travelled to New Zealand and were graciously hosted by Ian while conducting their research. The facilities he designed and studies conducted have set the standard for controlled environment research around the world.

He was Chief Executive of the Crown Research Institute, HortResearch, from 1996 to 2002 during which period the gold kiwifruit, bred by HortResearch, was commercialised. In 2002, Professor Warrington became Professor of Horticultural Science and subsequently, until 2010, the Regional Chief Executive and Deputy Vice-Chancellor at Massey University.

In 1994, Ian became the first New Zealander to be made a Fellow of the American Society for Horticultural Science. He is also a Fellow of the Royal Society of New Zealand, a Fellow of the International Society for Horticultural Science and an Honorary Fellow of the New Zealand Institute of Agricultural and Horticultural Science. He was Vice-President of the ISHS Board for 8 years. He is currently Co-President of the International Horticultural Congress to be held in Brisbane in 2014 and, as such, is an *ex-officio* member of the ISHS Board.

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 2011

- September 3-7, 2011, Xinzheng, Henan (China): **II International Jujube Symposium**. Info: Prof. Dr. Mengjun Liu, Research Center of Chinese Jujube, Agricultural Univesity of Hebei, Baoding, Hebei, 71001, China. Phone: (86)312754342, Fax: (86)3127521251, E-mail: lmj1234567@yahoo.com.cn or Dr. Jubin Shi, Haoxiangni Jujube Co. Ltd., Xinzheng, Henan, 451150, China. Phone: (86)37162489919, Fax: (86)37162489198, E-mail: ijs2008@yahoo.com.cn Web: http://www.ziziphus.net/2011/
- September 5-7, 2011, Pitesti (Romania): **II Balkan Symposium on Fruit Growing**. Info: Dr. Mihail Coman, Fruit Research Institute, Str. Popa Sapca, Nr. 14, Cod. 110150, Jud. Arges, Pitesti-Maracineni 0300, Romania. Phone: (40)248278292, Fax: (40)248278477, E-mail: mihailcoman1@gmail.com E-mail symposium: office@icdp-pitesti.ro Web: http://bsfg2011.icdp.ro/
- September 10-12, 2011, Damghan (Iran): **I International Symposium on Mycotoxins in Nuts and Dried Fruits**. Info: Dr. Hossein Abbaspour, Islamic Azad University, Damghan Branch, Damghan, Iran. Phone: (98)2325235214, Fax: (98)2325235214, E-mail: abbaspour75@yahoo.com E-mail symposium: afshari@mycotoxinsymp.com Web: http://www.mycotoxinsymp.com/
- September 11-15, 2011, Warsaw (Poland): **XIII Eucarpia Symposium on Fruit Breeding and Genetics**. Info: Dr. Emilian Pitera, Warsaw University of Life Sciences, SGGW - Department of Pomology, ul. Nowoursynowska 166, 02-787 Warszawa, Poland. Phone: (48)225932087, Fax: (48)225932111, E-mail: emilian_pitera@sggw.pl Web: http://www.eucarpia2011.woiak.sggw.pl/
- September 11-15, 2011, White River (South Africa): **II ISHS Genetically Modified Organisms in Horticulture Symposium: Paving the Way for a Sustainable Future**. Info: Ms. Adri Veale, University of Pretoria, Faculty of Natural and Agric. Science, Department of Genetics, 0002 Pretoria, South Africa. Phone: (27)12-4203939, Fax: (27)12-4203960, E-mail: adri.veale@up.ac.za E-mail symposium: ishsgmo2011@gmail.com Web: http://www.gmo2011.co.za/
- Symposium POSTPONED - New date soon to be announced September 17-19, 2011, Tunis (Tunisia): **I International Symposium on Cassava Market and Economy**. Info: Dr. Antonio Felice, Via Fiordiligi 6, 37135 Verona, Italy. Phone: (39)0458352317, Fax: (39)0458307646, E-mail: editor@greenmed.eu or Prof. Dario Salvatore Caccamisi, Monticello 10B, 41052 Guiglia (Modena), Italy. Phone: (39)059-792778, Fax: (39)059-792778, E-mail: dario.caccamisi.agronomo@hotmail.it
- September 18-22, 2011, Ghent (Belgium): **VII International Symposium on In Vitro Culture and Horticultural Breeding: IVCHB**. Info: Danny Geelen, Coupure Links 653, 9000 Gent, Belgium. Phone: (32)9264 60 76 E-mail symposium: IVCHB2011@UGent.be Web: http://www.ivchb2011.ugent.be/
- October 9-12, 2011, Tirana (Albania): **V Balkan Symposium on Vegetables and Potatoes**. Info: Prof. Astrit Balliu, Agricultural University of Tirana, Faculty of Agriculture, Horticultural Department, Tirana, Albania. Phone: (355)686022105, E-mail: aballiu@ubt.edu.al E-mail symposium: ssecretary@ubt.edu.al Web: http://5bsvp.ubt.edu.al/
- October 10-14, 2011, Salvador (Bahia) (Brazil): **International ISHS-ProMusa Symposium - ProMusa 2011**. Info: Dr. Edson Perito Amorim, Embrapa Cassava and Tropical Fruits, Embrapa Avenue, Cruz das Almas Bahia 44380000, Brazil. E-mail: edson@cnpmf.embrapa.br or Dr. Aristoteles Pires de Matos, EMBRAPA - CNPMF, Rua Embrapa s/n, Caixa Postal 007, Cruz das Almas, Bahia 44380-000, Brazil. Phone: (55)7536218000, Fax: (55)7536211118, E-mail: apmatos@cnpmf.embrapa.br E-mail symposium: symposium@promusa.org Web: http://www.gt5.com.br/promusa/
- October 16-19, 2011, University Park, PA (United States of America): **International Symposium on High Tunnel Horticultural Crop Protection**. Info: Dr. Michael Orzolek, 203 Tyson Bldg, The Pennsylvania State University, University Park, PA 16802, United States of America. Phone: (1)814 863-2251, E-mail: mdo1@psu.edu Web: http://horticulture.psu.edu/cms/ishs2011/
- October 16-20, 2011, Nebraska City, NE (United States of America): **V International Symposium on Acclimatization and Establishment of Micropropagated Plants**. Info: Prof. Paul E. Read, Univ. Nebraska, Inst. of Agr., & Nat. Resources, Dept. Hort., 377 Plant Sci., East Campus, Lincoln, NE 68583-0724, United States of America. Phone: (1)402-472-2854, Fax: (1)402-472-8650, E-mail: pread@unl.edu or Prof. Dr. John E. Preece, Supervisory Research Leader USDA-ARS, 1 Shields Avenue, University of California, Davis, CA 95616-8607, United States of America. Phone: (1)530-752-7009, Fax: (1)530-752-5974, E-mail: john.preece@ars.usda.gov Web: http://agronomy.unl.edu/isaemp-2011

- October 17-21, 2011, Barcelona (Spain): **International Symposium on Growing Media, Composting and Substrate Analysis**. Info: Prof. Dr. Xavier Martínez Farré, Escola Superior Agricultura (ESAB-EUETAB), Campus Baix Llobregat, Av. Canal Olímpic s/n, 08860 Castelldefels, Spain. Phone: (34)935521094, Fax: (34)935521001, E-mail: xavier.martinez-farre@upc.edu E-mail symposium: growingmedia.composting2011@upc.edu Web: http://www.upc.edu/growingmediacomposting2011
- November 2-4, 2011, Bogotá (Colombia): **II International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions**. Info: Dr. Maria Hernandez, ICTA Institute, Ciudad Universitaria, Universidad Nacional de Colombia, Ed 500 C - Bogotá, Colombia. Phone: (57)12536607, Fax: (57)12862418, E-mail: mshernandez@unal.edu.co
- November 2-4, 2011, Launceston, Tasmania (Australia): **International Symposium on Pyrethrum, The Natural Insecticide: Scientific and Industrial Developments in the Renewal of a Traditional Industry**. Info: Mr. Brian Chung, Botanical Resources Australia, PO Box 852, Sandy Bay, Hobart, TAS 7006, Australia. Phone: (61)362244511, Fax: (61)362244473, E-mail: bchung@pyrethrum.com.au E-mail symposium: py2011@pyrethrum.com.au Web: Second Announcement (pdf)
- NEW November 13-14, 2011, Algiers (Algeria): **International Symposium on Date Palm**. Info: Prof. Dr. Nadia Bouguedoura, Univ.of Science H. Boumediene, Biologie et Physiologie, BP 31 El Alia Babzzmar, Algiers 16111, Algeria. Phone: (213)771697122, Fax: (213)4247217, E-mail: nadiaboug@gmail.com E-mail symposium: sympada2011@gmail.com Web: http://lrza.info/ (website in French language only).
- NEW November 14-16, 2011, Chiang Mai (Thailand): **III International Symposium on Tropical Wines**. Info: Prof. Dr. Chaiyong Eurviriyanukul, Rajamangala University of Technology Lanna, RMUTL - Fac. of Science and Agric. Technol., 128 Huay Kaew Rd., Chiang Mai 50300, Thailand. Phone: (66)5392-1444, Fax: (66)5321-3183, E-mail: sat@rmutl.ac.th E-mail symposium: tropicalwine2011@gmail.com Web: http://www.tropicalwine2011.info/
- November 15-18, 2011, Chiang Mai (Thailand): **International Symposium on Medicinal and Aromatic Plants - Royal Flora 2011**. Info: Peyanoot Ms. Naka, Horticulture Research Institute, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)819076821, Fax: (66)25614667, E-mail: peyanoot@hotmail.com or Dr. Somchai Charnnarongkul, Department of Agriculture, Phahonyothin Rd., Chatuchak, Bangkok 10900, Thailand. Phone: (66)25799636, Fax: (66)29405412, E-mail: tosomchai@yahoo.com E-mail symposium: royalflorasymposium2011@yahoo.com Web: http://www.royalflora2011.com/index_eng.html
- NEW November 20-23, 2011, Antigua (Guatemala): **International Symposium on Medicinal and Aromatic Plants; History of Mayan Ethnopharmacology**. Info: Dr. Jalal Ghaemghami, PO Box 320172, West Roxbury, MA 02132, United States of America. Phone: (1)3393683868, Fax: (1)3393686838, E-mail: jalal@shmen.org E-mail symposium: ishs-tikal@shmen.org Web: http://www.antigua-ishs.com/
- November 22-25, 2011, Buenos Aires (Argentina): **VII International Symposium on New Floricultural Crops**. Info: Dr. Gabriela Facciuto, INTA, Los Reseros y Las Cabañas s/n, Castelar, 1712, Argentina. E-mail: gfacciuto@cnia.inta.gov.ar Web: http://www.inta.gov.ar/floricultura/newornamentals2011/index.asp
- November 24-27, 2011, Chiang Mai (Thailand): **III International Symposium on Papaya - Royal Flora 2011**. Info: Dr. Jirakorn Kosaisawe, Director General, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)25799636, Fax: (66)29405412, E-mail: jirakorn_k@yahoo.com E-mail symposium: royalflorasymposium2011@yahoo.com Web: http://www.royalflora2011.com/index_eng.html
- NEW November 27-30, 2011, Tel Aviv (Israel): **Frontiers of Citrus2011**. Info: Dr. Yair Erner, Department of Fruit Tree Sciences, ARO, The Volcani Center, PO Box 6, Bet-Dagan 50-250, Israel. Phone: (972)3-9683414, Fax: (972)3-9669583, E-mail: yerner@volcani.agri.gov.il or Prof. Dr. Raphael Goren, James de Rothschild Prof. of Horticulture, The Hebrew University of Jerusalem, PO Box 12, Rehovot 76-100, Israel. Phone: (972)89489348, Fax: (972)89489574, E-mail: rgoren@agri.huji.ac.il Web: http://www.frontierscitrus2011.com/
- November 29 - December 2, 2011, Chiang Mai (Thailand): **International Symposium on Tropical and Subtropical Fruits - Royal Flora 2011**. Info: Peyanoot Ms. Naka, Horticulture Research Institute, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)819076821, Fax: (66)25614667, E-mail: peyanoot@hotmail.com or Dr. Somchai Charnnarongkul, Department of Agriculture, Phahonyothin Rd., Chatuchak, Bangkok 10900, Thailand. Phone: (66)25799636, Fax: (66)29405412, E-mail: tosomchai@yahoo.com E-mail symposium: royalflorasymposium2011@yahoo.com Web: http://www.royalflora2011.com/index_eng.html
- December 3-6, 2011, Bangkok (Thailand): **International Conference on Quality Management in Supply Chains of Ornamentals (QMSCO 2011)**. Info: Dr. Sirichai Kanlayanarat, King Mongkut's University of Technology, Thonburi, Division of Postharvest Technology, Thungkru, Bangkok 10140, Thailand. Phone: (66)2 470 7720, Fax: (66)2 452 3750, E-mail: sirichai.kan@kmutt.ac.th E-mail symposium: qmsco@kmutt.ac.th Web: http://www.kmutt.ac.th/QMSCO2011/
- NEW December 3-6, 2011, Bangkok (Thailand): **Asia Pacific Symposium on Postharvest Quality Management of Root and Tuber Crops**. Info: Dr. Sirichai Kanlayanarat, King Mongkut's University of Technology, Thonburi, Division of Postharvest Technology, Thungkhru, Bangkok 10140, Thailand. Phone: (66)2 470 7720, Fax: (66)2 452 3750, E-mail: sirichai.kan@kmutt.ac.th E-mail symposium: APS2011@kmutt.ac.th Web: http://www.kmutt.ac.th/APS2011/
- December 3-6, 2011, Bangkok (Thailand): **I International Symposium on Postharvest Pest and Disease Management in Exporting Horticultural Crops**. Info: Pongphen Jitareerat, King Mongkut's Univ. of Technology Thonburi, Div. Postharv.Techn. School of Biores.& Techn., 83 Moo 8, Tientalay rd., 10150 BKK -Bangkhuntien, Thakham, Thailand. E-mail: pongphen.jit@kmutt.ac.th E-mail symposium: ppmd2011@kmutt.ac.th Web: http://www.kmutt.ac.th/ppdm2011/
- December 3-6, 2011, Bangkok (Thailand): **Southeast Asia Symposium on Quality Management in Postharvest Systems (SEAsia2011)**. Info: Dr. Sirichai Kanlayanarat, King Mongkut's University of Technology, Thonburi, Division of Postharvest Technology, Thungkru, Bangkok 10140, Thailand. Phone: (66)2 470 7720, Fax: (66)2 452 3750, E-mail: sirichai.kan@kmutt.ac.th Web: http://www.kmutt.ac.th/SEAsia2011
- December 9-12, 2011, Madurai (India): **I International Symposium on Cashew Nut**. Info: Dr. Ravindran Chandran, Assistant Professor, KVK, AC & RI, Tamil Nadu Agricultural University, Madurai, 625104 (Tamil Nadu), India. Phone: (91)452-2422955, Fax: (91)452-2422785, E-mail: ravi_hort@yahoo.com Web: http://www.cashewnut2011.co.cc/
- NEW December 19-22, 2011, Giza (Egypt): **V International Symposium on Vegetable Nutrition and Fertilization: Vegetable Farms Management Strategies for Eco-Sustainable Development**. Info: Dr. Ahmed Glala, Hoticultural Crops Technology Department, Agriculture Resarch Division, National Research center, Dokky, 12622 Giza (El-Bhoos Street), Egypt. Phone: (20)122963894, Fax: (20)237601877, E-mail: aaa_glala@yahoo.com Web: http://www.udvsq-nrc.com/ishs-2011

YEAR 2012

- January 9-13, 2012, Chiang Mai (Thailand): **International Symposium on Orchids and Ornamental Plants - Royal Flora 2011**. Info: Peyanoot Ms. Naka, Horticulture Research Institute, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)819076821, Fax: (66)25614667, E-mail: peyanoot@hotmail.com or Dr. Somchai Charnnarongkul, Department of Agriculture, Phahonyothin Rd., Chatuchak, Bangkok 10900, Thailand. Phone: (66)25799636, Fax: (66)29405412, E-mail: tosomchai@yahoo.com E-mail symposium: royalflorasymposium2011@yahoo.com Web: http://www.royalflora2011.com/index_eng.html
- January 15-20, 2012, Skukuza, Kruger National Park (South Africa): **II All Africa Horticultural Congress**. Info: Ms. Karin Hannweg, ARC-ITSC, Private Bag X11208, Nelspruit Mpumalanga 1200, South Africa. E-mail: karin@arc.agric.za Web: http://www.aahc.co.za/
- NEW January 23-26, 2012, Chiang Mai (Thailand): **International Symposium on Banana - Royal Flora 2011**. Info: Peyanoot Naka, Horticulture Research Institute, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)819076821, Fax: (66)25614667, E-mail: peyanoot@hotmail.com E-mail symposium: royalflorasymposium2011@yahoo.com
- NEW February 14-17, 2012, Zürich (Switzerland): **I International Workshop on Bacterial Diseases of Stone Fruits and Nuts**. Info: Dr. Brion Duffy, Agroscope Faw, Schloss, Postfach 185, 8820 Waedenswil, Switzerland. Phone: (41)447836111, Fax: (41)447836305, E-mail: duffy@acw.admin.ch
- February 18-22, 2012, Beijing (China): **VII International Strawberry Symposium**. Info: Dr. Zhang Yun-tao, Forestry & Pomology Institute of Beijing, Rui Wang Fen, Xiang-Shan, Hai Dian District, Beijing 100093, China. Phone: (86)1082592157, Fax: (86)1062598744, E-mail: ytaozhang@gmail.com E-mail symposium: strawberry2012@163.com Web: http://www.iss2012bjchina.org.cn/
- March 19-22, 2012, Temuco (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
- NEW 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/
- March 26-30, 2012, Nelson (New Zealand): **II International Symposium on Biotechnology of Fruit Species**. Info: 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.plantandfood.co.nz/conferences/biotechfruit-2012/
- As a result of the March 11, 2011 earthquake and tsunami the AHC2012 organizing committee decided to CANCEL the AHC2012 March 27-30, 2012, Tsukuba (Japan): **II Asian Horticultural Congress AHC 2012**. Info: Prof. Dr. Yoshinori Kanayama, Graduate Sch. of Agric., Tohoku Univ., 1-1 Tsutsumidori, Amamiyamachi, Aoba-ku, Sendai 981-8555, Japan. Phone: (81)227178642, Fax: (81)227178878, E-mail: kanayama@bios.tohoku.ac.jp E-mail symposium: info@ahc2012.com Web: http://www.ahc2012.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 2-3, 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
- 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/
- 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 Web: http://www.cpatsa.embrapa.br/3rdsygom/en/
- April 23-26, 2012, Santa Cruz (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
- NEW 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
- NEW 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/

- 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, One 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
- NEW 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
- June 10-12, 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
- 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
- NEW 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. Sciences, 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
- NEW 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
- 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
- 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
- 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
- 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
- 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
- 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/
- 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
- NEW 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, Res. Inst. of Pomol. & Floric., PO Box 105, ul. Pomologiczna 18, 96-100 Skierniewice, Poland. Phone: (48)468332041, Fax: (48)468333228, E-mail: teresa.orlikowska@insad.pl

- NEW 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
- 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 Web: http://www.olivesymposium2012.com.ar/
- October 14-19, 2012, Aracaju (Sergipe) (Brazil): **III International Symposium on Medicinal and Nutraceutical Plants and III Conference of National Institute of Tropical Fruits**. Info: Prof. Dr. Narendra Narain, Departamento de EngenhariaCCET, Univ Federal de Sergipe, Cidade Universitaria, 49100-000 Sao Cristovao-Sergipe, Brazil. Phone: (55)79 2105 6677, Fax: (55)79 2105 6679 E-mail symposium: 3ismnp@gmail.com
- October 15-18, 2012, Wageningen (Netherlands): **VII International Symposium on Light in Horticulture**. Info: Dr. Silke Hemming, Wageningen UR, Plant Research International, PO Box 16, 6700 AA Wageningen, Netherlands. Phone: (31)317 4 86921, Fax: (31)317 423110, E-mail: silke.hemming@wur.nl E-mail symposium: info@lightsym2012.com Web: http://www.lightsym2012.com/
- October 16-19, 2012, Porto de Galinhas, Pernambuco (Brazil): **X International Symposium on Postharvest Quality of Ornamental Plants**. Info: Prof. Fernando Luiz Finger, Depto. de Fitotecnia, UFV, 36570-000 Viçosa, MG, Brazil. Phone: (55)3138991128, Fax: (55)3138992614, E-mail: ffinger@ufv.br E-mail symposium: ispqop_2012@yahoo.com.br Web: http://www.ispqop2012.ufv.br/
- October 20-26, 2012, Wuhan, Hubei Province (China): **V International Symposium on Persimmon**. Info: Prof. Dr. Zhengrong Luo, Department of Pomology , Key Lab of Horticultural Plant Biology, Huazhong Agricultural University, Shizishan, Wuhan, Hubei 430070, China. Phone: (86) 27 8728 2677, Fax: (86) 27 8728 2010, E-mail: luozhr@mail.hzau.edu.cn
- October 22-25, 2012, Srinagar (Kashmir) (India): **IV International Symposium on Saffron Biology and Technology**. Info: Prof. Dr. F.A. Nehvi, Sher-e-Kashmir Univ.of Agric., K.D. Research Station, Old Ariport - PO Box 905, GPO Srinagar, J&K, 190001, India. Phone: (91)1942305084, Fax: (91)1942305084, E-mail: f.nehvi@rediffmail.com or Dr. Shafiq Wani, Sher-e-Kashmir Univ.of Agric., K.D. Research Station, Old Ariport - PO Box 905, GPO Srinagar, J&K, 190001, India. Phone: (91)1942463255, Fax: (91)1942461103, E-mail: shafiqwani@gmail.com
- November 4-8, 2012, Nanjing (China): **HortiModel2012: Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation**. Info: Prof. Dr. Weihong Luo, College of Agriculture, Nanjing Agricultural University, No1 Rd Weigang, Nanjing, Jiangsu 210095, China. Phone: (86)25-84399100, Fax: (86)25-84399100, E-mail: lwh@njau.edu.cn E-mail symposium: hortimodel2012@gmail.com Web: http://hortimodel2012.njau.edu.cn/
- November 12-16, 2012, Catania (Italy): **VI International Symposium on Brassicas and XVIII Crucifer Genetics Workshop**. Info: Dr. Ferdinando Branca, Dip.Orto-Floro-Arboricultura, Tecnologie Agroalimentari, Via Valdisavoia 5, 95123 Catania, Italy. Phone: (39)095355079 or 095234326, Fax: (39)095234329, E-mail: fbranca@unict.it
- NEW November 16-19, 2012, Dharwad (India): **V International Symposium on Human Health Effects of Fruits and Vegetables**. Info: Dr. Mahadev Chetti, University of Agric. Sciences, College of Agriculture, 58005 Dharwad, India. Phone: (91)9448495309, Fax: (91)8362445288, E-mail: mbchetti_uas@rediffmail.com
- December 2-6, 2012, White River (Kruger National Park) (South Africa): **IV International Symposium on Lychee, Longan and Other Sapindaceae Fruits**. Info: Mr. Derek Donkin, SA Lychee Growers' Association, PO Box 866, 0850 Tzaneen, South Africa. Phone: (27)153073676, Fax: (27)153076792, E-mail: derek@subtrop.co.za
- December 3-6, 2012, Stellenbosch (South Africa): **IX International Symposium on Temperate Zone Fruits in the Tropics and Subtropics**. Info: Dr. Nigel C. Cook, Hortgro Science, P.O. Box 12789, Die Boord, Stellenbosch 7613, South Africa. Phone: (27)826567088, Fax: (27) 218552722 E-mail symposium: reventer@netactive.co.za
- December 3-6, 2012, Stellenbosch (South Africa): **X International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems**. Info: Prof. Karen I. Theron, Department of Horticulture, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa. Phone: (27)218084762, Fax: (27)218082121, E-mail: kit@sun.ac.za

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- April 21-26, 2013, Santiago (Chile): **IX International Symposium on Grapevine Physiology and Biotechnology**. Info: Dr. Manuel Pinto, Instituto de Investigaciones Agropecuarias, Centro La Platina, Santa Rosa 11610, Santiago, Chile. Phone: (56) 27575164, Fax: (56) 27575164, E-mail: mpinto@inia.cl
- NEW April 24-27, 2013, Kusadasi (Turkey): **II International Symposium on Biological and other Alternative Approaches of Postharvest Diseases Control**. Info: Dr. Pervin Kinay, Ege University Faculty of Agriculture, Department of Plant Protection, 35100 Bornova IZMIR, Turkey. Phone: (90)232-388 4000, Fax: (90)232-374 48 48, E-mail: pervin.kinay@ege.edu.tr or Dr. Samir Droby, Aro, The Volcani Center, P.O.Box 6, 50250 Bet Dagan, Israel. E-mail: samird@volcani.agri.gov.il or Dr. Michael Wisniewski, Usda-Ars, 2217 Wiltshire Road, Kearneysville, WV 25430, United States of America. E-mail: michael.wisniewski@ars.usda.gov
- May 14-16, 2013, Giza (Egypt): **V International Symposium on Cucurbits**. Info: Dr. Ahmed Glala, Hoticultural Crops Technology Department, Agriculture Resarch Division, National Research center, Dokky, 12622 Giza (El-Bhoos Street), Egypt. Phone: (20)122963894, Fax: (20)237601877, E-mail: aaa_glala@yahoo.com
- May 18-22, 2013, Plasencia (Spain): **VII International Cherry Symposium**. Info: Dr. David González-Gómez, Instituto Tecnológico Agroalimentario, Ctra. de Cáceres SN, 06071 Badajoz, Spain. Phone: (34)924012699, Fax: (34)924012674, E-mail: david.gonzalezgo@juntaextremadura.net or Dr. Maria Josefa Bernalte García, INTAEX, Carr. de Cáceres sn, 06074 Badajoz, Spain. Phone: (34)924012699, Fax: (34)924012674, E-mail: bernalte@unex.es Web: http://www.cherry2013.com/
- May 27-31, 2013, Murcia (Spain): **VI International Symposium on Almonds and Pistachios**. Info: Dr. Federico Dicenta, CEBAS-CSIC, PO Box 164, 30100 Espinardo (Murcia), Spain. Phone: (34)968 396 339, Fax: (34)968 396 213, E-mail: fdicenta@cebas.csic.es

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