Chronica Horticulturae

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Horticultural Highlights

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Chronica Horticulturae

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Cover photograph: Inflorescense of milkweed. Photograph by Winthrop B. Phippen. See article p. 20.

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Contents

"Fingerprints" for Fruit and Nut Plants

Kim E. Hummer and Nahla V. Bassil

We in horticulture should be more aware of the identity of the plants that we use. We appreciate scientists who can determine species and cultivars with their botanical knowledge and keen powers of observation. However, sometimes plant identity is more than meets the eye. For example, studies have shown that the 'Stevens' cranberry (*Vaccinium macrocarpon* Ait.) from New Jersey has a different genotype than that same cultivar in Wisconsin or Oregon. Recently growers in the Northeastern US planted a newly released strawberry (*Fragaria* × *ananassa* Duchesne ex Rosier) cultivar, but as the season progressed, the plants didn't seem to match the description. Moreover, the yield wasn't right. Identity might have been mixed up in the laboratory or nursery. Although nursery people work hard to ensure that the plants they sell are correct, sometimes a dormant plant look-alike can be shipped by mistake. This past winter we ordered an elderberry (*Sambucus*) but were sent a *Viburnum*. The branching pattern helped us figure out that mistake. Taxonomy is a process needing constant vigilance. Now we have new laboratory "fingerprinting" techniques that can help us out.

Fingerprinting of humans for identity confirmation can be traced back to Babylon and ancient China. Only recently, since the late 1800s, did this technique become one of the most important parts of forensic investigation (Portland State University, 2013). Fingerprints serve as a highly accurate way to identify individuals of interest. Frequently we in the plant science world seek confirmation of plant identity, i.e., a so-called "fingerprint" for plants. In this paper we summarize recent advances in genetic tools used to confirm the unique identity of plants; to act as a plant fingerprint.

HISTORICAL CONTEXT

Throughout recorded history, people have drawn, examined and described the characteristics of plants (Fig. 1). Cultivated fruit and nut plants are propagated vegetatively, or clonally, i.e., with daughter plants maintaining the same genes and identity as the parent. Some orchard trees, such as *Pyrus* × *bretschneideri* Rehder 'Tse Li' or 'Ya Li' (duck pear from China), have been propagated by grafting, and have retained the same clonally descriptive identity for thousands of years (Postman, 1992).

PHYTOCHEMICAL IDENTITY

People may be unable to confirm a plant's identity based only on the plant's appearance in comparison with previously orally recited or written published descriptions. During the late 1990s, phytochemical analysis of plant parts began to be used for plant identity determination (Challice and Westwood, 1973). Scientists could determine a plant's species by looking at not only the botanical or horticultural qualities, such as color, shape and size of flowers and fruits, but by examining its phytochemical "fingerprint." For example, amounts of these chemicals, such as flavone glycosides or other phenolics found in leaves, were used to distinguish 26 taxa of pears (Challice and Westwood, 1973). While this technique was useful at the species and subspecies levels, the identification of unique pear cultivars was beyond its reach.

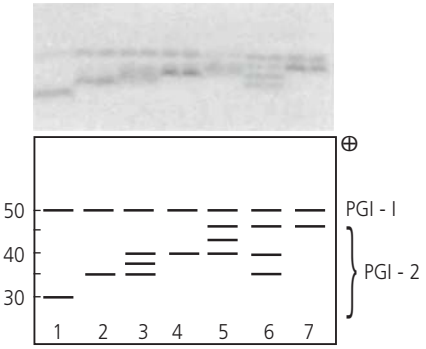
Scientists realized that production of phytochemicals varied depending on the season, environmental influences, such as available sun, water, and nutrients, pest and disease stress, and other external factors. Thus, phytochemical "fingerprints" were not necessarily as uniquely independent or consistent as desirable for plant identity confirmation.

ALLOZYME MARKERS

Plant scientists next turned to protein "markers". These markers were produced at specific locations on a particular chromosome. The most commonly used protein markers, isozymes, i.e., allozymes, were variant forms of the same enzyme which produced active phytochemicals. These enzymes were separated by "electrophoresis", a process that used an electric current to migrate chemicals through a thick slab of starch or plastic (polyacrylamide) gel. This process produced banding patterns that could be photographed and measured. Dr. Royce Bringhurst, a California strawberry breeder, and his colleagues, developed this technique to distinguish the identities of patented strawberry cultivars and species (Fig. 2) (Bringhurst et al., 1978; Arulsekar et al., 1981). This procedure was so sufficiently impressive and consistent that it was used as a tool for confirmation of strawberry cultivar identity to resolve legal disputes between nursery producers and growers. Laboratories were set up to perform isozyme analysis for identity confirmation of plants. However, the limited numbers of these isozymes in plants prevented their widespread use.

Figure 1. Ch'ien Hsian (ca. 1235-after 1307), pear blossoms, undated. Section of a handscroll, ink and colors on paper, 31.1 x 95.3 cm. The Metropolitan Museum of Art, Purchase, The Dillon Fund Gift, 1977.79 (Harrist, 1987).

Figure 2. Photograph and interpretive diagram of the banding patterns for phosphoglucosisomerase (PGI) allozymes in 7 genotypes of diploid strawberry [*Fragaria vesca* subsp. *californica* (Cham. & Schltdl.) Staudt]. From Arulsekar and Bringhurst, 1981.



As methods of DNA isolation, sequencing and DNA analysis tools began to unravel DNA's mysteries, plant scientists realized that these analyses could help them get to the source of the variation between closely-related plants. Isozyme proteins were a good system for identification of some individuals, and relatively inexpensive to perform, but DNA analysis would provide so much more information and could be more powerful in differentiating among all individuals.

So, innovative scientists proceeded from the product-oriented phytochemicals and their isozymes to direct DNA analysis. At first they examined random markers in the genome. These random fragments of different lengths produced useful genotypic patterns for separating individual organisms.

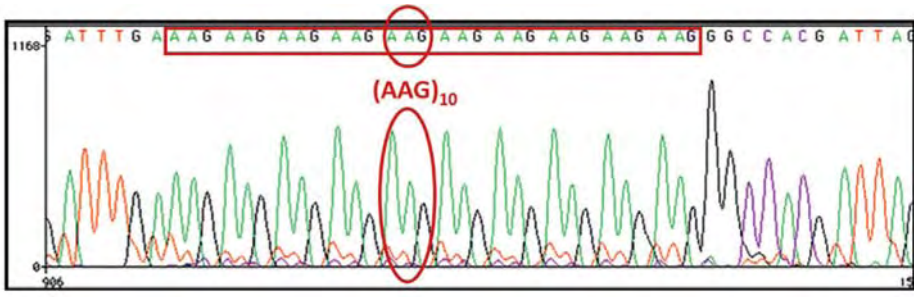
"RIF-LIPS," "RAPIDS" AND P-C-R, OH MY!

Restriction fragment length polymorphisms (RFLPs) used enzymes to cut DNA at specific locations. This was a relatively inexpensive tool for direct DNA analysis to be used for genetic fingerprinting. However, this process was slow, cumbersome, and required a large amount of DNA. With the invention of the polymerase chain reaction (PCR), a small sample of DNA extracted from plants, usually from newly expanding leaves, could be replicated to larger, measurable amounts using thermocyclers. Randomly amplified polymorphic DNA (RAPD) markers and other random or non-sequence-specific markers were next. Gardiner et al. (1996) used these techniques to examine paternity of *Malus domestica* Borkh.'Braeburn' apple. In 1952, this apple originated as a chance seedling found in an orchard in the Upper Moutere Region near Nelson, New Zealand (Gardiner et al., 1996). Using RFLP and PCR-RAPD markers, Gardiner et al. (1996) demonstrated that other cultivars were excluded from being a parent, but 'Lady Hamilton' was not. 'Lady Hamilton' was known to have been present in an orchard nearby to the 'Braeburn' seedling when it was discovered, and shared a rare phosphoglucomutase-3 allele *b* with it. Also, its genetic distance to 'Braeburn' was the lowest of any other potential parent examined.

MICROSATELLITES

During the mid-1990s, scientists were surprised to find that a large percentage of DNA was composed of short, tandem repeats. This means that the base pairs were frequently repeated two, three, four, or five times in a row proceeding down the DNA backbone. These tandem repeats were commonly found in all eukaryotic genomes, and were called microsatellites (Fig. 3). While these small fragments of DNA often did not code for genes, they were abundant throughout the genome, followed standard Mendelian inheritance patterns, and could be recognized landmarks as molecular markers. These characteristics, in addition to the relatively high amount of variation they detect as opposed to previous markers, prompted their use for determining parentage and identifying cultivars in many fruit and nut crops.

Figure 3. Sequence of a microsatellite-containing DNA region. The bases AAG are repeated in tandem 10 times making up a microsatellite sequence.



CLONAL IDENTITY CLARIFICATION

Growers' costs for nursery plant materials are quite large. They want to be assured that the identity of the plants that they receive is correct. If a base pattern has been established for a known cultivar, microsatellite analysis can determine if fruit plants are incorrectly labeled.

'Duke' Mascarade

Vaccinium corymbosum 'Duke', a northern highbush blueberry, was bred and released by the US Department of Agriculture in 2000. It is now one of the most planted blueberry cultivars in Chile. When a large Chilean company bought in vitro plants several years ago, they received mixed material of what they referred to as "yellow cane" 'Duke', "red cane" 'Duke', and a third morphologically different type. Growers did not realize the mix-up until the plants began to produce fruit. The Chileans grouped the blueberries into three morphological categories and sent leaf material to be analyzed in the NCGR genetics laboratory. Microsatellite analysis of 17 samples of these "Duke" plants revealed seven unique genotypes, each different from that of the true-to-type 'Duke' preserved at the US blueberry genebank in Corvallis. DNA analysis confirmed what they had suspected (Fig. 4). They had received a shipment of incorrectly labeled plants.

Rubus occidentalis L. Black Raspberry Jam

Over the past century, berry growers and researchers have noted how morphologically similar black raspberry cultivars appear. Recent

Figure 4. Fragment analysis of mis-labeled Chilean "yellow cane" 'Duke' (A) and true-to-type 'Duke' maintained at the NCGR (B) at the two SSR loci NA961 (green) and VCC_J1 (blue).

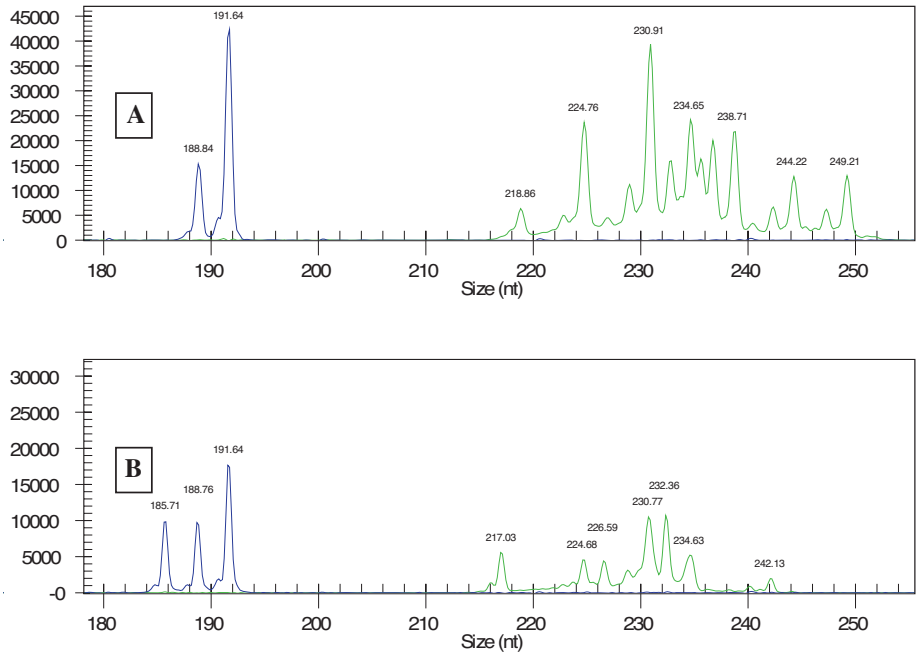


Figure 5. The black raspberry (*Rubus occidentalis* L.) 'Munger', fruit photographed here, has the same fingerprint as 'Britol', 'Cumberland', 'New Logan', 'Plum Farmer', and 'Shuttleworth'. They all have the same genotype! No wonder these black raspberry cultivars look alike.

microsatellite marker studies have confirmed more similarity than was suspected (Dossett et al., 2012). While the separate identities of some important cultivars, such as 'Bristol' and 'Mac Black', were confirmed, that of the most commonly planted cultivar, 'Munger' (Fig. 5) was not. 'Munger' sampled from nine different sources, had 11 different microsatellite-based fingerprints. This included multiple fingerprints from separate nurseries, and six different fingerprints for plants sampled from a grower's field.

Through sampling of multiple sources, a "consensus" 'Munger' fingerprint was determined. Unfortunately, this consensus 'Munger' fingerprint also matched 'Bristol' from every source, as well as 'Cumberland', 'New Logan', 'Plum Farmer' and 'Shuttleworth'. The conclusion: the original heritage genotypes for 'Cumberland', 'New Logan', 'Plum Farmer' and 'Shuttleworth' have been lost. Over the past century, mis-propagations or unknown re-propagations must have occurred. Many originally released genotypes are no longer with us.

PATERNITY DETERMINATION: SURPRISE, WHO'S YOUR DADDY?

Just as paternity testing in humans can sometimes lead to unexpected results, so can similar tests performed on plants. Knowing the correct paternity in a plant's pedigree is important to plant scientists, particularly breeders. In hazelnuts, unknown pedigrees were recently deduced. For cherries and pears, unexpected parental relationships have recently surprised the fruit research community.

Hazelnut Ancestry

In hazelnut (*Corylus avellana* L.), microsatellite markers were used to examine suspected duplications in 270 accessions in the US hazelnut genebank in Corvallis, Oregon, and at the Oregon State University hazelnut breeder's collections (Gokirmak et al., 2009). Seventy-two of these hazelnuts were unexpected duplicates. Some had come to the collections under translational synonyms from different countries. Duplicates were removed producing a more efficiently maintained collection without losing diversity.

In a second application, parentage analysis identified the two most likely, previously unknown, parents for 31 of the 198 unique genotypes. Several of these grower-selected cultivars originated in the Pacific Northwest where for several decades 'Barcelona' was the leading cultivar and 'Daviana' the most important pollinizer. Nine grower selections, including the well-known jumbo sized 'Ennis', were seedlings of 'Barcelona'. The pollen parent for one group of these selections was 'Daviana', for a second group its close relative 'Cosford', and for a third group an older cultivar named 'DuChilly'. This finding made sense because these three father clones were commonly planted in orchards of Oregon and Washington. Parents for an eastern filbert blight resistant cultivar, 'Zimmerman', found in a hedgerow near Boring, Oregon, were determined to be 'Barcelona' × 'Gasaway'. Knowing the parentage of particular cultivars is extremely important to plant breeders for planning their next generation of crosses.

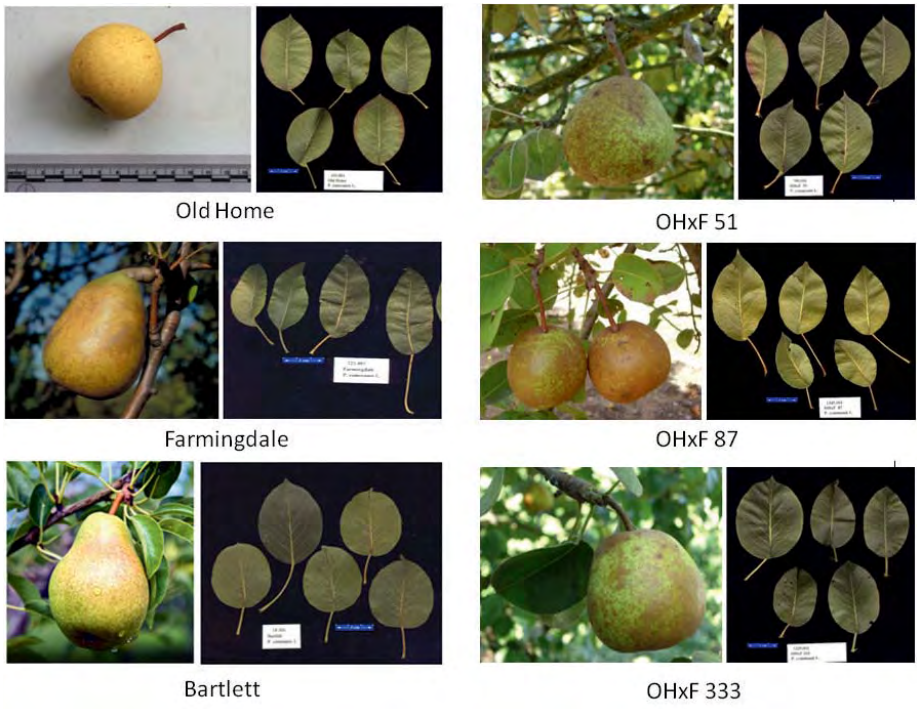
A Father for 'Bing' Cherry

A dark, sweet cherry, named 'Bing', a cultivar that is widely planted in the United States, was known as an open pollinated seedling from 'Black Republican', a red cherry. The father clone, source of the pollen for the cross, was originally unknown so it was called "open pollinated". Scientists at Michigan State University developed genetic markers to improve the chances of developing new and better cherry cultivars. In their study of 'Bing' they examined 60 genome-wide markers that covered the eight chromosomes of cherries. To their surprise, they found that the blush (yellow-fruited) cultivar, 'Napoleon', also known as 'Napoleon Bigarreau', is the father of 'Bing' (Warner, 2013). 'Napoleon' is a paternal grandparent of 'Stella', which was developed by Agriculture and Agri-Food Canada's breeding program at Summerland, British Columbia. This means that 'Bing' is related to new cultivars from the Canadian program. It's important to know family lineages when breeding fruit crops so that inbreeding can be avoided and diversity can be used to incorporate additional useful genes.

'Old Home × Farmingdale': Unexpected Father

Pyrus communis L. 'Old Home' and 'Farmingdale' pears are cultivars that originated in Illinois and have strong fire blight resistance. Both became important as parents for the development of new rootstocks. In the 1950s, an Oregon nurseryman collected seed from an 'Old Home' tree in British Columbia reported to be pollinated by 'Farmingdale' (Brooks, 1984). This cross became widely known in the fruit industry. A series of rootstocks were numbered, and named for the parents, 'Old Home' by 'Farmingdale' (OH×F). More than 45 numbers were selected having

Figure 6. Images of fruit and leaves of pears (*Pyrus communis* L.): 'Old Home', the mother; 'Farmingdale', the reported father; 'Bartlett' the actual father, as discovered by molecular fingerprinting; and of the offspring OHxF 51, OHxF 87, and OHxF 333.



desirable traits including a range of dwarfing and disease resistance (Fig. 6). These selections are valued in millions of US dollars annually in worldwide nursery production. Over the past 60 years, these rootstocks have been planted in Europe, South Africa, South America, New Zealand, Australia, as well as across the United States.

During routine fingerprinting, the US national pear genebank in Corvallis, Oregon, used microsatellite-based profiles to confirm paternity for these selections, and found that 'Farmingdale' could not have been the pollen parent (Postman et al., 2013). This assessment confirmed 'Old Home' as the mother, however, 'Bartlett' (synonym = 'Williams' in the UK) was identified as the likely pollen parent. Fruit and leaf morphology were also consistent with traits of 'Bartlett' and not 'Farmingdale'. The highly fire blight resistant 'Farmingdale' is apparently underrepresented in the pedigrees of current pear rootstocks, and deserves renewed consideration in breeding efforts.

CONCLUSION

DNA analysis is successful in fingerprinting plants both for clonal identification and paternity testing. This technique has identified and separated clones in many fruit and nut crops including apples, strawberries, raspberries, hazelnuts, cherries and pears. This technique is relatively inexpensive and the results can readily be transferred to appropriately equipped molecular laboratories. New technologies, such as DNA single code differences, called single nucleotide polymorphisms (SNP), are being developed for future plant genomic analyses but remain, as yet, expensive to perform.

Nurseries and plant sources are required by governmental quarantine regulations to certify that pathogens and diseases are not present prior to distribution. With the advent of rapid, relatively inexpensive molecular fingerprinting techniques, perhaps a new class of plant distribution, that of "identity certified" stock, could be established for horticultural purposes.

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Postcard

The other day at the University a colleague struck me with this sharp comment: "Your *Acta Horticulturae* is rubbish and I will never publish there again!"

I thought he was going to argue with the lack of an ISI impact factor, the old article layout or the soft review system, but the reason for such an unpleasant and unfair comment was quite different.

One year before this colleague had delivered the manuscript of his oral presentation to the convener of an ISHS symposium. At the same time, he submitted a presentation-related manuscript to a journal, which was reviewed and made available on-line in four months. One year later he was still waiting for the *Acta* paper!

Proceedings are valuable to rapidly publish information in tandem with the presentation at the meeting. Speediness is an important asset. I believe the new manuscript submission system being implemented by the ISHS will allow *Acta* to be published at the time of the symposium. Then the ISHS will have modernised its proceedings to allow quick publication of first-hand scientific and technical information.

António Monteiro, President of ISHS

Letter to the Editor

Regarding the interesting article on the "History and Early Development of the Modern Chrysanthemum" (*Chronica Hort*. 53(1):20-26) by Judith Taylor, I would like to make the following comment.

On page 21, she states: "A Dutch merchant, Jacob Layn, had introduced chrysanthemums into The Netherlands in about 1688,…". This family name Layn is fictitious and should be corrected to Breyn(e), Brayn(e), or Breynius.

The Dutch-speaking polyglot, Jacob Breyne, was a rich merchant living in Danzig, Poland, with family roots in Antwerp and Holland. He described and named "new" exotic plants in Latin, observed in famous Dutch gardens of rich, influential and aristocratic plant collectors during his visits to Holland, such as in 1688. In the following year, 1689, he published these descriptions in his *Jacobi Breynii, Gedanensis, Prodromus Fasciculi Rariorum Plantarum Secundus, Anno M.DC. LXXXIIX in Hortis Celeberrimis Hollandiae observatarum*, or a small introductory bundle on Exotic Plants. Breyne described two types of mums: small (simple white and double) and big-flowered (six colours) and classified them as *Matricaria Japonica flore minore* and *maxima*, respectively. In contrast to most other plants, he did not mention the garden where he had seen them. To the small-flowered mums he added: "*Cum priore a Clarissimo ten Rhijne obtinuimus*," (= we obtained it with the other from the most distinguished Ten Rhijne). This was not repeated with the big-flowered types. It is very likely that it was also the case, Breyne just forgot to repeat it. Breyne's friend Willem ten Rhijne had been a physician at Deshima, Japan, the Dutch trading factory of the Dutch East India Company, in the years 1674-76. So, in this period or shortly after, Breyne would have received the seeds and raised them in his own remote garden in Danzig, more than 900 kilometers from Amsterdam. This may explain the fact that no one other than Breyne has seen and smelled ("*foetu luxuriantibus or excessive scent*") the mums. There are no further public accounts to be found yet, besides some references (e.g., John Ray, Plukenet, Petiver). As Breyne lived in the "Little Ice-Age" with severe winters, it is likely that, not being well-informed on their hardiness and without greenhouses, he could not keep his plants alive, which so miraculously disappeared, leaving later taxonomists in confusion. Possibly, as late-flowering types, these plants could not provide new seeds in that unfavorable climate with low temperatures and little light (54°N 18°E). English breeders would experience the same phenomenon in the beginning of the 19th century. Like his friends in Holland, Breyne was also a collector of exotic plants, mostly provided by VOC related people. Similar to his statement that Holland was his "beloved native country", he may have considered his garden to be Dutch, as suggested in the title of his book, though 900 km off.

The faulty name of Layn was introduced in 1960 by a correspondent in Tokyo, Japan (called B.B.D. ?) of the German horticultural magazine, Deutsche Gärtnerbörse 60:298. Very likely, this mistake originated from linguistic problems when transliterating a Japanese text. Since then, for more than fifty years, this mix-up has been echoed in Holland by growers, by Ben van der Hoeven who referred to this name in *Acta Horticulturae* 197, 1987, and now again by Mrs. Taylor, probably not for the last time.

In the 1960s, a famous Dutch breeder Leen Hoek, named a fine big-flowered mum after Jacob Layn, which will now always be a genuine fantasy cultivar name.

Jaap Spaargaren, Aalsmeer, The Netherlands

Plant Factory in Japan – Current Situation and Perspectives

Toyoki Kozai

'Plant factory with artificial light (PF)' has been used in Japan for commercial production of leaf vegetables. Its annual sales volume per unit land area is roughly 100-fold that of open fields. PF can be built at any location and in any building, because it needs neither solar energy nor natural soil; its productivity is independent of the outside climate and soil fertility. In the near future, PF will play an important role in local production for local consumption of healthy and safe leaf vegetables and other short-height leafy crops in large cities. In this article, the construction characteristics, the operating principles, the potential, the challenges and the current commercial and non-commercial uses of PF in Japan are discussed.

WHAT IS PF (PLANT FACTORY)?

PF refers to a plant production facility consisting of 6 principal components: a thermally insulated and nearly airtight warehouse-like opaque structure, 4 to 20 tiers equipped with hydroponic culture beds and lighting devices such as fluorescent and LED (light emitting diodes) lamps, air conditioners with air fans, a CO_2 supply unit, a nutrient solution supply unit with water pumps, and an environment control unit (Figs. 1 and 2) (Kozai, 2007). Workers generally enter the cultivation room of the PF only after taking a hot water or air shower and wearing clean clothes.

Using PF, high quality pesticide-free plants are produced all year round owing to the optimal control of the aerial and root-zone environment. Leaf vegetables produced in PF are clean and need no further wash before cooking or processing. Shelf life of PF-grown vegetables after harvest is doubled compared to those produced in a greenhouse, because the bacterial load is generally lower than 300 CFU g^{-1}, which is 1/100th-1/1000th that of field-grown vegetables after washing with tap water.

COMMERCIALIZATION AND COST PERFORMANCE

It is estimated that the number of PF in commercial production exceeded 120 in December 2012, and this number is predicted to increase further in 2013. The largest PF in Japan, Spread Co., Ltd., can produce close to 25,000 leaf lettuce heads per day or 9 million heads per year. It is roughly estimated that 20% of PFs are making profit, 60% are breaking even, and 20% are losing money. The number and percentage of PF that are profitable have been increasing steadily since 2009. Depreciation costs account for roughly 30%, labor costs for 25%, and electricity costs for 20% of the total production cost (Kozai, 2013a). In 2012, the total production cost per lettuce head including depreciation per head was about 0.6 EURO and its sales price was 0.7-0.8 EURO.

It is estimated that half the cost of setting up a PF unit is required to construct the outer structure, while about half is needed to equip the unit. The total initial investment of a PF with 10 tiers is said to be around 4,000 EURO per square meter. Then, it will take 5-7 years to recover the initial investment.

The relative annual production capacity and sales volume of leaf vegetables per unit land area of a PF with 10 tiers are estimated to be, respectively, roughly 90-fold and 117-fold, compared with those in the open field (Table 1).

PLANTS SUITABLE FOR COMMERCIAL PRODUCTION IN PF

Plants produced in PF need to be shorter than around 30 cm in height because the distance between tiers is around 40 cm for maximum use of the air space. Plants suitable for commercial production using PF are those that grow well at relatively low light intensity, thrive at a high planting density and for which most parts (leaves, stems and roots) are edible or saleable at a high price. These include leaf vegetables, herbs, root crops, medicinal plants and others with a height of 30 cm or less. Staple food plants consumed for their calories (wheat, rice, potatoes, and others) are not suitable for commercial production in PF, because their economic value per kg (dry mass) is generally much lower than that of leaf vegetables, etc. In addition to the production of leaf vegetables, smaller PF units with a floor area of 15-100 m^2 have been used for commercial production of seedlings at about 150 different locations in Japan as of October 2012. Using this type of PF, grafted and non-grafted seedlings of tomato,

Figure 1. Six principal components of a plant factory (PF). Most sub-components of the PF are mass produced at low cost, can be purchased at home centers, and are suitable for later reuse.

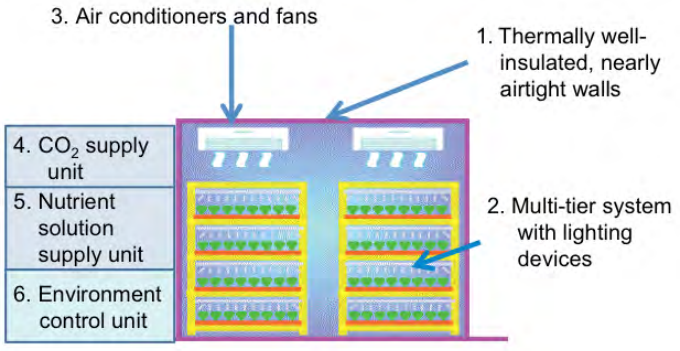


Figure 2. Plant factory (PF) on the Kashiwa-no-ha campus of Chiba University. Floor area of cultivation room: 338 m^2, 10 tiers, 9 rows, production capacity: nearly 3,000 leaf lettuce heads per day or one million per year, 10 workers with 7 working hours per day.

Table 1. Estimated relative annual production capacity and sales volume of PF per unit land area by its components in comparison with those in the open field.

No.	Magnification by PF compared with the open field	Component factor	Multiplied factor
1	10-fold by use of 10 tiers	10	10
2	2-fold by optimal environment control for shortening the culture period from transplanting to harvesting by half	2	20
3	2-fold by extending the annual duration of cultivation to year-round production with virtually no time loss between harvest and next transplanting	2	40
4	1.5-fold by increased planting density per cultivation area	1.5	60
5	1.5-fold per cropping by no damage due to abnormal weather such as typhoon, heavy rain and drought, and outbreak of pest insects	1.5	90
6	1.3-fold sales price due to improved quality and less loss of produce after harvest	1.3	117

cucumber, eggplant, etc., seedlings for hydroponic spinach, lettuce, etc. and seedlings/cuttings of ornamental plants and bedding plants are produced.

INCREASED DEMANDS IN FOOD SERVICE INDUSTRY

Currently, most leaf vegetables and herbs produced in PF are not sold at supermarkets or grocery stores, but are sold to the food service industry including the home-meal-replacement industry. In such industries, the cost of hygiene processing is considerably reduced by using PF-produced leaf vegetables, which, without washing, do not contain pesticide, contaminants and insects. PF-produced leaf vegetables are also used to produce paste for baby food and food for fragile elderly and sick people. R&D is under way to use safe and high quality PF-produced vegetables and medicinal herbs for use as raw materials in pickles, frozen foods, food and drink additives, sauce, traditional medicine, supplements, cosmetics, and more.

RESOURCE SAVING CHARACTERISTICS

Essential resources for growing plants in PF are light energy, water, CO_2 and inorganic fertilizers. However, in PF, electricity is needed to provide the light energy and to control the air temperature, air current speed and nutrient solution cycling and control. Lighting, air conditioning and nutrient solution control account for approximately 80, 15 and 5% of respective total electricity consumption in the cultivation room (Kozai, 2007, 2013b).

PF units are always cooled by air conditioners, even during the nights of the coldest season. This is because at least 40-60% of the lamps are always turned on at night to minimize the daily maximum power consumption and minimize lighting and cooling costs. A significant amount of heat energy generated from lamps must thus be removed by air conditioners. While cooling the air, these conditioning units condense about 95% of the water evaporated from leaves, which is returned to the nutrient solution tank for recycling. The rest of the irrigated water (about 5%) is either kept in the plants or released to the outside through the air gaps within walls (Kozai, 2007). The PF must also be airtight because CO_2 is enriched at 1,600-2,000 ppm (4-5 times higher than that of outside air) to promote photosynthesis and plant growth. The units are also sealed to prevent insects and dust from entering. Light energy use efficiency of plants in PF is a few times higher than can be obtained in the greenhouse. It is believed that this efficiency can be further improved (Kozai, 2011).

CHALLENGES

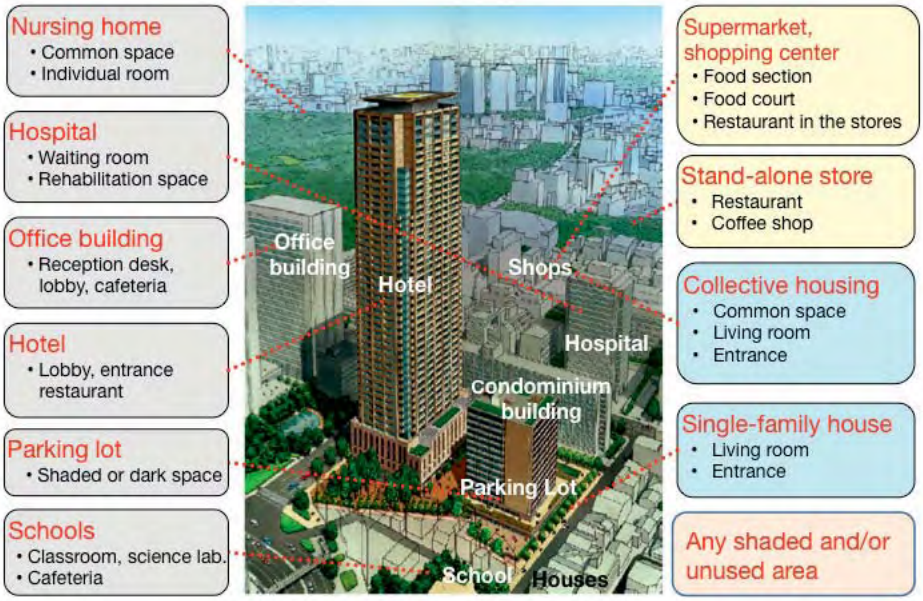
Challenges facing the wide adoption of the PF are: 1) to make a comprehensive Life Cycle Assessment (LCA); 2) to develop schemes to use PF in hotels, restaurants, hospitals, schools, community centers, etc.; 3) to improve the lighting system and light quality; 4) to improve automation in the PF; 5) to develop an integral environment control and management system; 6) to integrate the PF with other bio-production and resource recycling systems; 7) to develop management systems for the production of medicinal and other functional plants; 8) to have third-party evaluation of the safety and security of plants produced; 9) to streamline the cooperation process between outdoor agriculture and protected horticulture; 10) to use natural reusable energy sources and implement information technology; 11) to develop a universal design for PF for aged or challenged persons and a user-friendly design.

SMALL PF AT A VARIETY OF LOCATIONS

Beginning in 2009, small PFs (Fig. 3) were set up in a wide variety of non-traditional locations including private residences, various educational institutions, public facilities, commercial premises, hospitals, hotels, restaurants, shopping malls, and convenience stores (Fig. 4). The small PF in Figure 3A can be installed in a living room, allowing the family to grow fresh and tasty vegetables without the use of pesticides. By controlling the quality and quantity of light generated, among other factors, it is possible to control the plants' rate of growth and nutritional value. A diversity of plants are amenable to cultivation in these factories. For instance, leaf vegetables, such as lettuce, spinach, komatsuna

Figure 3. A. Household plant factory (Panasonic Corp.) installed with LED, built-in camera, irrigation control unit, etc., connected with internet. Size: 60 cm wide, 80 cm high and 35 cm deep. Electricity consumption: ca. 100 W. B. Small plant factory at the lobby of Sakakibara Memorial Hospital, Fuchu city, Tokyo. It is planned that vegetables be grown by the clients and served to the hospitalized clients. C. Small plant factory for eye-catching display at LalaPort shopping center in Kashiwa city, Chiba, Japan.

Figure 4. Image sketch of a ubiquitous plant factory in urban areas in the near future.



(Japanese mustard spinach), and mizuna (potherb mustard); herbs, such as mint and basil; small fruit vegetables, such as grape tomatoes and strawberries; and small flowering plants can be successfully grown in these units. These plants help create a soothing "green interior" that benefits people's well-being as they spend time caring for their plants on a daily basis and eating them at the end.

POSSIBILITIES OF PF NETWORK

Individual owners of the small PF won't be left alone, as internet technologies allow them to link to a large network of users. This community of PF growers will have access to the latest information on cultivation methods and plant varieties, downloadable from cloud servers. They will also have access to FAQ and social network service (SNS) functions where they will be able to exchange tips about cultivation and food preparation. The performance of plants in the units will be checked automatically and remotely to assess how plants are doing in real time using in-built cameras and specialized software. These will be useful to ascertain optimal environmental conditions such as temperature, humidity, and light, and suggest and eventually adjust these settings. PF growers will have the capacity to upload their own cultivation instructions, which they will upload onto cloud servers, making them available to others. Social media tools such as Twitter and Facebook will also be used. In summary, a network of small PFs could bring together a community of people with similar interests to share information on plant growing, employing the network efficiently, preparing and tasting the harvested produce, and communicating which information they liked, in both virtual and real space.

A TRIAL PROJECT OF PF NETWORK

A trial project along these lines using well-designed small PFs (Fig. 3A) was launched in 2012 in the Kashiwa-no-ha district of Kashiwa City in Chiba Prefecture, Japan. This project is being conducted by the Working Group of "Town PF Consortium Kashiwa-no-ha", a consortium made up of Chiba University, Mitsui Real Estate Co., Ltd., Panasonic Corporation, and Mirai Co., Ltd., with the collaboration of local residents acting as end-users for the project (http://www.miraibatake.net/) (Fig. 5).

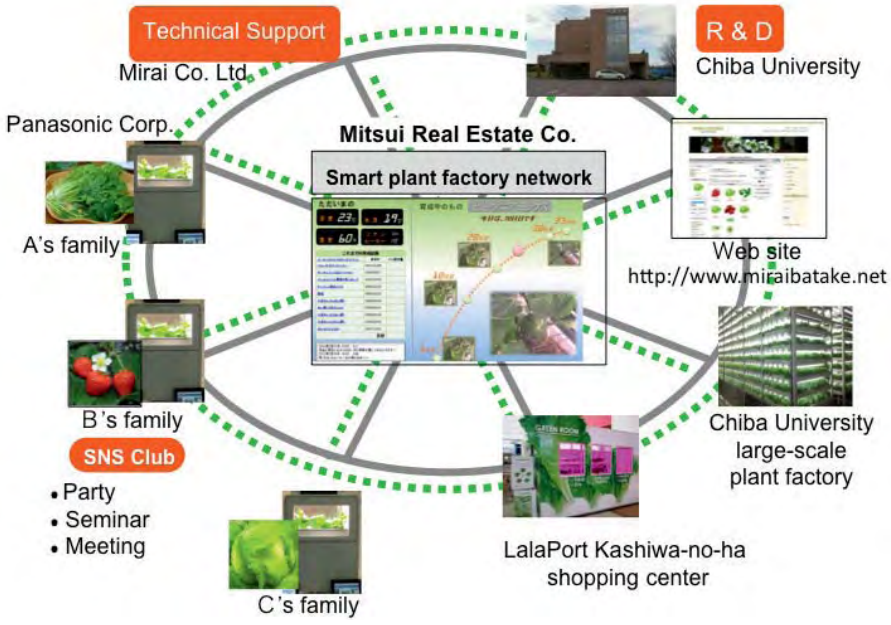
Objectives of the Trial

The trial project was intended to examine (1) how people can grow vegetables in household spaces; (2) the effectiveness of the supply of cultivation advice and the operability of the factory equipment; and (3) the added value of creating a network. It also assessed the usefulness and commercial feasibility of an exclusively web-based service where PF growers can ask experts questions on cultivation management, share information on their own circumstances and experiences, and arrange to exchange the vegetables they have grown. This project is an integral part of making Kashiwa-no-ha in Kashiwa City a "smart, streamlined" community, keeping with its designation as an "Environmental-Symbiotic City" that is sensitive to preserving green spaces and maintaining the harmony between cities and agriculture.

Further Applications

This project is assessing the implementation of a network linking people's homes, the experiences and results, but it can be extended to networks that link schools, local communities, hobby grower groups, restaurants, hospitals, and hotels. Then, the so called 'big data' can be collected via internet for 'data mining'.

Figure 5. A scheme of the household plant factory network being conducted in 2012 at Kashiwa-no-ha area in Kashiwa city, Japan. (http://panasonic.co.jp/corp/news/official.data/data.dir/jn120528-5/jn120528-5.pdf)



One can also foresee that similar networks could be established for fish farming, raising tropical fish and aquatic plants and creating biotopes integrating plants, mushrooms, insects, and small animals. The small-scale experiences and results could also be applied to large-scale commercial and industrial PFs. Lastly, by being connected to household and local community energy management systems, these networks can form their backbone. In this way, PF will play an important role in the near future in urban agriculture or vertical farming, as pointed out in by Despommier (2010).

Indirect Benefits of Using PF

As these networks are based on a model of collaboration between a community of small growers, they will allow their members to gain an implicit and integrated understanding of the scientific principles at work in the environment, natural resources, food production, and ecosystems through empirical experience, while experiencing the joy of raising living things. These networks can become practical tools for educating people about diet, the environment, nature, energy, and natural resources, be it in schools, as part of lifelong learning, or within the family. Using these networks will reinforce people's awareness of the vital importance of food and living things in our environment, of reducing our consumption of natural resources, and of preserving and protecting the environment.

VIRTUAL PF CONNECTED WITH REAL PF

With a virtual system incorporating an e-learning function, and a real system involving the actual cultivation of plants, these networks have a dual aspect. In the virtual system, growers can operate a PF using a simulator that incorporates a plant growth, an environment and a business model. After attaining a certain level of proficiency in the simulator, they can transfer their newly obtained knowledge to the real PF. They can obviously participate in both approaches in parallel.

Since small PFs represent almost entirely sealed environments, it is possible to quantitatively identify the amount of resources that they consume and produce. Mandatory as inputs are the light energy, water, CO_2, and organic fertilizer essential for the plant photosynthesis. It will also be possible to measure the exact amount of electrical energy required for lighting, air conditioning and circulation of nutrient solution. At the same time, analysis of the factory's camera images and measurements of plant weight will allow estimates to be made of the amount of plant growth. Lastly, taking those factors together with weight (or mass) and electric and light energy balance equations, it will be possible to estimate the rate of photosynthesis, rate of transpiration, and amount of fresh weight increase (Li et al., 2012a, b, c). It will also be possible to visualize in real-time the rates of input and output of energy and of materials (such as light energy, CO_2, O_2, water, inorganic material and carbohydrates) in the plant's ecosystem.

PF AS A MODEL ECOSYSTEM

PFs can therefore be described as a simplified model of an ecosystem. As people become familiar with this model, their ability to obtain a maximal production of food while maximizing the benefits in terms of quality of life will become second nature, as they minimize their environmental impact by reducing their electricity and water consumption, producing no waste water, absorbing carbon dioxide, and producing more oxygen for the atmosphere. Along with achieving this increase in their quality of life will come the joy of supporting living entities and from helping to protect the ecological balance. Small PF networks are a tool for visualizing "streamlining" grounded in the transformation of values that govern human life and society, and going "smart" based on information and sensor technology.

CONCLUSION

Plant factories with artificial light (PF) are becoming increasingly important in Japan for commercial production of leaf vegetables and other short-height leaf plants to enhance local production for local consumption in urban areas.

Residents/users living in urban areas and having little chance to grow plants in the open field may enjoy using a household PF. It is suggested that such a PF and its network have the potential to contribute to a better life for people in urban areas, and to provide an educational perspective to them about science, technology, virtual community, plant growing, origins of food, global ecosystems and global productivity.

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The Arziki Onion Store: New, Effective and Affordable Onion Storage for Small Producers

Dov Pasternak, Issaka Housseini and Uri Drori

Figure 1. Traditional onion stores covered with grass roof near Madoua.

INTRODUCTION

Niger is the second biggest producer of onions in sub-Saharan Africa after Nigeria. The total annual production of onions in Niger is around 800,000 tons. About 65% of the onions produced are exported to West African counties, particularly Ghana and Ivory Coast. Onion is the third largest export product from Niger after uranium and livestock. Total annual revenue from onion sales (exports and local) amounts to US$100 million. The price of onions in Niger fluctuates sharply within the year and between years. At harvest time (February-May) the price of a bag of onions (120 kg) varies between US$8.0-10.0. In August-September the price can be as high as US$100. This large variation in price is a result of the lack of effective onion stores. Producers are forced to sell all their production within one to three months after harvest. The onion 'Violet de Galmi', the dominant cultivar in West Africa, can have a storage life of 7-8 months before it starts sprouting. Storage of onions for long periods of time (5-7 months) would result in the leveling of prices throughout the year and probably in the expansion of onion production and exports.

Over the years there have been many attempts in Niger to construct effective onion stores. But until now most of these attempts have failed. Thus, producers continue to store onions in the traditional stores that are made of wooden poles and straw (Fig. 1). In these stores about 10% of the onion bulbs are spoiled by fungi and bacteria after three months of storage; after 6 months, 60% of the bulbs are spoiled.

Figure 2. A. Massive onion store building in Gaya with aeration holes. Expensive and unsuitable. B. Metal cages for onion storage in Gaya. Not enough aeration.

Figure 3. A. Wankoye onion store. Onions are piled on separated wooden planks and cool moist air is forced through the wooden planks. B. Cooling and humidifying room at Wankoye store. Air is pulled through the moist pad on the right to evaporate water that is recycled from a reservoir (bottom). The cool moist air is pushed into the store by powerful fans (back) through the spaced wooden planks.

RECENT EXPERIENCE WITH ONION STORES IN NIGER

Brice et al. (1997) reviewed the various storage facilities for onions. The main models of onion stores recently tested in Niger have been:

- The Gaya store (Fig. 2). This is a large and expensive building. Onions were stored in expensive metal cages. Lack of appropriate ventilation and bulk storage in the cages (no aeration) resulted in massive spoilage and the structure was abandoned.

- The Wankoye stores (Fig. 3). An entrepreneur called Boureima Wankoye constructed a series of big stores using Australian technology. The floor of the stores was made of spaced wooden planks through which cool, moist air was forced over a large pile of onions. This approach also failed and the stores were abandoned.
- The Reseda stores (Fig. 4). These stores are constructed using mud blocks. Onions are stored on shelves along the walls and in the center of the building. Aeration is achieved through the many holes that are cut in the outer walls. This store is more effective than those described above. The main disadvantage of this store is that most of the building volume is not utilized. Moreover, the Reseda stores are built to accommodate the harvest of many producers, but Niger producers are reluctant to transport their onions to a central store because of transportation costs and lack of personal supervision of the storing and the sale of their onions.

MEANS TO EXTEND STORAGE LIFE IN ONIONS

Brice et al. (1997) described the various factors affecting shelf life of onions: genetic composition, bulb size and morphology, crop husbandry and ambient temperatures and ventilation during storage.

- Genetic composition. Onion dormancy is an important determinant of storage life and the length of dormancy is determined by the genetic composition of the specific cultivar/line. ICRISAT tested about 50 different lines of 'Violet de Galmi' that were multiplied by the best onion seed producers in Niger. A specific line (no. 28) found in Madoua had the longest storage life (7-8 months). Seeds of this line can be obtained from the Aïnoma Seeds Company (masalifou@yahoo.com).
- Large bulbs are not suitable for storage because they are more susceptible to fungi and bacteria and have a higher percentage of sprouting (Ward, 1979). Damaged (bruised) bulbs should also be discarded. Bulbs with many scales conserve better than bulbs with few or no scales. The dry scales reduce the loss of water from the bulb and prevent the penetration of pathogens.
- Crop husbandry prior to harvest also affects storage life. Irrigation and fertilizer application should end when the onion leaves start to fall (Biswas et al., 2010). The bulbs should be totally dry before harvesting and the dry leaves should be removed.
- Onions can be stored at fairly high temperatures (more than 30°C) without detrimental effects to storage life (Opara, 2003). Onion storage at 10-20°C can actually result in early sprouting. However, storage at high temperatures and low humidity might result in significant weight loss.
- Keeping the bulbs dry during storage is probably the biggest determinant of long storage life since most fungi (*Botrytis, Aspergillus, Penicillium*) and bacteria (*Erwinia, Pseudomonas*) develop on wet surfaces. Moisture on the surface of the bulbs induces fungi and bacteria development. High temperatures that decrease relative humidity and ventilation are means for preventing moisture accumulation on the surface of the bulbs.
- In addition to the above measures, one should prevent the bulbs from touching each other to avoid disease transfer from affected to healthy bulbs.
- And lastly, one should be able to effectively inspect the onions during storage and discard the bulbs that are spoiled.

Figure 4. Reseda onion store. Built of low cost mud bricks. Windows and aeration holes are cut in the wall. Quite effective but wasteful in space.

THE ARZIKI ONION STORE

The Arziki onion store, named after a USAID food security project in Niger (Fig. 5), has an "igloo" shape and uses the same construction materials as the traditional grain store found in the Tahoua region. It is constructed with 20 cm thick mud bricks plastered over with crushed mud bricks to prevent moisture absorption (Fig. 5C). The pilot stores have a 3 m diameter at ground level and a height of 2.5 m.

The bottom of the store is based on hard wooden timber from the "ronier" (*Borassus aethiopum*) palm over which a thick (3 mm) wire net is attached (Fig. 5B). It is necessary to construct a strong base to carry the onion load that will sit on top of it. The floor lays on stones that elevate the construction 40 cm off the ground. Before construction starts a mix of crushed charcoal and salt is spread on the ground at 10 kg/m^2 of charcoal and 30 kg/m^2 of salt (Fig. 5A). The charcoal-salt mix is incorporated into the soil and wetted. This preparation is a traditional means to repel termites.

A wide 80x80 cm window covered with a removable metal sheet is cut in the side of the structure at a height of 1.5 m. The window is used for filling or emptying the store of onions and for periodical inspection of the condition of the bulbs in order to decide when to sell the onions based on the spoilage situation (Fig. 5G).

Two "chimneys", each 2 m high, are made of bendable thin wood material revolving around a circular wooden base (Fig. 5D). The chimneys are placed in two sides of the store. A removable 80 cm high chimney is set up on top of the construction (Fig. 5E).

The whole store is "painted" with used motor oil to prevent absorption of moisture. The upper 1 m of the store is painted with a black tar paint to allow maximum collection of solar radiation (Fig. 5E).

Loading Bulbs into the Onion Store

Onion bulbs with their dry leaves intact are laid down in single layers. Each bulb layer is separated from the next by a layer of millet straw (Fig. 5F). This set-up reduces contact between spoiled and unspoiled bulbs and facilitates ventilation.

The cost of the first prototype with a capacity for storing up to 5 tons of onion bulbs was US$1,000. Bigger stores with a storage capacity of 10-20 tons can easily be constructed using the same model.

Arziki Onion Store Operation

The Arziki onion store is based on "passive solar ventilation". This technology was developed for ventilating buildings (Hoy-Yen Chan et al., 2010) and was perfected by Drori et al. (2005) for small commercial structures.

Sun radiation is absorbed by the mud brick walls of the store, particularly by the surface painted with black tar. The heated bricks heat the air inside the structure. Hot air escapes through the roof chimney pulling cooler air from the bottom of the structure through the wire net that lines the bottom. The cooler air rises through the onion bulbs separated by millet straw and through the two ventilation chimneys. Air flowing through the chimneys creates a thermo-siphon effect combined with a Ventury effect resulting in air being sucked from the sides. Since the bricks have relatively high thermal mass, they will continue to dissipate heat well into the night. Ventilation will continue as long as heat is being dissipated from the mud bricks.

Pilot Study of the Arziki Onion Store

In March 2012, four prototypes of the Arziki onion store were constructed in the district of Illela in Niger. Illela belongs to the greater region of Tahoua. One store was constructed in the

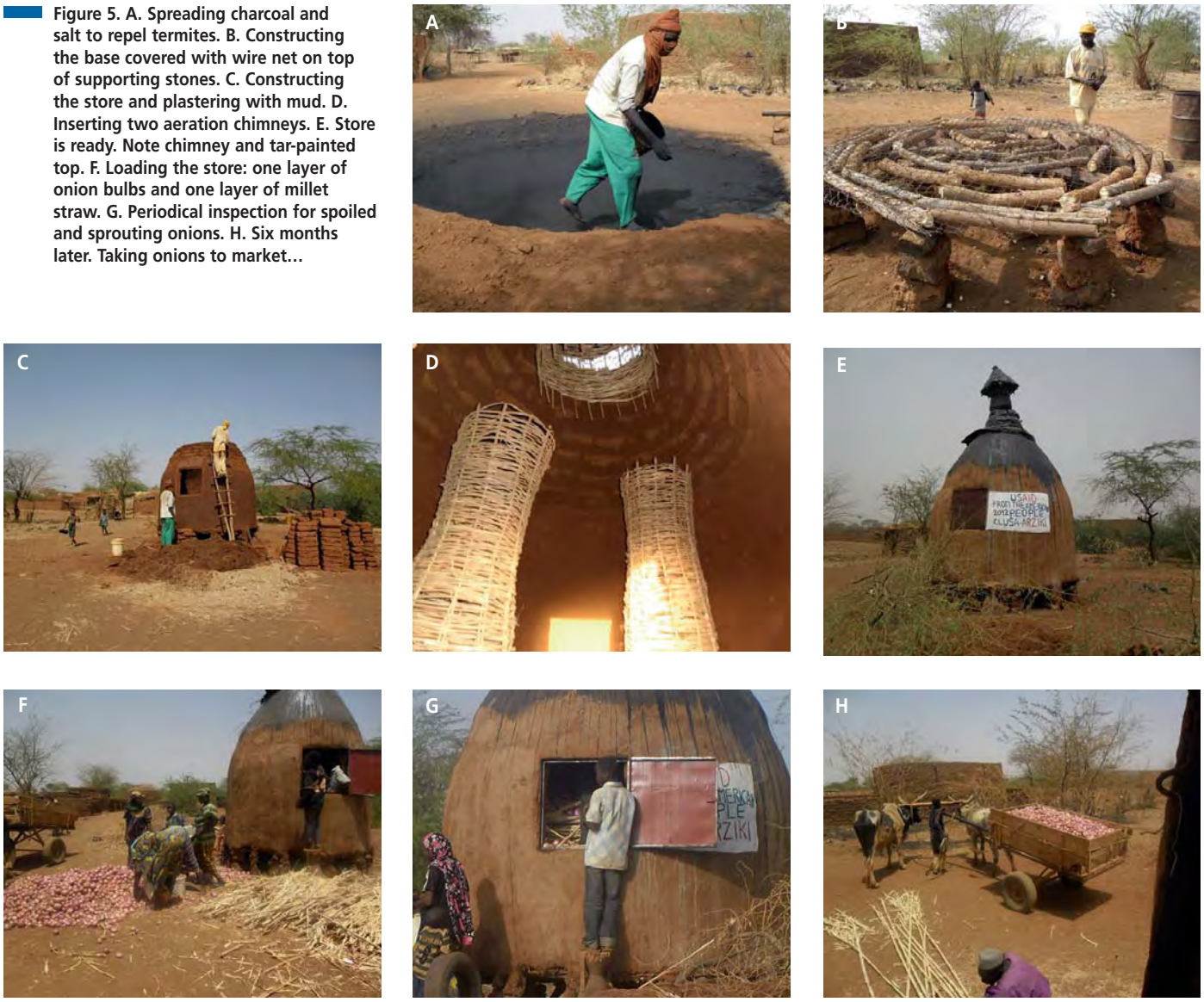

Figure 5. A. Spreading charcoal and salt to repel termites. B. Constructing the base covered with wire net on top of supporting stones. C. Constructing the store and plastering with mud. D. Inserting two aeration chimneys. E. Store is ready. Note chimney and tar-painted top. F. Loading the store: one layer of onion bulbs and one layer of millet straw. G. Periodical inspection for spoiled and sprouting onions. H. Six months later. Taking onions to market...

Roukouzoum village, one in the Dandi village and two in the Zouraré Sabara village.

Results of the Roukouzoum Village

Following 6 months of storage there was only a 3% loss (less than anticipated) in weight but practically no loss due to bulb spoilage (Table 1). During the same period the percentage loss of onions stored in a nearby traditional store amounted to 60%, mostly due to bulb spoilage. At the end of six storing months, the price of a sack of onions increased by a factor of nine compared with prices at the beginning of storage.

Results of the Dandi Village

In Dandi the producer removed all bulbs after three months of storage, this being the maximum storage time in the traditional stores. This producer had less faith in the Arziki store as compared with the producer from Roukouzoum. Accordingly, he was able to sell

Table 1. The effect of the Arziki onion store in the Roukouzoum village on bulb recovery after 6 months of storage.

Date	Activity	Number of sacks	Weight of individual sack (kg)	Total weight (kg)	Price of sack (US$)
May	Onions storage	35	120	4,200	10.0
October	Removal from storage	34	120	4,080	90.0
Percentage loss				3%	

Table 2. The effect of the Arziki onion store on bulb recovery after 3 months of storage in the Dandi village.

Date	Activity	Number of sacks	Weight of individual sack (kg)	Total weight (kg)	Price of sack (US$)
May	Onions storage	30	120	3,600	10.0
July	Removal from storage	29	120	3,480	35.0
Percentage loss				3.5%	

Table 3. The effect of the Arziki onion store on bulb recovery after 3 months of storage in the Zouraré Sabara village by two producers (producer No.1 and producer No.2).

Date	Activity	Number of sacks	Weight of individual sack (kg)	Total weight (kg)	Price of sack (US$)
May	Onions storage	No.1: 3 No.2: 30	120	No.1: 360 No.2: 3600	10
July	Removal from storage	No.1: 3 No.2: 12	120	No.1: 360 No.2: 1440	40.0
Percentage loss				No.1: 0% No.2: 60%	

his onions at US$40.0 per sack as compared with the first producer who sold his onions at US$100.0 per sack (Table 2).

Results of the Zouraré Sabara Village

In the Zouraré Sabara village producer No.2 did not follow storage instructions (use of aeration chimneys and millet straw) and the results reflected this (Table 3).

CONCLUSIONS

The Arziki onion store provides solutions to most of the constraints of existing onion stores in Niger. A store that contains 5.0 tons of bulbs costs about US$1,000 and is affordable to most onion growers in Tahoua and elsewhere. The payback period for the Arziki store is less than six months, making it a very attractive opportunity for short-term micro-credit. The store is small and suitable for individual producers that do not wish to use central and far away storage. It is made out of local materials and can be constructed by local builders.

The combination of cultivars with long storage life capacity, right crop management, the preparation of onions for storage and passive solar ventilation, can result in a full six months of storage of 'Violet de Galmi' with negligible storage losses. The Arziki onion store should even out the price of onions over the year, bringing higher revenue for producers, lower prices for consumers and increased onion production for the local market and for export.

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Jackfruit: Genetic Diversity and Culture

Sisir Mitra

The domesticated jackfruit tree, *Artocarpus heterophyllus* Lam., is important in tropical and subtropical regions, particularly in South and Southeast Asia. The tree is a major component of subsistence and small farmers' farming systems and the fruit often assumes the role of a secondary staple food as well as contributing to the livelihoods of the poor. Jackfruit has been in cultivation in India from ancient times. It was probably taken by Arab traders to the East African coast, and it has now spread throughout the tropics. The tree is a multipurpose source, providing food, timber, fuel and fodder.

Jackfruit is widely esteemed in tropical Asia where it originated as a cultigen, but its distribution is now pantropic through introduction in the past. Although it is well-known and widely used and cultivated in Bangladesh, India, Sri Lanka, and many other countries of the world, it remains underutilized because it has undergone very little scientific improvement.

The genus *Artocarpus* is a member of the family *Moraceae*. The genus contains about 50-60 species, distributed throughout the Indo-Malaysian region and Southern China. All the species are monoecious, with the male flowers in pseudo-catkins and the female in pseudo-heads. All produce a multiple fruit (a syncarp), the achenes being surrounded by fleshy pulp and the common receptacle becoming fleshy (Haq, 2006).

Jackfruit is an evergreen medium sized tree (10-25 m tall), with a rounded or irregular crown and a scaly and greyish brown or dark grey bark. Branches spread from low down on the

trunk, twigs are cylindrical and mostly glabrous, but sometimes with minute, short, white hairs, becoming glabrous later. Leaves are of different shapes (oblong, obovate or elliptic) and sizes (2-25 cm long and 2-12 cm wide) and are inserted alternately on horizontal branches, but tend to be spiral on ascending branches with 2/5 phyllotaxis.

USES

Jackfruit, with its many and varied uses, is a favourite fruit particularly in South-east Asia. The perianths (bulbs) are eaten fresh when ripe and young fruits are used for making vegetable curry, pickles and many other culinary preparations. A number of value-added products developed from jackfruit bulbs and perigones are increasingly in use. Technologies for the development of jam, jelly, squash, ready-to-serve (RTS) beverage, fruit candy, fruit roll, *halwa*, fruit cheese, fruit *murrabah*, pickle and pappad have been standardised. The dehydrated, shredded nip bulbs can be stored for a longer time and are used in the preparation of fried chips. The outer peel of ripe fruit is used as cattle feed and the seeds are eaten boiled or roasted. Starchy flour is also made from mature seeds. The timber of the tree is a prized wood for making furniture and for other uses such as doorframes, etc. The leaves of the jackfruit tree are commonly used for feeding goats and sometimes used as elephant fodder.

COMPOSITION

The ripe jackfruit has high nutritive value. In India it is called the "poor man's fruit". The fruits are normally fibrous and are composed of mono- and di-polysaccharides. The ripe fruit also significantly contributes to the nutrition of low income families as a source of vitamins, minerals and calories. The young fruit (used as a vegetable) is high in protein, fibre and minerals, while the seed is a good source of protein, fat, carbohydrate and minerals (Table 1).

Table 1. Composition of the edible parts (100 g edible portion) of jackfruit (on the basis of fresh weight) (adopted from Haq, 2006).

Composition	Young fruit	Ripe fruit	Seed
Water (g)	76.2-85.2	72.0-94.0	51.0-64.5
Protein (g)	2.0-2.6	1.2-1.9	6.6-7.04
Fat (g)	0.1-0.6	0.1-0.4	0.40-0.43
Carbohydrate (g)	9.4-11.5	16.0-25.4	25.8-38.4
Fibre (g)	2.6-3.6	1.0-1.5	1.0-1.5
Total sugars (g)	-	20.6	-
Total minerals (g)	0.9	0.87-0.9	0.9-1.2
Calcium (mg)	30.0-73.2	20.0-37.0	50.0
Magnesium (mg)	-	27.0	54.0
Phosphorus (mg)	20.0-57.2	38.0-41.0	38.0-97.0
Potassium (mg)	287-323	191-407	246
Sodium (mg)	3.0-35.0	2.0-41.0	63.2
Iron (mg)	0.4-1.9	0.5-1.1	1.5
Vitamin A (IU)	30	175-540	10-17
Thiamine (mg)	0.05-0.15	0.03-0.09	0.25
Riboflavin (mg)	0.05-0.2	0.05-0.4	0.11-0.3
Vitamin C (mg)	12.0-14.0	7.0-10.0	11.0
Energy (kJ)	50-210	88-410	133-139

PLANT GENETIC RESOURCES

Jackfruit is a tetraploid and the somatic chromosome number ($2n$) is 56 ($2n=4x=56$), hence the basic chromosome number (x) is 14. Although *Artocarpus heterophyllus* is an out crossing species, it freely crosses with *A. integer*. The trees are cross-pollinated and mostly propagated by seed. They exhibit a wide range of variations in

Table 2. Cultivars of jackfruit (adopted from Haq, 2006).

Country	Cultivar names
Australia	Golden Nugget, Black Gold, Honey Gold, Lemon Gold, Cheena, Chompa Gob, Coching, Galaxy, Fitzroy, Nahen, Kapa, Mutton, Varikkha
Bangladesh	Topa, Hazari, Chala, Goal, Koa, Khaja
India	Kooli, Varika, Gerissal, Barica, Ghila, Karcha, Rudrakshi, Champa, Hazari, Gulabi, Safeda, Khaja, Bhusila, Bhadaiyan, Handia, T-Nagar jak, Velipala
Indonesia	Kandel, Mini, Tabouey
Malaysia	J-30, J-31, NS-1, Na2, Na29, Na31
Myanmar	Talaing, Kala
Philippines	J-01, J-02, TVC, Torres
Sri Lanka	Vela, Varaka (Waraka), Peniwaraka, Kuruwaraka, Singapore Jak/Ceylon Jak
Thailand	Dang rasimi, Kun Wi Chan, Kha-num nang, Kha-num lamoud
USA: Florida	Black Gold, Cheena, Dang Rasimi, Galaxy, Golden Nugget, Honey Gold, Lemon Gold, J-30, J-31, NS-1, Tabouey, Delightful

Diversity in fruit shape and size.

tree size, fruit shape, size, weight, spine density, rind and bulb colour and fruit acidity (Ghosh, 2000; Mitra, 2000; Haq, 2006). There has been limited collection of jackfruit germplasms for evaluation and selection in India, Indonesia, Nepal, Malaysia, Thailand, the Philippines, Sri Lanka, Vietnam and Bangladesh, and thus limited information is available on performance of accessions. Germplasms were introduced to Florida from Thailand, Malaysia and Australia. Variations exist between and among populations and these can be selected for clonal propagation. Therefore, there is ample scope to identify genetic diversity to select superior clones. The jackfruit cultivars available in different countries are listed in Table 2.

CULTURE

Climate and Soil Requirements

Jackfruit grows well in moist tropical climates and deep well drained soils ranging from loose textured sandy loams through to laterite and alluvium. It can be grown on almost any type of soil under proper drainage conditions. Jackfruit is sensitive to frost.

Propagation

Seed propagation is still the most popular method of reproduction in all jackfruit growing countries. However, due to variation in the growth and performance of seedlings, this is being discouraged (Haq, 2006). Seed propagation is also necessary to raise rootstocks for vegetative propagation, which removes such variations in planted trees. The seeds do not retain viability for a long period when exposed, and are best planted immediately after extraction from the fruit. Seeds can be stored for a short period (4-5 weeks) in coir dust or sand without losing viability, but if the cotyledons become dry and shrivel up, they fail to germinate. Vegetative propagation produces progeny that is genetically identical to the mother plant. The common vegetative propagation methods include marcottage (air layering), budding and grafting on seedling rootstocks. Propagation is also possible by cutting and in vitro tissue culture. Air layering to multiply superior jackfruit clones is commonly in practice in India and Bangladesh. Treatment with auxin (IBA 3000-5000 ppm) and phenolic compound (ferulic acid at 200 ppm) resulted in 80-90% rooting of air-layers (Dhua and Sen, 1984). Epicotyl grafting (on 15-day-old rootstock), softwood grafting, splice, cleft, inarching and veneer methods of grafting have been tried in different countries with a varying degree of success (30-90%). Different budding methods (patch, chip, T, ring) were also tried in India, Bangladesh, Sri Lanka, Thailand and Vietnam and the success rates reported were as low as 20% to as high as 100% (Haq, 2006).

Seeds and bulbs of jackfruit.

Manuring, Fertilization and Irrigation

Fertilizers are usually not applied to jackfruit trees when grown in home gardens. The trees, however, need nutrition for regular good cropping. Application of farmyard manure (50 kg/plant), 750 g ammonium sulphate, 625 g single superphosphate and 800 g muriate of potash per plant per year in the second and third year of planting and increased doses of 938 g ammonium sulphate, 781 g single super phosphate and 375 g muriate of potash in the fourth year were found to increase growth, flowering and fruiting. For quick growth of the trees, manures and fertilizers may be added twice a year; before and after monsoon (Ghosh, 2000). Fertilizers can be applied in a 5-10 cm deep trench or in holes made along the periphery of the tree canopy and then covered with soil. However, further studies are needed to determine the optimal fertilisation requirements of jackfruit.

Jackfruit trees are normally not irrigated. However, irrigation during dry periods is considered essential in dry/sub-humid regions for normal growth. In home gardens, trees are hand watered during the first 2 to 3 years, till the root system has penetrated deep enough and is well established. For mature trees irrigation is recommended during dry periods if they occur between onset of flowering and until the fruit is fully developed.

FLOWERING

Jackfruit is monoecious with male and female inflorescences appearing separately on the same tree. During flowering season specialized laterals develop on the trunk on the main branches (cauliflory). There appears to be no regular sequence in the incidence of male and female inflorescences, although there are considerably more males than females. Each terminal is enclosed by a pair of thick stipules that protect the bud initially, but have a prominent annual scar on the node. Whereas male and female inflorescences are similar during early development, the female is later distinguished by a thicker peduncle and a large annular disc at the base of the spike. The female is noticeably shorter and wider than early-emerged males at anthesis, but later-emerged males are smaller. The female inflorescence is 5-8 cm x 3-5 cm

Flowering and fruit set.

Diversity in leaf shape and size.

and light green in colour, while the male inflorescence is oblong and light green and grows to a length of 5-10 cm x 2-4 cm. The jackfruit is anemophilous (pollination by wind) and under open pollination the fruit set is about 75%, which could be improved by hand pollination. Pollination and fertilization of a spike are completed within 3-6 days after anthesis. The axis of the inflorescence, the ovaries and perianths all grow simultaneously and develop into a multiple fruit. The pericarp around each seed and the fleshy perianth are edible.

RIPENING, MATURITY, HARVESTING AND STORAGE

In Asia, jackfruit ripens primarily from March to June, April to September or June to August depending on the climatic region. There are some off-season crops from September to December and a few fruits have been reported at other times of the year (Mitra, 2000). Jackfruits are harvested immature green (1-3 months of age) for use in cooking, or mature for fresh use. Maturity of the fruits depends on the cultivar, season and growing conditions, but usually takes 5-8 months after flowering. The characteristics of fruit maturity are i) changes of rind colour from green to yellow or greenish yellow, ii) spines become well-developed and well spread and yield to moderate pressure, iii) last leaf on the footstalk turns yellow, and iv) fruit produces a dull hollow sound when tapped by a finger. The maturing fruit will develop an aroma, usually beginning from the stem-end. However, the aroma is often only discernable when the fruit is already ripe on the tree. Fruit are cut with a sharp knife leaving a short stem. Once harvested, the fruit should be stored at a comfortable room temperature of 24-27°C for ripening. The fruit will ripen within 3 to 10 days depending on the maturity. They can be stored for 2-6 weeks at 10-12°C and 85-90% RH, but the fruit at this temperature ripened improperly and occasionally had poor quality.

Fruiting on the branches.

HANDLING AND TRANSPORT

The harvested fruits are carried individually by holding the stalk and sent by bullock carts and push carts to nearby towns, where they are sold to consumers or to visiting tradesmen from bigger cities. When there are long distances between the producing centres and city markets, the fruits are transported in trucks. The cost of production of a fruit at the site of production in India varied from US $ 0.5 to 8 in 2012 depending on its size.

PESTS AND DISEASES

As many as 38 species of insects are known to attack jackfruit in India. However, most of them are not a very serious cause of concern. The shoot and fruit borer (*Diaphania caesalis*) is one of the major insect pests. The insect lays eggs on tender shoots and flower buds. On hatching, the reddish brown caterpillars bore into shoots, flower buds and fruits, resulting in wilting and drying of affected parts. Tender fruit often drop under severe infestation. To protect from oviposition, fruits should be covered with polyethylene bags. Spraying of carbaryl at 4.0 g per litre of water during flowering is recommended. Among the diseases, fruit rot or blossom rot (*Rhizopus artocarpi*) is reported as a serious disease of jackfruit, and results in 15-32% crop loss. The inflorescence or tip of the flowering shoots, or the stalks of the tender fruits are infected and blackened by sporangia. Spraying with Bordeaux mixture (0.5%) or copper oxychloride (0.2%) is recommended for controlling the disease.

MARKETING

Jackfruit is mainly grown in small holdings as a component of home gardens in India, Bangladesh, Sri Lanka, Myanmar and other countries. A few organized orchards are seen in Thailand, Malaysia, China and India. Domestic marketing of mature fruits involves middlemen and the different stages of marketing are i) retailer, ii) wholesaler-retailer, iii) assembler-wholesaler, iv) assembler-retailer, v) wholesaler-shipper and vi) wholesaler and processor. There are also commission agents of wholesalers who sometimes also act as wholesalers. They provide short term finance, find buyers and sellers for wholesalers and retailers and provide storage.

Haq and Huges (2002) estimated that the production of jackfruit will expand mostly due to an expanding market for processed products. It is also estimated that the demand for fresh fruits will expand in countries such as Japan, Malaysia and the United Kingdom in addition to Singapore, Hong Kong and some Middle Eastern countries. The main exporters of jackfruit in Asia are Thailand, China and Malaysia, and among them, Thai products are considered to be the market standard, followed in quality by Malaysia and China. Colombia, India, Malaysia, Uganda, Jamaica, Thailand, Sri Lanka, Bangladesh and Kenya export jackfruit to the United Kingdom market. Jackfruit is available in the wholesale markets in Sydney, Melbourne and Brisbane of Australia. The fruits are mainly supplied from Queensland

Village market.

Transportation from assembler to wholesaler.

Fruiting on the trunk.

and Northern Territory and are consumed by the ethnic groups such as Pacific Island communities and Southeast Asian communities resident in Australia. Jackfruit is popular in Hongkong and the fruits are supplied from Thailand, Malaysia, Phillipines and China (Haq, 2006).

Processed Products

Dried Flakes. Fruit is sliced lengthways into two to four pieces depending on the size of the flake. The slices are blanched in hot water containing permitted levels of preservative at 80-90°C for five minutes. These are spread on a perforated tray and dried in a mechanical drier for 12 h to a moisture content of 8-10%. The dehydrated flakes are packed, sealed and stored at room temperature.

Jackfruit Powder. Fruit is sliced lengthways into two to four pieces and then across into two pieces. The slices are blanched as before, spread on a perforated tray and dried in a mechanical drier for 12-14 h to a moisture content of 7-8%. The dehydrated slices are powdered in a grinder. The powder is sieved and packed in bags, sealed and stored at room temperature.

Jackfruit Leather. Slices of jackfruit are blended with sugar. The blended pulp is mixed with preservative and concentrated in a steam-jacketed pan. The concentrated mass is spread on a stainless steel tray and dried in a mechanical drier for 18-20 h to a moisture content of 9-12%. The dehydrated pulp is then cut into squares or rectangles and packed, heat sealed and stored at room temperature.

Jackfruit Toffee. Slices of fruit are blended with sugar and milk. The blended pulp is mixed with other ingredients and preservative. The mixture is concentrated in a steam-jacketed pan. The concentrated mass is transferred to a stainless steel plate and diced into the desired toffee size. The toffees are packed in printed polypropylene pouches coated with aluminum foil and stored at room temperature.

Jackfruit Juice. Jackfruit pulp should be collected from fresh fruit and the seed should be removed. The pulp is homogenized and a measured amount of water is added. It is then heated to boiling point for about five minutes and cooled, treated with enzyme and left overnight. Juice is collected by filtration. Measured amounts of water, sugar and preservative are added and heated to 80-85°C. The juice thus prepared is bottled, sealed and cooled.

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3rd European Turfgrass Society Field days, 30 September – 1 October 2013, Monte Carlo, Monaco. Info: Dr. Claudia de Bertoldi, Email: info@etsfielddays2013.com, Web: www.etsfielddays2013.com

Drip Irrigation Summit, 18-21 November 2013, Tel Aviv, Israel. Info: Ms. Adi Ben-Tovim, MASHOV Group Ltd., 118 Hahaluts St., Beer-Sheva 84207, Israel, Phone: +972-8-6273838, Fax: +972-8-6230950, Email: DripSummit@mashov.net, Web: drip.mashovgroup.net

SEAVEG 2014: Families, Farms, Food. Regional Symposium on Sustaining Small-Scale Vegetable Production and Marketing Systems for Food and Nutrition Security, 25-28 February 2014, Bangkok, Thailand. Info: Dr. Grisana Linwattana, Horticulture Research Institute, Department of Agriculture (DOA), Bangkok 10900, Thailand, Email: sym-veget@hotmail.com or Dr. Robert J. Holmer, AVRDC – The World Vegetable Center, Kasetsart University, Bangkok 10903, Thailand, Email: seaveg2014@worldveg.org, Web: www.seaveg2014.com

International Conference on Medicinal Plants and Their Use in Therapeutic Practice, 14-16 May 2014, Stara Lubovna, East Slovakia, Slovakia. Info: Ing. Vilhelm Oravec, 17. novembra 32, Stara Lubovna, 064 01, Slovakia, Phone: 00421 52 43 23100, Mobile phone: 00421 903 902 748, Fax: 00421 52 43 23100, Email: vilora_sk@hotmail.com, vilora@stonline.sk, gaia@iol.sk, Web: www.medicinal-plants-2014-slovakia.com

Nomenclature and Iconography of Common Milkweed

Jules Janick and Winthrop B. Phippen

INTRODUCTION

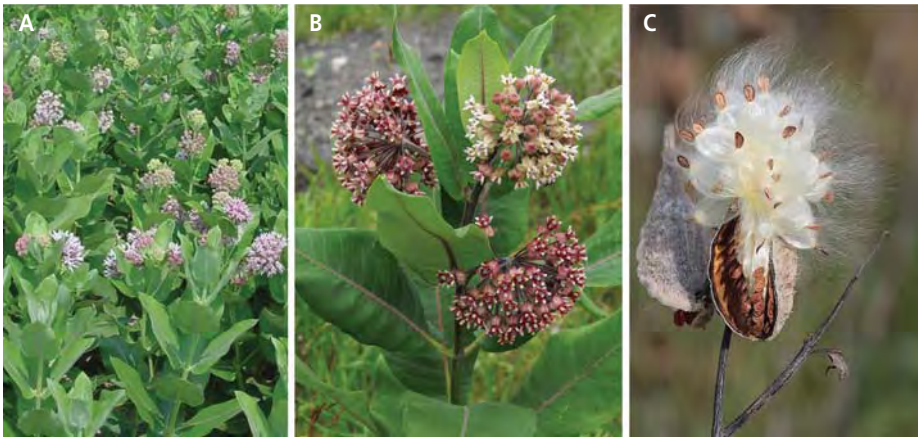
Milkweeds, members of the genus *Asclepias* L., are indigenous to North America. Because of their supposed medicinal properties, Linnaeus (1753) named the genus after *Asklepios*, the Greek God of Medicine and Healing. However, this name was originally used by Pedanius Dioscorides in his *Materia Medica* of 65 CE to refer to plants identified as *Vincetoxicum officinale* Moench, *Apocynaceae* (dogwood family of 130 genera), now generally known as swallowwort, named from the fruit which resembles the forked tail of the swallow; *Vincetoxicum* means "conquers poison." The English translation from Dioscorides by Beck (2005, p.225) is as follows:

III, 92 ἀσκληπιάς [asklepias]

The swallowwort: it sends out small sprays on which the leaves are like those of ivy; it has many slender and fragrant roots, a flower that has a heavy smell, and seed like the axeweed's [*Securigera securidaca* L.]. It grows on mountains.

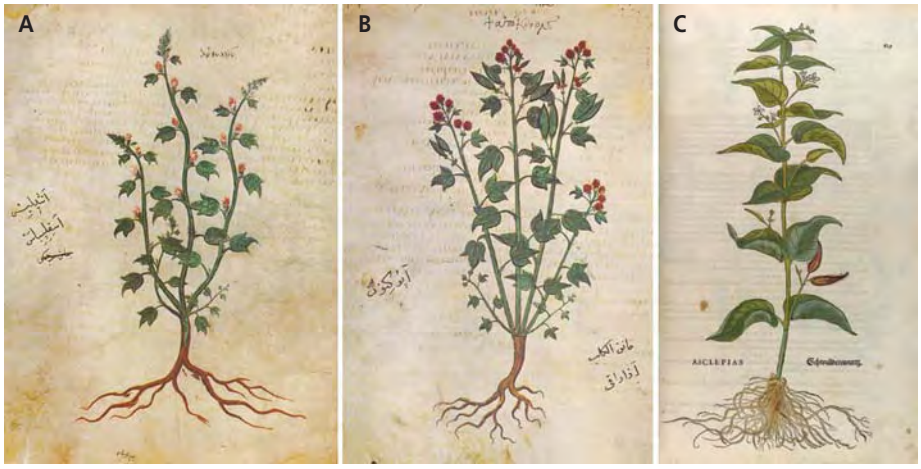
Drunk with wine, the roots help the colicky and those bitten by wild animals, as do also the leaves when plastered on. They are also suitable for breast and uterine malignancies.

Figure 2. Plants (A), inflorescence (B), and follicle filaments attached to the seed of milkweed (C). Source: W.B. Phippen; Nature Manitoba, T. Reaume; Provincial Park, Ontario, Canada.



The *Juliana Anicia Codex* of 512 (Der Wiener Dioskurides, 1998, 1999) illustrating Dioscorides' *Materia Medica* has two illustrations of swallowwort. One (Fig. 1A) was identified as *Asclepias Dioscoridis* by Otto Mazal, the editor of the facsimile, and another (Fig. 1B) titled *Apocynum* (dogbane) as *Cynanchum erectum* L., whose leaves kill dogs, and according to Hortus Third is a synonym of *Vincetoxicum*; the name *Apocynum* literally means "away dog" in Greek. These figures are similar to the *Asclepias* (*Hirundinaria*) of Fuchs (1542) identified as *Vincetoxicum hirundinaria* (Fig. 1C).

Figure 1. Illustrations of *Vincetoxicum* spp.: (A) *Asclepias*, folio 47v, and (B) *Apocynum*, folio 68v, in the *Juliana Anicia Codex* of 512 CE; (C) *Asclepias* from Fuchs' herbal, folio 129, of 1542.



Common milkweed (*Asclepias syriaca* L., syn. *A. cornuti* Decne) is a weedy plant with milky sap and seeds with silky hairs (pappus) whose fragrant flowers are an important nectar source for insects (Fig. 2). The plant is the primary larval food source for the monarch butterfly and is routinely used in butterfly gardens and sometimes incorporated in wild landscapes. The genus previously belonged to *Asclepiadaceae* but is now considered a subfamily *Asclepiadoideae* of the *Apocynaceae* whose species also contain milky juice and seeds with tufts of hair (Endress and Bruyns, 2000). *Asclepias* is known under various common names including: milkweed, silkweed, and butterfly flower. Approximately 200 species are distributed primarily in North America and Africa (Hortus Third, 1976). Carl Linnaeus in *Species Plantarum* (1753) described common milkweed, an American species, as *Asclepias syriaca* due to confusion with an *Apocynum* species from Asia Minor. The seed hairs (floss) from the follicles are hollow and coated with wax, resulting in good insulating qualities. The floss was collected during World War II as a substitute for kapok for "Mae West" life flotation devices. It has minor uses as a hypo-allergenic filling for pillows and was used as a replacement for down in jackets. Although common milkweed exudes copious amounts of white milky latex, it has less than 1.5% natural rubber

content and has had no commercial success for this purpose. The plant is known to contain cardiac glycoside poisons and related species have been used to poison arrows by indigenous peoples of the New World. Gaertner (1980) has suggested that the common milkweed is the great underachiever among economic plants since it has never lived up to its potential.

The confusion between species of *Apocynum, Vincetoxicum*, and *Asclepias* has bedeviled their nomenclature and iconography. Dogbane (*Apocynum cannabinum* L.), a look-alike American species, can be distinguished from milkweed by the branching in the upper portions of the plant and smaller elliptical leaves compared to the elongated elliptical leaves of common milkweed. The leaves ascending the stalk of milkweed are smaller than dogbane (Thayer, 2006). Milkweed stalks are hollow and dogbane stalks are solid. Flowers of dogbane have large sepals and a five-lobed white corolla. The common milkweed inflorescence is a roundish umbel consisting of up to 130 flowers varying in color from pink to purplish to whitish yellow. Dogbane can be mistaken for milkweed when young, but the stems typically branch and are hairless. Swallowwort (*Vincetoxicum* spp.) is a perennial, herbaceous, European plant having fibrous poisonous roots (Bullock, 1958). Leaves are only 7-10 mm long and 5-7 mm wide. Flowers have five petals that are star-shaped ranging in color from white to black. Seed pods are light brown and very slender.

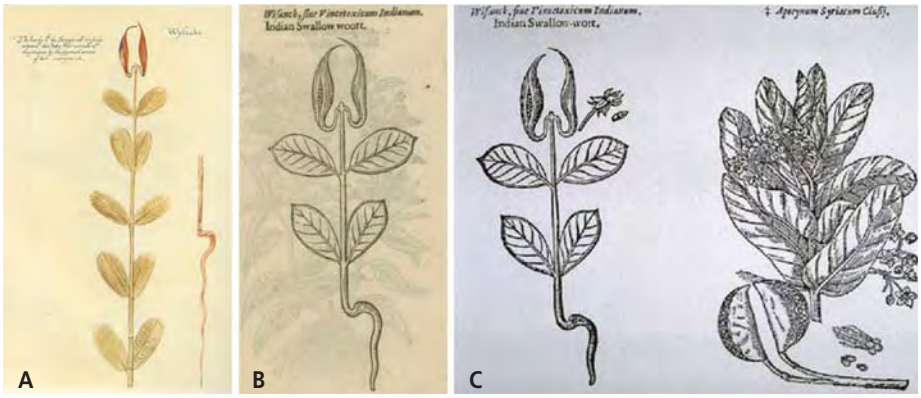
Milkweed has a fascinating history and convoluted nomenclature. The objective of this paper is to retrace the early steps of naming common milkweed and its associated iconography.

THE FIRST ILLUSTRATIONS OF COMMON MILKWEED

The earliest definitive illustration of milkweed is a watercolor painting (Fig. 3A) by John White (1540s-1593) that was a part of a series purchased by Sir Hans Sloane in 1715 from White's heirs and is now known as the Sloane collection of the British Museum (Sloan, 2007). White was an artist and mapmaker who sailed in the 1585 expedition to Roanoke, now North Carolina, in Sir Water Raleigh's attempt to establish an English Colony, which was famously rescued by Sir Francis Drake in June of 1586. White became governor of Roanoke in the second ill-fated voyage of 1587 to reestablish the colony (Lorant, 1946; Sloan, 2007; Janick, 2012). Note that the follicles (pods) in the White painting are smooth and the leaves more closely resemble *Apocynum* than *Asclepias*. The elements from the two species may have been combined (Merrill and Feest, 1975).

During his first voyage to Roanoke, which included a stop in Puerto Rico, John White made a large number of watercolors including maps, flora, fauna, and life among the native inhabitants at Roanoke and surrounding areas. The Indian portraits were immortalized

Figure 3. Early illustrations of milkweed: (A) Painting by John White, ca. 1585. Source: Sloan, 2007; (B) Indian Swallow woort of John Gerard(e) (1597) with woodcut based on painting of John White; (C) Milkweed from the 2nd edition of Gerard(e)'s *Herball* (1633) edited by Thomas Johnson. The illustration on the right is labeled *Apocynum Syriacum* Clusii and can be found in the 1601 edition of *Rariorum Plantarum Historia*, lib. V. lxxxvi. Cap. 1111.



in the etchings of Theodore de Bry and were published in 1590 to illustrate Thomas Hariot's 1588 Report to the investors of the expedition (Lorant, 1946). The watercolor of milkweed, probably painted in 1585 or 1586 is inscribed with White's comments as follows:

> Wysauke, The herbe w[hi]ch the Savages call Wysauke wherewith theie cure their wounds w[hi]ch they receave by the poisoned arroes of their enemyes.

Wysauke (wisakon, wisank) is a generic Algonquin term that means bitter (Merrill and Feest, 1975). The drawing was passed on to John Gerard (1545-1612), the herbalist and barber-surgeon, who had a woodcut prepared for his *Herball* of 1597 (Sloan, 2007). Gerard became a supporter of the Roanoke expedition and obviously knew and respected the talents of John White who is referred to as an "excellent painter who had carried very many people into Virginia" in an entry on "sarza parella." Gerard has a separate entry for swallowwort and identifies two kinds: White Swallow-woort (*Asclepias flore albo*) and Blacke Swallow-woort (*Asclepias flore nigro*) but notes that herbalists call this *Vincetoxicum*. A chapter titled Indian Swallow woort includes a woodcut derived from White's painting of wysauke (Fig. 3B) and includes the first published description of the plant (listed in the Box below; with modern orthography, the letter f changed to s, u to v, and i to j, when appropriate).

In the 1633 edition of Gerard(e)'s *Herball*, editor Thomas Johnson adds a woodcut of what appears to be common milkweed and labels it *Apocynum Syriacum* Clusii (Fig. 3C). His comments that were added to the text of Gerard(e)'s are as follows:

> This Plant, which is kept in some gardens for the name of Virginia Silke Grasse, I take to be the same, or very like the Beidelsar of Alpinus; and the *Apocynum Syriacum* of Clusius: at Padua they call it Esula India, by reason of the hot milky juyce. Bauhinus hath very unfitly named it *Lapathum Aegytiacum lactescens siliqua Asclepiadis*. But he is to be pardoned; for Johannes Carolus Rosenbergus, cap.16.p. 46. of his *Anima.& Excerc. Medica*, or, *Rosanobilis iatrica*, hath taken upon him the credit and invention of this absurd denomination; I may call it absurd, for that neither any way or shape or qualities if resembles or participates anything with a Docke. I have given you the figure of our author with his title, and that of Clusius with his: in the former the cods are only well exprest; in the later the leaves and floures reasonably well, but that they are too few in number, and set too far asunder.....The leaves and stalkes of this plant are very full of a milky juyce.

This added woodcut can be traced to Book V (lxxxvij) of the *Rariorum Plantarum Historia* of 1601 by Clusius (Jules-Charles de L'Ecluse). Clusius (1526-1609) born in Flanders was a botanist and teacher. He visited England and met Sir Francis Drake in 1571, 1579, and 1581 through whom he obtained plants from the New World (Arber, 1938; Willes, 2011). The associated Latin text explains that the plant named *Apocynum Syriacum* facit. by Clusius derives from seed collected by Christopher Weixius from Heiricus (likely Jericho) by the Jordan River in Palestine. This might suggest the species *Calotropis procera* (apple of Sodom) but the two pods drawn resemble milkweed with muriate pods and not the round smooth fruit of apple of Sodom. Clusius exchanged plants with Pieter Garet, an apothecary in Amsterdam who was known to have received plants from Virginia in 1591 (Egmond, 2010, p. 204). Based on these considerations, we conclude that the plant described by Clusius as *Apocyanum Syriacum* must be milkweed from Virginia rather than a dogbane from Jericho.

Gerarde's *Herball* (1597)

Of Indian Swallow woort. Chap. 320

The description.

There growth in that part of Virginia, or Norembega, where our English men dwelled (intending there to erect a Colony) a kind of *Asclepias*, or Swallow woort, which the Savages call Wisanck: there riseth up from a single crooked roote, one upright stalk a foote high, slender, and of a greenish colour: whereupon do grow faire broade leaves sharpe pointed, with many ribs or nervves running through the same, like those of Ribwoort or Plantaine, set together by couples at certain distances. The flowers come foorth at the top of the stalks, which as yet are not observed, by reason the man that brought the seeds and plants hereof did not regard them: after which, there come in place two cods (seldome more) sharpe pointed like those of our Swallow woort, but greater, stuffed full of most pure silke ribbed, are likewise most pure silk; and also the pilling of the stems, even as Flaxe is torne from his stalks. This considered; beholde the justice of God, that as he hath shut up those people and nations in infidelitie and nakedness; so hath he not as yet given them understanding to cover their nakedness, nor matter wherewith to do the same; notwithstanding the earth is covered over with this silke, which daily they tred under their feet, which were sufficient to apparel many kingdomes if they were carefully manured, and cherished.

The place.

It growth, as before is rehearsed, in the counties of Norembega, and now called Virginia by the H. Sir Walter Raleigh, who hath bestowed great summes of monie in the discoverie thereof, where are dwelling at this present English men, if neither untimely death by murdering, or pestilence, corrupt aire, bloodie flixes, or some other mortall sicknes hath not destroyed them.

The time.

It springeth up, flowreth, and flourisheth both winter and sommer, as do many or most of the plants of that countrie.

The names.

The silke is used of the people of Pomeioc, and other of the provinces adjoining —(being parts of Virginia) to cover the secret parts of woman that never tasted man, as in other places they use a white kinde of mosse Wisanck: we have thought *Aseclepias Virginiana*, or *Vincetoxicum Indiaum*, fit and proper names for it: in English Virginia Swallow woort, or the silke woort of Norembega.

The nature and vertues.

We find nothing by report or otherwaies of our own knowledge, of his phisicall vertues, but only report of the abundance of most pure silke, wherewith the whole plant is possessed.

The comments in the 1597 edition of the *Herball* indicate that Gerard did not grow the plant when he described it. Gerard's description probably comes from conversations with John White or, as suggested by Sloan (2007), from dried specimens perhaps brought to Gerard when White returned to London for additional supplies in 1587. This would explain why Gerard makes no mention of the milky latex. In Gerard's *Catalogue* of 1596 where he lists all the plants in his garden, he includes *Apocynum rectum, Apocynum repens*, and *Asclepias* (swallowwort). It seems unlikely that any of these are milkweed. In contrast, Johnson's additional text in the 1633 edition of the *Herball* indicates he was familiar with the plant based on the comments that the plants are very full of "milky juyce." It was this character that was to give milkweed its common name, which was to supersede silkweed or Indian Swallow woort.

No illustrations that could be identified as milkweed were found in herbals of Schoeffer, (1485), Brunfels (1534), Fuchs (1542), Tragus (Bock) (1551), Dodoens (1554), Clusius (1576, 1583), or Camerarius (1588). However, two illustrations that resemble milkweed under different names appear in the works of John Parkinson (1567-1650), the famous English horticulturist and herbalist. In *Paradisi in Sole Paradisus Terrestris* (1629), an illustration entitled *Periploca recta*, Virginian Silke, that closely resembles common milkweed based on flower structure and leaf shape (Fig. 4) is found. On the left side of the illustration, two pods have been added that are a mirror image of White's painting and the two woodcuts of Gerard(e) (1597,1633). The written text indicates that the "long and crooked pointed cods contain flat brownish seede, dispersedly lying with a great deale of fine, soft, and whitish browne silk very like unto the cods, seede and silk of *Asclepias*, or Swallow-wort", although the cods are larger, more crooked and with a harder outer shell. He reports that the seed was received from Virginia and thus gives it the English name Virginia silk. He notes that the whole plant, as well as leaves and stalks, being broken, yields a "pale milke." He provides the name *Periploca* rather than *Asclepias* because Parkinson is of the belief that this plant is not the same as the Indian Swallow woort of Gerard under the mistaken notion that the plant described by Gerard "giveth no milke" (Merrill and Feest, 1975, footnote 9). In the Appendix (p.1679) Parkinson underscores his contention that the *Apocymus syriacum* described by Clusius in 1601 is not from near the river Jordan but is "naturall" to Virginia. Gerard refers to *Periploca* as dogbane and Hortus Third (1976) includes this genus under the *Asclepiadaceae*. *Periploca* flowers and leaf shape are quite different from *Asclepias*.

In Chapter XX (*Apocynum* sive *Periploca*. Dogs bane) of *Theatrum Botanicam, The Theater of Plants* of 1640, Parkinson provides a figure of "The greater and lesser American Dogs bane" (Fig. 5A) that is clearly common milkweed. Parkinson mentions that it comes from our "English plantations in America." In fact, the woodcut is identical to the copper engraving (Fig. 5B) found in the book *Canadensium Plantarum aliarúmque nondum editarum Historia* and entitled *Apocynum Maius Syriac Rectum* of Jacques Philippe Cornuty (1635), a French physician who drew the plants from a garden in Paris. These illustrations can be compared with an accurate painting of milkweed by Kops et al. made in 1868 (Fig. 5C).

HISTORICAL PERSPECTIVE

The first illustrations of milkweed in Europe are associated with a fascinating period in world history that involved attempts by the French and English to gain a foothold in North America as a direct response to Spanish hegemony in the New World. French sailors reached the Americas by 1503 (Harisse, 1892) and Giovanni da Verrazano explored the New World for

Figure 4. *Periploca recta Virginiana*, Virginian silke, from *Paradisi in Sole Paradisus Terrestris* (*The Garden of Pleasant Flowers*) of John Parkinson (1629, p.443) that appears to be common milkweed. Note the addition of mirror images of pods from painting of John White and woodcuts of John Gerard.

Figure 5. The common milkweed image from three sources: (A) *Apocynum rectum latifolium & angustifolium Americanum sive majus & minus*. The greater and lesser American Dogs bane from *Theatrum Botanicum* (1640, p.386) of John Parkinson. Note the addition of two pods on the left and a larger mature pod on the right; (B) *Apocynum Maius Syriac Rectum* from *Canadensium Plantarum aliarúmque nondum editarum Historia…* published in Paris by Jacques Philippe Cornuty (1635); (C) *Asclepias syriaca* L. [as *Asclepias cornuti* Decne.] from Kops et al., 1868.

France seeking a northern route to the Indies in 1532. Jacques Cartier in 1533-1536 and Samuel de Champlain in 1603-1615 established colonies in what is now Canada. The ill-fated expedition of Jean Ribault to Florida in 1564-1565 underscores the struggle between France and Spain for dominance in the New World. It proved a disaster for France but a lasting unexpected cultural byproduct were the fantastic images of the Timucua Indians by Jacques Le Moyne de Morgues, the artist on the 1564 expedition to Florida led by Rene Goulaine de Laudonniere (Harvey, 2008). The contemporary notebooks of Le Moyne were lost after the rout of the French by the Spanish and his escape from Fort Caroline near present day Jacksonville, Florida. His drawings or paintings must have been made from memory after the event; and with the possible exception of one disputed painting, they have also disappeared over time. These illustrations, some of the first European images of indigenous Indian life, were purchased from Le Moyne's widow after his death in 1588 by the engraver Theodore de Bry and published in the famous work *Florida* in 1591. An image of a milkweed plant (Fig. 6) was included in an amazing representation of a gold extraction operation that so tempted the Spanish (Dickenson, 1998).

In 1584, the English made the first exploratory expedition to Virginia, the land north of Florida named for Queen Elizabeth I, the Virgin Queen. This attempt to establish colonies in North America along with government sanctioned piracy against the treasure ships of Phillip II of Spain were the two wings of Elizabeth's policy to gain a continent on the cheap. The French had already made headway into Canada, and the struggle between the English and the French for control of North America would continue for over two centuries. A subsequent 1585 foray into the tiny island of Roanoke in ships commanded by Sir Richard Grenville consisting of a small armed force of about 200 soldiers was the next salvo in the colonial scheme promoted by Sir Walter Raleigh. The leader of the expedition, Ralph Lane, was accompanied by the scientist Thomas Harriot, a Jewish mining engineer named Joachim Gans, and the artist John White whose extraordinary talents, long underappreciated, gave visual expression to Indian life, fauna, and flora. An example of his knowledge can be seen in his painting of a Chief's wife and daughter holding a trade doll supplied by the English (Fig. 7). The girl is unclothed but wears a string girdle holding a milkweed silk pad against her genitals as suggested by Gerard although Thomas Hariot in his 1588 Report of the 1585 expedition to Roanoke indicates that moss was used for this purpose (Sloan, 2007).

Unfortunately, the expedition ended badly. The explorers returned to London in 1586 thanks to the rescue operation of Sir Francis Drake who was returning from his ferocious foray into the Spanish Main, which included attacks on Santo Domingo and Cartagena. White and his paintings reached London in 1586. By a twist of fate, White was a colleague of Jacques Le Moyne and John Gerard who later became a financial supporter of the colony. White's undated painting of milkweed probably made in 1585 or 1586 would end up in a woodcut in John Gerard's famous *Herball* of 1597 destined to be the first published image of milkweed available to the botanical world. Gerard suggested that the plant was related to the well-known swallowwort, called *Asclepias* by Dioscorides, and gave it the common name of Indian Swallow woort. Linnaeus (1753) would choose *Asclepias* for the name of the genus. Gerard mentioned the "savage" name of *Wisanck* (sic) provided by White, a generic Algonquin name for bitter substances, but this appellation did not stick. Gerard proposed the common name Virginia silkweed and was familiar with the name *Vincetoxicum*, a synonym for *Apocynum* (dogbane). He was struck with the silky seed tuffs and commented extensively on this attribute but does not refer to the milky latex, suggesting his description was not made from growing plants in his garden.

Although Gerard died in 1612, his *Herball* continued to be a brisk seller without competition. The publisher, however, became aware that a certain John Parkinson was working on a new herbal and commissioned the apothecary and botanist, Thomas Johnson, to undertake a second edition in 1632 which was published in 1633. This edition became even more famous than the original with all the emendations made by Johnson indicated by symbols. Johnson's additions refer to the milky juice of Indian Swallowtail indicating that he was familiar with the growing plants. He also included a woodcut

Figure 6. Etching of gold extraction by Timucua Indians of Florida by Theodore de Bry based on a drawing by Jacques Le Moyne with milkweed and cattails in the upper left. Source: Lorant, 1946.

of *Apocynum Syriacum* of Clusius published in 1601 which closely resembles milkweed but, according to Clusius, was an *Apocynum* growing near the Jordan River and obtained from a Christopher Weixius. The precise source of the *Apocynum Syriacum* woodcut of Clusius remains a mystery, but we are convinced it was milkweed based on the image, especially the pods and flower structure. It could have been grown in a Paris garden from sources in Virginia for it is known that Pieter Garet of Amsterdam did exchange plants from Virginia with Clusius in 1591 (Egmond, 2010). A catalogue of the Kings Garden in Paris (Robin, 1601) contains *Apocynum repens* and *Apocynum rectum* and perhaps the latter is the origin of the plant identified as *Apocynum Syriacum* by Clusius and *Apocynum Maius Syriac Rectum* from Cornuty. Linnaeus later listed *Apocynum syriacum* as a synonym for *Asclepius syriacum*.

Figure 7. Chief's wife and her daughter by John White, 1585. Pad surrounding genitals of daughter may be milkweed silk or moss. Source: Sloan, 2007.

Milkweed clearly was grown in English gardens prior to 1633 and probably distributed from Gerard's garden or from other reintroductions from Virginia. John Parkinson provides two illustrations. The first in 1629 (*The Garden of Pleasant Flowers*) indicates that he was familiar with John Gerard's 1597 *Herball* since he includes part of the pods based on White's original paintings. The second illustration was clearly copied from the copper engravings of Jacques Philippe Cornuty's 1635 work on Canadian plants. These were made in Paris from plants imported from Canada. We know milkweed grew there since a picture of milkweed is found on a 1613 map made from sketches of Champlain (Fig. 8). In 1744, a plant of milkweed was engraved by Pierre Francois Xavier de Charlevoix from Cornuty's sketches and labeled *Petit Apocynum du Canada* (Fig. 9).

The name milkweed first appears in English in 1814 when naturalist Jacob Bigelow (1787-1870) wrote that *Asclepias syriaca* was called common silk weed or milk weed. Asa Gray (1810-1888) was the first to refer to *Asclepiadaceae* as the Milkweed Family. The

Figure 8. Inset of a 1613 map of New France drawn by David Pelletier from sketches of Samuel de Champlain showing milkweed between two Native people. Source: Dickenson, 1998.

Figure 9. Milkweed labeled *Petit Apocynum du Canada* by Pierre Francois Xavier de Charlevoix (1744) from *Histoire et description générale de la Nouvelle France* engraved from Cornuty (1635). Source: Dickenson, 1998.

nomenclatural and iconographic history of milkweed is one example of the early convoluted response of botanical and horticultural science to the introduction of New World plants.

SUMMARY

Common milkweed (*Asclepias syriacus* L.), a species indigenous to North America, has a convoluted iconographic and nomenclatural history due to confusion with *Apocynum* (dogbane)

and *Vincetoxicum* (swallowwort). Casual images of milkweed can be found in an engraving by Theodore De Bry in *Florida* (1591, Plate LVI) based on a lost drawing or painting of Jacques Le Moyne de Morgues based on his sojourn in Florida between 1564 and 1565. A crude drawing of milkweed appears in a 1613 map inset of New France (Canada) based on sketches of Samuel de Champlain. The first definitive common milkweed illustration is a water color painting by John White who refers to it by an Algonquin name *Wysauke*. The painting accurately shows a single tap root and two terminal pods but the small opposite rounded leaves are atypical indicating artistic license. The White drawing was incorporated into a woodcut in the 1597 *Herball* of John Gerard(e) published in London under the name Indian Swallow woort with a lengthy description emphasizing the silky seeds without mention of the milky juice. The woodcut was duplicated in the 1633 edition of the *Herball* edited by Thomas Johnson and paired with a woodcut of milkweed by Clusius first published in 1601 in *Rariorum Plantarum Historia* under the name *Apocynum Syricacum*. In 1635, Jacques Phillippe Cornuty engraved milkweed from plants growing in Paris under the name *Apocynum Maius Syrika Rectum*. There are two woodcuts of milkweed in works by John Parkinson. The first from *Paradisus Terrestris* (1629) is labeled *Periploca recta*, Virginian silke; and the second from *Theatrum Botnicum* (1640) is labeled *Apocynum rectum latifolium & angustifolium Americanum sive majus & minus* and is a remaking of the engraving of Cornuty (1635).

CONCLUSION

An examination of iconography is necessary to clarify plant taxonomy and nomenclature. In the late 1500s, French and English explorers illustrated milkweed found in North America, a plant well known to indigenous populations. English and European herbalists mislabeled this plant and misrepresented its taxonomy. A study of the descriptive literature and imagery enabled us to better understand the horticultural and botanical issues involved in the great Columbian exchange of plant species after the European encounter with America.

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Section Medicinal and Aromatic Plants

Third Int'l Symposium on Medicinal and Nutraceutical Plants

Opening ceremony. From left to right: Marcos Wandir Nery Lobão (President of Sergipetec), Dr. Edson Eduardo Melo Passo (Head of Embrapa-Tabuleiros), Prof. Dr. Franco Maria Lajolo (USP), Prof. Dr. Narendra Narain (Symposium Convener), Dr. Ricardo Alves Elesbão (ISHS representative), Prof. Dr. V. Prakash (President, International Society of Nutraceuticals and Nutritionals).

The 3rd International Symposium on Medicinal and Nutraceutical Plants (3-ISMNP) along with the 3rd Conference of the National Institute of Science & Technology (INCT) for Tropical Fruits were held from 14-19th September, 2012 at the Convention Center of the State of Sergipe in Aracaju city, Brazil. The symposium was organized by ISHS along with the Federal University of Sergipe and INCT for Tropical Fruits/CNPq, Brazil and chaired by Prof. Dr. Narendra Narain, Program Coordinator for Post-Graduate Course in Food Science & Technology. The event was attended by more than 370 participants and speakers from more than 16 countries. During the conference participants had the opportunity to exchange their views and to explore possibilities of future interdisciplinary collaboration.

The plenary lectures were delivered in the opening ceremony on 14th September by two distinguished scientists. Prof. Dr. Franco Maria Lajolo of the University of São Paulo talked about "Functional Foods: Scientific Basis, Challenges and Perspectives". Some of the nutraceutical compounds obtained from different Brazilian plants were the focus of his lecture. This was followed by a presentation by Prof. Dr. Vishweshwaraiah Prakash, distinguished scientist, CSIR-India and President of the International Society of Nutraceuticals and Nutritionals (ISNAN). His topic of presentation was "The Role of Nutraceuticals in Innovating New Functional Foods and Medicinal Products: India's Case Studies of Ayurceuticals". Some of the major plants grown in India, especially those traditionally used as remedies for various diseases, were part of his presentation. The Ayurvedic importance in medicinal plants and the status of advanced research in this area were also detailed in his lecture.

The symposium was attended by scientists/groups from modern medicine, Ayurveda and other systems of medicine, and by analytical chemists from all over the world. The bottle-

Dr. Ricardo Elesbão Alves (left) presenting the ISHS certificate and medal to Dr. Narendra Narain (right).

Participants during a lecture.

necks in analytical methodology and characterization of functional compounds were also discussed in various lectures offered over the course of the symposium. For the participants, it was a great opportunity to bring about an integrated approach to highlight the role of medicinal and nutraceutical plants in modern day medicine. During the initial three days of the symposium, different aspects such as the growing of medicinal and nutraceutical plants, methodologies for extraction of chemical constituents, investigation of medicinal properties in experimental models, and use of medicinal and nutraceutical plants in modern medicine were presented.

During the symposium, participants presented research papers and discussed topics ranging from cultivation conditions to improve quality and yield of nutraceutical and medicinal plants, genetic modifications to improve chemical constituents, extraction methodologies, in vitro assessment of antimicrobial and other functional properties, animal model experiments to investigate clinically important topics such as diabetes, antioxidants, anti-cataract properties, immunology and clinical trial results of patients and healthy individuals. Some of the prominent lectures were by Dr. Rudolf Bauer from Austria on "Phytochemical and Pharmacological Investigation of the Active Ingredients of Medicinal Plants with Anti-Inflammatory and Immunomodulatory Activities" and on "Towards a Holistic Approach in the Analysis of Medicinal Plants"; by Dr. Nirmal Joshee from USA on "Ethnobotany of the Genus *Scutellaria*"; by Dr. Elena Stashenko from Colombia on "Chromatographic Analysis (GC, GCxGC, GC-MS, GC-MS-MS) and Antioxidant Activity of Essential Oils and SFE Extracts of *Verbenaceae* Aromatic Plants"; and by Dr. Judith Maria Rollinger from Austria on "The Antiviral Activity of Higher Medicinal Plants". The health aspects of food rich in antioxidants were discussed by Dr. Kalidas Shetty from USA. Most of the lectures generated enthusiastic response from the participants and there was excellent interaction between them. There was also discussion on the potential of tropical fruits, new products, quality evaluation, and development of products for export purposes. The work developed by the team of the Federal University of Sergipe, the Federal University of Ceará and Embrapa Tropical Agroindustry of the project of INCT of Tropical Fruits was presented along with the new products developed. Thus overall the symposium was a great success.

Narendra Narain

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HORTICULTURE DOWN UNDER

A number of *Chronica horticulturae* articles that feature Australian, New Zealand and Pacific Island horticulture and horticultural science may be found on the Media Centre homepage (**http://www.ihc2014.org/media_and_news.html**) on the IHC2014 website (**http://www.ihc2014.org/**) which includes information on a diversity of foods and lifestyle services across Oceania. If you are interested in reading on the different fruits and vegetables of Australia, New Zealand or the Pacific Islands or the more specific commodities like ginger, the macadamian nut, the pineapple, pyrethrum or turfgrass, then it's all available from the Media Centre. Poster material may also be downloaded from **http://www.ihc2014.org/publications.html**

Fourth Int'l Symposium on Saffron Biology and Technology

His Excellency Governor of J&K State releases Souvenir and Book of Abstracts at the inaugural function.

Saffron is the world's most valuable culinary spice, produced from the careful separation and drying of the stigmas of the flowers of *Crocus sativus*. It is grown mainly in Iran, India, Afghanistan, Spain, Greece and Italy, though promotion programmes are being carried out in many other countries including Morocco, China, New Zealand and France. Research in the fields of biology, chemistry, pharmacology and advances in production technologies and trade have accumulated over the years. In this context, the ISHS has been endeavouring to provide a platform for professional interaction of the various collaborators, so that the countries involved in production of this high value crop continue to share significant profits and key factors influencing production and consumption. This is particularly important in the developing world where saffron cultivation could help to reduce rural poverty.

In continuation of the effort to address the issues of saffron farming and trade, the Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir came forward and organized the 4th International Symposium on Saffron Biology and Technology, "Advances in Saffron Biology, Technology and Trade" on 22-25 October 2012 at Sher-e-Kashmir International Convention Centre, Cheshmashahi, Srinagar, India. The symposium was conducted under the aegis of the ISHS and was a follow-up of the first three symposia held in Spain (2003), Iran (2006) and Greece (2009). The symposium was organised under the patronage of the following dignitaries: Jenab Ghulam Hassan Mir (Hon'ble Minister for Agriculture, J&K State), Jenab Javeed Ahmad Dar (Hon'ble Minister of State for Agriculture, Horticulture and Floriculture, J&K State), Shri Madhav Lal (Ex-Chief Secretary, J&K State), Shri Ashish Bahugun (Secretary Agriculture & Cooperation, Ministry of Agriculture, Govt. of India), Prof. Tej Partap (Hon'ble Vice Chancellor SKUAST-Kashmir), Shri Anup Kumar Thakur (Additional Secretary Agriculture & Cooperation, Ministry of Agriculture, Govt. of India), Shri Shaleen Kabra (Commissioner/Secretary Agriculture Production Department, J&K State), Prof Shafiq A. Wani (Director Research SKUAST-Kashmir), Dr. Farooq Ahamd Lone (Director Agriculture Kashmir), and Prof. F.A. Nehvi (Professor SKUAST-Kashmir, Organising Secretary).

About 140 delegates from Spain, France, Azerbaijan, Iran, Afghanistan and India participated in the symposium that was inaugurated by Shri N.N. Vohra, His Excellency the Governor, J&K State. Jenab Ghulam Hasan Mir, Hon'ble Minister for Agriculture, J&K State, Jenab Javed Ahmad Dar, Hon'ble Minister of

Hon'ble Vice-Chancellor releases Book on Saffron at the valedictory function.

Awardees of the 4th International Symposium on Saffron Biology and Technology.

Delegates in saffron fields (A) and in saffron processing unit (B), Kashmir, India.

State for Agriculture/Horticulture, J&K State, Dr. Tej Pratap, Hon'ble Vice Chancellor SKUAST-Kashmir, Shri Sanjeev Chopra Jt, Secretary and Mission Director (NSM), Ministry of Agriculture, Govt. of India, Shri Shaleen Kabra, Principle Secretary Agriculture Production Department, J&K, and ISHS representative Dr. Manuel Carmona were also on stage for the inauguration. The importance of the Saffron Symposium to the Kashmir saffron industry was highlighted. Symposium medals were presented by the ISHS representative to SKUAST-Kashmir for successfully conducting the symposium.

The symposium was organised into five technical sessions in which 32 oral and 43 poster papers were presented. Sessions I and II on Evolution and Diversity of Saffron and its Allies and on Advances in Biology and Biotechnology of Saffron were conducted under the chairmanship of Prof. Yusif M. Aghayev, Genetic Resources Institute, Baku, Azerbaijan. Prof. Shafiq A. Wani, Director Research SKUAST-Kashmir, co-chaired the session and 10 papers were presented on genetic improvement and resource management, in vitro micropropogation, molecular and genetic diversity, and apocarotenoids and their genes in saffron.

Session III on Opportunities and Innovations for Harnessing Saffron Productivity and Profitability was conducted by Prof. G.H. Zargar, Ex Director Research SKUAST-Kashmir, and co-chaired by Dr. Nazir Ahmad, Director Central Institute Temperate Horticulture, Srinagar. Fourteen papers were presented on disease and pest management, integrated disease management, postharvest technologies of saffron, engineering aspects related to farm power machinery and tools and the role of the National Saffron Mission in reviving saffron cultivation in Jammu and Kashmir.

Session IV on Future Challenges for Growth of the Saffron Industry was conducted by Prof. Afifa S. Kamili, Director Extension SKUAST-Kashmir. Prof. F.A. Zaki, Registrar SKUAST-Kashmir, co-chaired the session. Deliberations by various researchers were presented on the response of saffron to pollutants, phytochemical and pharmacological attributes of saffron by-products, commercialization of saffron in non-traditional areas, the role of saffron cultivation in women empowerment, and the historic perspective of saffron. Dr. Kohaf Khan, Director GIAHS, FAO, Rome, congratulated the organizers for their initiative and thanked SKUAST-Kashmir and the organising secretary Prof. Nehvi, whose role has been critical in getting the Kashmir saffron site recognised by GIAHS Rome.

Dr. S. Zahra Bathaie Tarbiat Modares, University Tehran, Iran, and Dr. Manuel Carmona and Dr. Amaya Zalacain Aramburu, UCLM, Spain, conducted Session V on Advances in Medicinal and Industrial Application of Saffron. Deliberations reflected the importance of saffron as functional food, analytical procedures to detect saffron frauds and contaminants and ISO standards for quality assurance.

During the technical tour delegates visited the saffron villages of Pampore, the Saffron Research Station SKUAST-Kashmir and two Agro Processing industries: Kashmir kessar Mart Srinagar and Souvenir Brand Saffron Wuyan Pampore. Delegates interacted with saffron farmers to learn how saffron is grown in Kashmir.

Prof. Yusif M. Aghayev, Genetic Resources Institute, Baku, Azerbaijan, Dr. S. Zahra Bathaie Tarbiat Modares, University Tehran, Iran, Dr. Manuel Carmona, UCLM, Spain, Dr. Amaya Zalacain Aramburu, UCLM, Spain, and Dr. Gull Zaffer, SKUAST-Kashmir, identified eight best oral and poster awards for the different technical sessions and the scientists were congratulated by Hon'ble Vice-Chancellor SKUAST-Kashmir with a memento and a merit certificate during the plenary session. The awardees were Mrs. Salwee Yasmin from SKUAST-Kashmir (best oral presentation Theme-2), Mr. Javeed Ahmad from the University of Kashmir (best poster presentation Theme-2), Dr. Joyti Wakhloo from the University of Jammu (best oral presentation Theme-3), Dr. Gowhar Ali from SKUAST-Kashmir (best poster presentation Theme-3), Mr. Mudasir A. Mir from the Sharmila Institute of Medicinal Products and Research, Tamil Nadu (best oral presentation Theme-5), Dr. Baseerat Afroza from SKUAST-Kashmir (best poster presentation Theme-4), Ms. A. Mancini from the University of L'Aquila (best poster presentation Theme-5), and Ms M. Karami, Tehran, Iran (best poster presentation Theme-5).

Seventeen universities, organizations, institutes and ministries including Genetic Resources Institute, Baku, Azerbaijan, Firdowsi University, Mashad, Tarbiat Modares University, Tehran, University of Castilla La Mancha, Spain, Ministry of Agriculture and Livestock, Afghanistan, Anand Agriculture University, Ananad, NBPGR, New Delhi, Himalayan Bio-Resources Institute, Palampur, SKUAST-Kashmir, SKUAST-Jammu, University of Kashmir, University of Jammu, National Horticulture Board Gurgaon Haryana, Central Institute of Temperate Horticulture Srinagar, Directorate of Agriculture Kashmir, Directorate of Agriculture Jammu, HEADS on behalf of FAO Rome were recognized for their contribution to saffron science.

We thankfully acknowledge our sponsors for their financial support in conducting this successful event. Our sponsors included National Horticulture Boards, Govt. of India, Ministry of Agriculture, Govt. of India, Jain Irrigation System Jalgaon, J&K Bank, Haneef Motors, Khyber Agro Products, Souvenir Brand Saffron, BCS Power Weeder Kashmnir Kesar Mart.

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Int'l Symposium on Medicinal Plants and Natural Products

Participants of the symposium.

The International Symposium on Medicinal Plants and Natural Products was held on 3-6 December 2012 in Quito, Ecuador under the aegis of ISHS. This was the second in the series of symposia organized in Latin America and served to promote advances in knowledge about native plants of Ecuador and innovative modern research in horticulture, ethnobotany and phytochemistry. Expert scientists from various regions of the world, including Guatemala, Colombia, Peru, Mexico, Canada, the US, Germany, Denmark, Israel and Saudi Arabia, gathered at this event to present and to plan their research advances. The main partnerships for this event were made between participants from Europe, Asia, the Italo-Latin American Society of Ethnomedicine (SILAE) and researchers from many national universities of Ecuador.

The organizers appreciate the contribution and productive efforts of students from Guatemala and Ecuador. They organized all logistics for the symposium and contributed a great deal to the realization of an exciting event at one of the well-known universities in Ecuador, Pontificia Universidad Catolica del Ecuador (PUCE).

After registration, participants visited the Botanical Garden of Quito to hear about projects at the facilities during a 2-hour tour. They received information about various species of orchids, cacti, and many other regional plants representative of the three main climates in Ecuador. The importance of ethnobotany, regional collaborations and joint research with universities from the United States were among the topics discussed. The Chairs of the Scientific Committee, Armando Cáceres and Rocío Alarcón, were introduced to the audience. This session ended after announcing a new partnership between the Medicinal Plant and Natural Products Working Group (MPNP) of the ISHS and the newly formed Society of Ethnobiology in Ecuador. This society will receive support from MPNP and is invited to participate as a partner in future events to be scheduled by ISHS and MPNP.

Round-table conversation about ISHS activities led by Dr. Ghaemghami and his team to review future collaboration opportunities with public health experts, to expand networking and create a multidisciplinary team. Professors Caceres, Hierich, Craker and Dudai shared their remarks and support of the ISHS MPNP Working Group symposia in Guatemala, Ecuador, Peru and Colombia.

The opening ceremony was scheduled during the afternoon at PUCE, where invited guests and delegates provided opening remarks. These guests were from the national government of Ecuador, including representatives from the office of support for scientific exploration (Senescyt) and the Ministry of Natural Resources and Environment, leading organizations like ECOLEX, Ecofondo, US AID, the host academic institution, and the Salesiana University. Prof. Dr. Hugo Navarrete of the host university opened the session and provided welcoming remarks to all participants. Prof. Navarrete briefly described research activities at the PUCE and invited Dr. Jalal Ghaemghami to review the goals of the symposium. Dr. Lyle Craker represented ISHS, provided information about the Society, and welcomed the audience to the meeting on behalf of Prof. Akos Máthé, Chair of the ISHS Section on Medicinal and Aromatic Plants. The last welcoming speech was delivered by Dr. Rocio Alarcón who was acknowledged by the ISHS representative as Co-Convener of the event. In her remarks, she emphasized the importance of collaborative work between Ecuadorians and other nations with respect to traditional knowledge on medicinal plants and their use. She also noted the importance of gaining information and advancing in research on plant species while assuring commitment to sustainable practices. Dr. Alarcón presented Forestry Engineer Walter Palacios with a national acknowledgement for his contribution to science and natural resource management; she appreciated his superb knowledge of plant species in Ecuadorian jungles and forests and thanked him for his kind contribution to the symposium. Dr. Palacios provided five copies of his book, *Arboles del Ecuador* (Trees from Ecuador), that was recently published as an encyclopedia of plant species in Ecuador, and includes the ecology and management of the natural sources of Ecuador and a review of the most relevant species in the Amazonian region, amongst others Tagua (*Phytelephas* sp.), Ungurahua (*Oenocarpus bataua*), and vegetable ivory palm (*Phytelephas aequiatorialis*). Participants applauded Dr. Palacios for his contribution to advancing scientific knowledge while maintaining a caring practice in the environment. Dr. Manolo Morales, Executive Director of Ecolex, one of the main sponsors of the event, provided information about their organizational goals advocating for sustainable, ethical and cultural standards of scientific research on natural resources. Over one hundred individuals were at the opening ceremony, which was an increase of two or three times over the last symposium in Antigua, Guatemala. This indicated the growing interest of the

Lyle Craker giving a workshop on how to write scientific manuscripts.

L. Rastrelli from SILAE, A. Caceres from Universidad de San Carlos de Guatemala, S. Caceres from Laboratorios de Productos Naturales Farmaya, S. Abdo from Escuela Superior Politécnica de Chimborazo del Ecuador and Yann-Olivier Hay from Farmaverde of Colombia.

scientific community in the natural products and medicinal plants of Latin America.

After the opening ceremony, lectures on the extraction and preservation methods of herbs and approaches to medicine were presented by Prof. Dr. Luca Rastrelli of the SILAE. A presentation on the chemical composition and bioactivity of five essential oils from the Ecuadorian Amazonian forest was delivered by the Dean of the University of Salesiana, Dr. Paco Fernando Noriega Rivera. On the same day, the ISHS Working Group MPNP and SILAE held their business meetings and agreed on future collaboration in organizing events in Latin America.

On Tuesday morning, the symposium focused primarily on phytochemistry, pharmacology and ethnobotany. Prof. Dr. Michael Heinrich offered the ELSEVIER Author Workshop, which was very rewarding for those who aim to publish scientist manuscripts.

Nativ Dudai from the Newe Ya'ar Research Center, Agricultural Research Organization, Israel, conducted the plenary session on Tuesday, talking about domestication and conventional breeding of medicinal and aromatic plants. He emphasized plant breeding that, according to Dudai, is the art and science of changing the genetics of plants in order to produce desired characteristics. He also discussed acclimation of new crops, breeding plants for several purposes, studying the physiology and chemistry of MAP as well as the development of agro-technical methods and new uses.

Laura Scalvenzi from Italy who works for the State University Amazonica, Puyo, Ecuador, presented a very interesting talk about the new frontiers of essential oils research, the biotransformation of the phytocomplex and its pure compounds by endophytic fungi. The main goal of Scalvenzi's research is to biotransform the essential oil of *Piper aduncum* tissue, which is a tropical plant used in traditional medicine by natives because of its antiseptic, insecticidal and antibiotic properties, by endophyte isolation in vitro of endophytic fungi.

The Ecuadorian scientist Natalia Bailón shared his research results and advances in the cytotoxic, cytostatic and genotoxic effects of Argentatie B derivatives. This gave the audience a new understanding of Argentatine B, which is a triterpene isolated from the resin of *Parthenium argentatum* that can inhibit normal cellular development.

On Tuesday afternoon two workshops were conducted simultaneously. The one given by Lyle L. Craker focused on students and professionals who want to start writing scientific manuscripts. The Colombian Yann-Oliver Hay in company with Sebastian Caceres from Guatemala led the second workshop entitled "The International Market for Natural Products – Risks and Opportunities for Latin America", addressing how individuals may explore the marketing of natural products and meet the challenges of natural products' security and safety.

On the last day of the symposium Susana Abdo, from the Polytechnic Superior School of Chimborazo, Ecuador, and Tatiana Mosquera, from the Salesiana University, led the plenary session on the applications of natural cosmetic products, informing the audience about the importance of phytocosmetics, how functional they are and the wide variety of natural, active ingredients that exist. They also discussed the manufacturing of phytocosmetics as the basis for the development of cosmeceutical research in Ecuador. At a business meeting with Dr. Ghaemghami, the group initiated a new working area for scientists from various disciplines including phytocosmetics and natural products.

Heinrik Balslev, a recognized scientist who studies Amazonian palms for medicinal products, gave the fourth workshop. Maria Burbano from the National Herbarium Father Luis Sodiro (QPLS) concluded the day by talking about the valuable historical collection of botanical specimens that includes more than 200 types.

Dr. Ghaemghami moderated a round-table discussion at the closing ceremony where Professors Cáceres, Craker, Dudai and Heinrich discussed the importance of interdisciplinary research in medicinal plants and natural resources and future collaborations with experts in public health. Participants in this round-table discussion agreed on the importance of active students participation in symposia and other scientific events. The next symposium was also considered and the announcement of the symposium in Peru during 2013 was shared with the audience. The final outcome of this event includes the publication of the manuscripts in the symposium proceedings as a special volume of *Acta Horticulturae* in 2013, formulating and developing new scientific collaborations with members of SILAE and other international partners, and advancing knowledge of sustainable practices in science and industry.

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Seventh Int'l Symposium on Olive Growing

Participants of the symposium.

As proposed by INTA, San Juan province in Argentina had the support of foreign olive associations to be the venue of the VIIth International Symposium on Olive Growing on 25-29 September 2012. Local specialists and researchers from 22 countries around the world presented their latest advances related to olive growing and the olive industry.

For the first time, Argentina was the venue of the most important international scientific olive meeting. It meant commitment to good organization and the even greater responsibility to capitalize on the substantial contributions of knowledge fostered by the symposium. The active participation of more than 300 attendees proved that there is real interest to make good use of such knowledge.

The 5-day symposium was the result of nearly four years of intense collaboration between INTA (Instituto Nacional de Tecnología Agropecuaria) – the institution that proposed Argentina as a possible venue – and the Universidad Nacional de San Juan, the Universidad Católica de Cuyo, CRILAR-CONICET and AACREA with the aim of promoting links between researchers, students and growers, as well as encouraging the development of cooperative research projects in the future.

Organizing Committee.

Taking into account the full programme, the opening of the symposium was short and to the point. There, the Minister of Production of San Juan province, Marcelo Alós; the delegate of the International Society for Horticultural Science (ISHS), Juan Caballero Rey; the Director of the Regional Center Mendoza-San Juan (INTA), Carlos Parera; and the main convener of the event, Facundo Vita Serman, highlighted the principal topics that were going to be discussed as well as the productive activities of San Juan.

OLIVE, A PERMANENT MATTER OF STUDY

The VIIth International Symposium on Olive Growing offered a diversified array of scientific contributions. Lectures, panel discussions and academic posters motivated the debate about germplasm, genomics, genetic improvement and propagation; biology and physiology; orchard design and management; olives and oil technology and quality; and also economy, marketing and health-promoting properties.

Recent research on the reproductive physiology of olive and its relationship to extreme environmental conditions was presented by Hava F. Rapoport from the Institute of Sustainable Agriculture, CSIC, Córdoba, Spain. "Environmental limitations related to water availability and extreme temperatures may critically impact at different moments during the process of inflorescence differentiation, particularly in new areas of olive farming which vary from the strict Mediterranean climate, where the olive tree originated and to which it is adapted", remarked the specialist. Rapoport also illustrated with specific cases "the effect

Drs. Barjol, Hamdam, El-Kholy, Caballero and Vita Serman presenting *Scripta Horticulturae* 13 - Following Olive Footprints (*Olea europaea* L.) - Cultivation and Culture, Folklore and History, Tradition and Uses.

ISHS representative Dr. Juan Caballero (right) presenting the ISHS medal award to Symposium Conveners Ing. Agr. Facundo Vita Serman (center) and Dr. Carlos Alberto Parera (left).

of water deficits on inflorescence development, frost damage to floral buds, cold accumulation requirements for bud break, and high temperature effects on inflorescence development and fertilization."

Turning to production issues, Leandro Ravetti from Modern Olives-Boundary Bend Limited and Australian Olive Association spoke about technology for improving the efficiency of mechanical harvesting in modern olive growing. Considering that "harvesting efficiency is defined as the ratio between the fruit that is effectively harvested and the fruit that was originally on the trees, many aspects need to be considered simultaneously while deciding when to harvest the fruit", said the lecturer. "The moment at which the olives have the maximum amount of oil of the highest quality varies according to environmental conditions, variety characteristics and amount of fruit per tree. There are several aspects of grove design that should be considered prior to planting, or afterwards if possible, in order to improve the overall harvesting efficiency in an olive grove." Speaking about olive growing management practices, Ravetti affirms "the main goal of pruning is to improve canopy efficiency. The objectives of pruning trees in full production are to: produce high yields of high quality, stimulate vegetative growth of fruiting shoots, maintain an adequate tree structure, prevent ageing of the canopy, eliminate dead wood, and improve air circulation and light penetration. Pruning should be also aimed at maintaining the canopy within a size compatible with economical management of the grove. Certain fruit loosening agents, when applied at correct rates, times and conditions, can show a positive effect on decreasing the fruit retention force and on increasing harvest efficiency. The continuous control on the work performed by the harvesters is also extremely important in order to improve and/or to maintain acceptable efficiency levels."

Technical tour to Olivares del Acequion farm. Analyzing the soil.

ARGENTINA TO THE WORLD

Hosting this international symposium was of the greatest importance for Argentina, and especially to San Juan province, as it was chosen by the ISHS to show to the world a modern olive industry outside the traditional Mediterranean area. It's worth mentioning that the choice of Argentina as a venue was supported by the olive associations of the southern hemisphere nations (Australia, New Zealand, South Africa, Uruguay, Chile and Argentina). For this reason, it was a challenge for the symposium organizers to introduce to the world the advances in olive growing in a non-traditional region, and particularly to present the roadmap proposed by Argentina to promote this culture.

Santiago Centeno and Facundo Vita Serman

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First Int'l Symposium on Jackfruit and Other *Moraceae*

Participants of the symposium. Sitting from left to right: Mr. Anwar Faruque (DG Seed wing, MOA, Govt. of BD), Dr. Md. Rafiqul Hoque (VC of BAU), Dr. M.A. Rahim (Symposium Convener), Dr. Sisir K. Mitra (representative of ISHS); Dr. Masum Ahmad (Symposium Secretary) standing 4th from right.

The First International Symposium on Jackfruit and Other *Moraceae* was held at the Bangladesh Agricultural University, Mymensingh, Bangladesh from 18-20 November 2012. Jackfruit being the national fruit of Bangladesh, the symposium attracted many researchers from this country, but was also attended by participants from India, Malaysia and Vietnam. The symposium was organized by the Bangladesh Agricultural University (BAU) in collaboration with the International Society for Horticultural Science (ISHS), the International Tropical Fruits Network (TFNet), the Fruit Science Society of Bangladesh (FSSB), the Seed Science Society of Bangladesh (SSSB), the Ministry of Agriculture (MOA), the Bangladesh Government and Hamdard Laboratories.

The opening ceremony was chaired by Prof. Dr. M.A. Rahim, Director BAU GermPlasm Centre. Prof. Dr. Masum Ahmed, Secretary of the Organizing Committee, welcomed the participants. Prof. Dr. Rafiqul Hoque, Vice-Chancellor, BAU, and Mr. Yacob Ahmed, CEO TFNet, addressed the participants. Prof. Dr. Sisir Mitra, Chair, Section Tropical and Subtropical Fruits, and Working Group Chair, Jackfruit and Other *Moraceae*, ISHS, welcomed the delegates and presented the activities of ISHS in developing horticultural sciences worldwide.

While the attendance was lower than expected, there was a broad range of presentations covering the topics of genetics, breeding, germplasm evaluation, pest and disease management, orchard management, postharvest handling and processing. The scientific highlights of the meeting were the keynote lectures by Prof. Dr. M.A. Haque on 'Jackfruit research in Bangladesh'; by Prof. Dr. Sisir Mitra on 'Genetic diversity of jackfruit – an overview' and by Prof. Dr. M.A. Rahim on 'Jackfruit – Bangladesh perspectives'.

After the sessions, the participants went on a field trip to the GermPlasm Centre of the Bangladesh Agricultural University. Participants were offered a wonderful gala banquet to close the event. The Working Group members decided that the symposium should be held every three years and India may be considered as the next venue by the ISHS.

Sisir K. Mitra and Masum Ahmad

Participants visiting Botanical Garden.

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Section Tropical and Subtropical Fruits

Fourth Int'l Symposium on Lychee, Longan and Other *Sapindaceae* Fruits

Symposium participants at the conference venue.

The 4th International Symposium on Lychee, Longan and Other *Sapindacae* Fruits was held in White River, South Africa, from 2-6 December 2012. The symposium was jointly organized by the South African Litchi Growers' Association (SALGA) and the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC) under the auspices of ISHS. The Mpumalanga Department of Agriculture, Rural Development and Land Administration (DARDLA) is thanked for their great financial support of the symposium. The symposium was attended by 150 delegates from South Africa, China, Thailand, India, Israel, Australia, Mexico, Chile, Brazil, Egypt, Germany and New Zealand. Four keynote presentations, 40 oral and 40 poster presentations were delivered. Presentations and poster viewing were spread over 4 days, interspersed with a mid-symposium technical tour.

At the opening ceremony Mr. Gavin Hardy, Chairman of SALGA, Mr. Derek Donkin, Convener of the symposium, and Ms. Candith Mashego-Dlamini, MEC of DARDLA, welcomed the delegates. Prof. Sisir Mitra, Chairman of the ISHS Tropical and Subtropical Fruits Section, presented a summary of ISHS activities and its members, as well as an outline of upcoming symposia and *Acta Horticulturae*. Prof. Errol Hewett, ISHS Board member from Massey University, New Zealand, gave a presentation about the importance and value of horticulture across the world, based on the ISHS publication "Harvesting the Sun". Each morning the session started with keynote addresses by eminent scientists on topical issues facing the global litchi industry. Keynote speakers included Prof. Houbin Chen and Prof. Xuming Huang, both from the South China Agricultural University (SCAU) in Guangzhou, China, giving an overview of world litchi production with specific reference to China's litchi industry and research programmes, and an overview of physiological aspects relating to litchi production and strategies to improve litchi production, respectively. Prof. Sisir Mitra from BCKV University, India, and Dr. Schalk Schoeman from the ARC-ITSC, presented overviews of litchi postharvest treatments and control strategies for stinkbugs and moths in litchi, respectively.

Discussing litchi packaging and fruit quality during a packing house visit in the Malelane area.

During the symposium, presenters reported on recent advances and the most interesting topics relating to world production, marketing and technology transfer, cultural practices and crop physiology, postharvest management, pest and disease control as well as germplasm and breeding of litchi and longan. Although litchi and longan, the two biggest commercial crops in the *Sapindaceae* family, are rather small crops compared with deciduous fruit, they have great importance in the Asian regions, which are responsible for 95% of world production. The

Invited speakers Prof. Houbin Chen, Prof. Sisir Mitra, Prof. Xuming Huang, Prof. Errol Hewett, and organizers Mr. Gavin Hardy and Mr. Derek Donkin (Convener) (from left to right).

Participants visiting a litchi orchard.

world litchi industry, for example, has expanded rapidly in the past 20 years because of increasing interest in exotic fruit in Europe and increasing wealth in Asia, which in turn have provided lucrative returns to growers. However, productivity is low in many countries. Most industries are based on only one or two major cultivars, which limits the production season. Lack of technology innovation and research as well as high labour costs further limit these industries. The presentations at the symposium focused on research towards mitigating these challenges. The influence of climate change on litchi and longan production and fruit quality and possible changes in orchard management to adjust to climate change were discussed. Various papers also highlighted the importance of good fertilization, organic nutrient management and irrigation practices for sustainable production. Good overviews of various orchard management practices to improve litchi production over a wide range of cultivars in different countries were presented. Such practices included the use of plant growth regulators, mulching, pruning practices and orchard mechanization. Research papers on the use of sulphur treatments to extend postharvest shelf-life as well as alternatives to sulphur, including coatings, different packaging and hydro-cooling to maintain fruit quality as well as drying techniques for both litchi and longan fruit were discussed. Besides chemical and organic control strategies for pests and diseases, the role of breeding efforts and the use of genetic markers for improved cultivars that extend the harvesting season were discussed.

During the poster viewing session ample opportunity was given for all delegates to further discuss research work and interact. An introduction to the cultivar display at the entrance to the symposium venue gave insight into the litchi germplasm available in South Africa.

Apart from scientific reports and discussions, the delegates had the opportunity to learn about the South African litchi orchard and nursery practices as well as packing house technology and treatments during the mid-symposium tour.

To give the delegates a truly South African experience, they were treated to a game drive with dinner in the bush in the famous Kruger National Park. There was also entertainment by a marimba band and gumboot dancers during the dinner after the technical tour.

Regina Cronje

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Section Tropical and Subtropical Fruits – Section Pome and Stone Fruits

Ninth Int'l Symposium on Temperate Zone Fruits in the Tropics and Subtropics

The 9th International Symposium on Temperate Zone Fruits in the Tropics and Subtropics (TZFTS) was held in Chiang Mai, Thailand from 26-28 March 2013. One hundred and eighty-three participants from 17 countries attended the symposium. The program consisted of a keynote address, eight invited lectures, and several interesting contributed lectures on production, biotechnology, breeding, physiology, plant protection, postharvest management and processing of temperate fruits in the tropics and subtropics. There were 22 excellent poster presentations displayed for two days during the symposium.

At the opening session His Serene Highness Prince Bhisadej Rajani, President of the Royal Project Foundation, Thailand, highlighted the importance of growing temperate fruits in the highlands of Thailand. He also mentioned the research that was initiated in 1969 to test peaches as a substitute crop for opium poppy. Mr. Suwit Chaikiattiyos, Deputy Director General, Department of Agriculture, Thailand, stated that the objectives of the symposium were to share knowledge and experience related to production and marketing of TZFTS, to provide a forum to allow the exchange of valuable views, and to give an opportunity to introduce to people from all over the world the rich diversity of TZFTS in the region and its

Participants of the symposium.

trade potential. Mr. Hiroyuki Konuma, Assitant Director General, FAO Regional Representative for Asia and the Pacific, highlighted the role of TZFTS in food and nutrition security and how we can achieve future production targets. Professor Sisir Mitra, Chair ISHS Section Tropical and Subtropical Fruits, stated that the potential for development of TZFTS depends on continuous improvement in technology for production and postharvest management and that many countries in the tropics have physiographic features and climatic conditions that could be effectively exploited for the production of temperate fruits.

Mr. Hiroyuki Konuma in his keynote address analyzed the FAO data base on fruit production and demand up to 2050 and provided recommendations on how we can achieve the future production targets following the sustainable crop production intensification approach that has been further elaborated by and detailed in the "Save and Grow" approach. An overview of temperate zone fruits in the Royal Project was elaborated by Mr. S. Rojanasoonthon. Professor Sisir Mitra presented a review of TZFTS in the north eastern Himalaya of India. He mentioned that this region is one of the richest reservoirs of genetic variability and diversity of different horticultural crops. The major challenges are to develop production practices and devise management strategies for optimizing productivity of fruit crops without resource degradation.

Dr. R. Nissen from Australia elaborated on the improved cultural practices that need to be followed for growing temperate fruits in the tropics and subtropics. An overview of the Korean citrus industry was presented by Dr. K. Kim. Dr. D.H. Byrne, USA, discussed the progress and potential of low chill peach breeding. He stated that the development of commercial stone fruit production in medium and low chill areas throughout the world is increasing in importance. The adaptability and growth of Armenian fruit trees like plum, peach, apricot, pomegranate, mulberry, fig, quince, walnut, hazelnut, sweet cherry and grape in Thailand was presented by Dr. H. Hovhannisyan, Armenia.

On the third day of the symposium, participants visited Inthanon Royal Agricultural Station, Doi Inthanon and Royal Agricultural Research Station at Chiang Mai. It was highly educative to see the improved cultivation techniques of grape, persimmon, fig, strawberry, peaches, kiwifruit, etc. The participants enjoyed the fresh fruits of different cultivars of peach, kiwifruit, grape and apricot.

Social and cultural events and the wonderful banquets featuring Thai cuisine and drinks were enjoyed by the participants. During the symposium, a Working Group meeting was organized and it was decided that the 10th TZFTS Symposium will be held in 2017 in Oman. The participants also unanimously elected Prof. Dr. A.B. Küden, Turkey, as the new Working Group Chair of TZFTS.

Sisir Kumar Mitra, Peyanoot Naka and Narong Chomchalow

Field trip in the Royal Agricultural Research Center.

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Brassica 2012: Sixth Int'l Symposium on Brassicas and Eighteenth Crucifer Genetics Workshop

Brassica 2012 participants group.

The 6th International Symposium on Brassicas and 18th Crucifer Genetics Workshop were held in Catania, Italy, from 12-16 November 2012. The symposium was organized by the Department of Agriculture and Food Science (DISPA) of Catania University under the aegis of ISHS. Brassica 2012 was devoted to the "Exploitation of Brassica Diversity for Improving Agriculture Chains" with the patronage of the Società di Ortoflorofrutticoltura Italiana (SOI), the Società Italiana di Agronomia (SIA), the Società Italiana di Genetica Agraria (SIGA), the Società Italiana di Scienze e Tecnologie Alimentari (SISTAL) and the Società Italiana di Patologia Vegetale (SIPaV).

The Convener of the Symposium was Prof. Ferdinando Branca and the President of the Organizing Commitee was Prof. Salvatore Luciano Consentino, both from the Catania University. As ISHS representatives we were joined by Prof. João Silva Dias, Chair of the ISHS Working Group on Brassica, and Prof. Silvana Nicola, Chair of the ISHS Section Vegetables, who, on behalf of the ISHS, handed over to the Convener, Prof. Ferdinando Branca, the ISHS medal in recognition of his meritorious service to the Society.

At the opening ceremony Prof. Ferdinando Branca expressed a cordial welcome to all the participants, approximately 180 scientists and specialists from 26 countries (Australia, Belgium, Canada, China, Czech Republic, Denmark, France, Germany, Hungary, India, Ireland, Italy, Japan, New Zealand, Norway, Poland, Portugal, Romania, Russia, Serbia, South Korea, Spain, Sweden, The Netherlands, United Kingdom, USA). Participation in sharing scientific knowledge was excellent and there was a high quality and varied scientific program with 6 invited keynote presentations, 75 oral and 147 poster presentations.

The symposium was opened daily with a keynote lecture. On the first day Prof. Edwards David talked about "Characterising Diversity in the *Brassica* Genomes" showing the diversity across *Brassica* genomes, providing an understanding of recent selection pressures on plant genomes, on the contribution of genomic components to plant adaptation, and on genes that have been the target of selection. Prof. Meng Jinling offered a view on "Breeding a Dynamic Population of New Type *Brassica napus* Containing Unique Elite Genes from Oilseed *Brassica* Subgenomes via Genome Selection", discussing the perspective of new types of canola. Prof. Hammer Karl talked on "The Wild and the Grown – Remarks on Brassica", turning attention to the evolution of cultivated plants related to breeding progress of brassicas in different periods over the last 10.000 years. He demonstrated the difficulties in classifying wild and cultivated *Brassica* plants under the same system.

On the second day Prof. von Bothmer Roland talked about the question "Is There a Need for the Svalbard Global Seed Vault and Are Our Genetic Resources Safe for the Future? Examples in *Brassica*." He highlighted the need for international efforts to focus on an effective and safe back-up security system for all unique gene bank accessions of the world. On the third day Prof. Mithen Richard showed his long term work related to "High Glucoraphanin Broccoli – the Development of BeneforteTM Broccoli and Evidence of Health Benefits." He described the genetic basis of the high glucoraphanin trait and its effect on sulfur metabolism and partitioning, and he showed how the high glucoraphanin broccoli perturbs human lipid metabolism. Finally, on the fourth day Prof. Bartoszek Agnieszka talked about "The Innovative Exploitation of Brassica Vegetables in the Health Quality Food Production Chain. From Field to Fork." He discussed the multidirectional opportunities and gave examples of innovative exploitation of chemical and biological properties of brassica vegetables.

The 222 abstracts were discussed within eight sessions including Genetic Diversity Conservation and Use, Biotechnology and Breeding, Nutraceuticals and Processing, Agronomy, Pests and Diseases and three workshops related to Crucifer Genetics, Isatis and Clubroot.

The Brassica 2012 symposium was structured to encourage debate and dialogue and so it was an excellent opportunity to launch new

Brassica 2012 opening session: Prof. João Silva Dias (ISHS Brassica Working Group Chair), Prof. Ferdinando Branca (Convener), Prof. Salvatore Luciano Cosentino (Chair of Organizing Committee), Prof. Silvana Nicola (ISHS Vegetables Section Chair).

Technical excursion: Prof. Ferdinando Branca showing vegetable specialties of Catania peri-urban farmers such as violet cauliflower.

ideas and to establish personal contacts for future collaborative projects. At the end of the symposium Prof. Branca thanked all the participants and he indicated that Brassica 2012 was a starting point for research and collaborative work for the next decade and that this event in Sicily had made a strategic contribution to the development of future research activities. During the symposium the social dinner was held at the Palazzo Biscari, the most magnificent Baroque style building in Catania where all participants were delighted by several traditional foods based mainly on brassica vegetables. The symposium ended with an excursion to the Messina farm in the peri-urban vegetable growing area of Catania. Participants observed the wide range of vegetables, several of which represent specialty produce highly sought after by local markets. The technical tour continued around the west side of Mount Etna and the participants visited the castle of Nelson in Maniace. Lunch was offered by the Organizing Committee at "Il Casolare delle Balze" where participants appreciated the traditional cuisine of the Catania province. The tour moved on to the north side of the volcano with wine tasting at the Vivera "company" at Linguaglossa. Both of these events were not only an escape from the full and intensive scientific programme but also an excellent opportunity to get to know each other and learn of related scientific activities. Of course, it was also an excellent opportunity to learn a little more about Catania, its history and people, folk and traditions, and cultural values.

The Symposium Convener thanks the President and all the members of the Organizing and Scientific Committees and the Organizing secretariat, led by Dr. Alessandro Tribulato, for their excellent work, such as Prof. Giuseppe La Malfa and Prof. Carlos Quiros who supported the initial idea to organize this symposium in Catania.

João Silva Dias and Ferdinando Branca

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Section Vegetables – Commission Molecular Biology and In Vitro Culture

Int'l Symposium on Biotechnology and Other Omics in Vegetable Science

The International Symposium on Biotechnology and Other Omics in Vegetable Science was organized by the Department of Horticulture, Faculty of Agriculture, Akdeniz University and was sponsored by ISHS. The meeting was held on 29 April-2 May 2012 in a 5 star hotel situated at the internationally reknown Konyaaltı beach in Antalya, Turkey. Antalya is the largest city and a year round holiday resort on the Turkish Mediterranean coast. It is surrounded by the Taurus mountain range in the north, and offers over 200 km of beaches, coves, bays, valleys, forests and picnic sites to explore and enjoy.

The symposium was attended by nearly 70 persons representing 16 countries. The welcoming reception was held on 29 April 2012 overlooking the beautiful artificial lake within the university campus. The symposium opened on 30 April 2012 and the welcome remarks were made by Prof. Dr. A. Naci Onus, Convener, and Prof. Dr. Silvana Nicola, Chair of the ISHS Section Vegetables. This was followed by a mini concert performed by students of the

Prof. Dr. Silvana Nicola (right) presenting the ISHS medal to Symposium Convener Prof. Dr. A. Naci Onus (left).

Visit to Perge ancient city.

Participants of the symposium.

Akdeniz University conservatoire. Afterwards, Prof. Dr. Jim Dunwel, University of Reading, England, delivered a keynote talk entitled "The role of plant biotechnology in the future of food security". During the symposium Prof. Dr. Rod J. Scott, University of Bath, England, also delivered a keynote talk entitled "The future of genetically modified crops – what is preventing greater uptake?" Both of the keynote talks and all the presentations made by participants were of great interest to the audience.

A total of 27 oral and 32 poster presentations were made in the themes of in vitro propagation, plant regeneration processes, somatic embryogenesis, gene identification, candidate genes, association mapping, molecular markers, marker assisted selection, disease resistance/tolerance to biotic and abiotic stresses, release and commercialization of transgenic varieties, stability, and public acceptance of GM vegetable crops.

A small meeting was held to discuss the importance of omic technologies in plant science, specifically in vegetable plant science. It was emphasized that if we want to develop sustainable approaches for producing high crop yield and improved texture, flavor and aroma, we need to better understand and apply the most advanced technologies available to study plant life. In this context omic technologies can be a great help. Many participants pointed out that the present was the first ever symposium to discuss omic technologies in vegetable science. At the end of the discussion it was decided to propose to ISHS that a Working Group on Omics in Vegetables be set up, to be chaired by Prof. Dr. A. Naci Onus, with the aim of bringing together scientists using omic technologies under the umbrella of ISHS. The offer was kindly acknowledged by Prof. Dr. Silvana Nicola as Chair of the ISHS Section Vegetables.

On 1 May 2012 a trip was organized to Perge, an ancient Greek city in Anatolia and the capital of Pamphylia. Today the location is a large site of ancient ruins 15 kilometers east of Antalya on the coastal plain where there is an acropolis dating back to the Bronze Age. Participants were informed that during the Hellenistic period, Perge was one of the richest and most beautiful cities in the ancient world, famous for its temple of Artemis. Symposium participants greatly enjoyed the trip.

After the last day of presentations on 2 May 2012, Prof. Dr. A. Naci Onus acknowledged, on behalf the Organizing Committee, all the oral and poster presentations and valuable discussions that took place during the symposium.

Finally, the symposium ended with a gala dinner. Participants were introduced to Turkish music as well as international music, sung in different languages.

Ahmet Naci Onus

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Section Vegetables – Commission Plant Genetic Resources
Eurasian Symposium on Vegetables and Greens

Vegetable production is one of the leading sectors in Armenian agriculture and has a history and tradition of thousands of years. The Government of the Republic of Armenia has been consistently implementing programmes to develop the horticultural sector through improvement of irrigation systems, pasture irrigation, integrated pest control, soil improvement, rural infrastructure development and other important programmes. These have resulted in positive trends in the production of vegetables and general improvements in the area of horticulture. Raising the competitiveness of domestic farm products and developing export-oriented agriculture, particularly in the area of vegetable production, are among the main targets of the agricultural development strategy in the country. Therefore, the idea of organizing the Eurasian Symposium on Vegetables and Greens in the Republic of Armenia under the auspices of the ISHS was widely supported by the scientific community, the processing industry and farmers.

The symposium was held on 16-20 October 2012 in the Ani Plaza Hotel in Yerevan, the capital and largest city of Armenia and one of the world's oldest cities with a history of thousands of years, dating back to the rise of the oldest civilizations in the world. The symposium gathered 61 participants from nine countries (Germany, Latvia, Albania, Uzbekistan, Colombia, Italy, Moldova, Georgia and Armenia), including government officials and policymakers, researchers and farmers, and representatives of international (FAO, CIAT) and non-governmental organizations.

Presentation on genetic resources for pepper breeding by Gyane Martirosyan from the Scientific Center of Vegetables and Industrial Crops, Armenia.

The overall objective of the symposium was to discuss research topics important to the country to provide a vision of how technology transfer, knowledge exchange and innovations in the area of vegetable growing can be a base for faster sustainable development of the agricultural sector as a vital part of the national and regional rural economy.

The agro-ecological conditions in Armenia, its geographical position and multipurpose use of vegetables have led to a large diversity of vegetable crops, such as tomato, cucumber, cabbage, onion, eggplant, radish, carrot, garlic, estragon, asparagus, spinach, pepper, bean, cauliflower, turnip, garden radish, parsley, basil, and others. In addition, serious studies are being conducted concerning the cultivation of wild leafy vegetables. Consequently, cultivation technologies, postharvest technologies and quality management in supply chains as well as plant health and product safety were included in the topics for abstracts and manuscripts.

During the introductory session of the symposium, representatives of the Ministry of Agriculture, the National Agrarian University and the Armenian Harvest Promotion Center outlined the state of vegetable production in Armenia. They presented a general overview of the production of vegetables and greens in Armenia, addressed the obstacles facing vegetable crop development in the country and ways to overcome them, and presented vegetable production perspectives in Armenia. Doubling of the vegetable production volume from 1990 to 2011 (from 389.7 thousand tons to 789.3 thousand tons), mostly due to intensive factors, and the under-developed production potential of the Republic's vegetable growing sector were reported. A number of main issues and possible solutions to increase the income of farmers and reduce poverty were discussed.

Armenia is a primary and secondary center of origin for many vegetable plants. Two hundred and eighty vegetable species are reported in the Republic. Currently, the significance of conservation and the sustainable use of genetic resources of plants used in food production and agriculture are growing to become critical components of the country's agricultural and environmental policy. Genetic resources of vegetable crops are valuable starting materials in crop selection, promoting economic growth, national autonomy and food security, and simultaneously playing an important role in maintenance of the environmental balance. Decline of the environment, as a result of mankind's activities and climate change, is reducing the natural population of wild relatives of crop plants. Therefore, in comparison with previous scientific events, some new topics such as genetic resources and germplasm accessibility, and molecular tools in the evaluation of genetic material, were the focus of discussions held at the session dedicated to the problems of conservation and use of genetic resources. The

Demonstration of farmer products.

keynote speech on genetic resources and germplasm accessibility in view of climate change and food security, highlighted the better utilization of plant genetic resources by facilitating access and improving the use of germplasm collections through recognizing the importance of characterization and evaluation of the main traits required to respond to pressure factors such as influence of climate change, loss of biodiversity, degradation of natural resources and less water availability.

The effective use of genetic resources of vegetable crops such as capers, pepper, lettuce, etc. and approaches to enhance nutritional security and livelihoods through regional cooperation were presented by researchers from Uzbekistan and Armenia. At the Breeding and Seed Production session, an overview was given of modern technologies for producing vegetables and greens of high value, and the use of callus culture in selection of some vegetable crops and methodologies of assessment of genetic variability were presented and discussed. Techniques and tools for plant disease detection were presented by Loewe®, a company that sponsored the symposium and that specializes in developing and producing premium diagnostic reagents for the detection of plant diseases.

The symposium was structured to provide an opportunity not only to researchers, but also to producers dealing with breeding, cultivation, processing of vegetables and greens, as well as to farmers to discuss and share achievements and to debate future targets and ways to reach them. Armenian farmers were actively involved in discussions on cultivation technologies of vegetables in the open field and under greenhouse conditions and during the symposium a small exhibition of farmer products was organized.

Greenhouse visit.

During the field trips a visit to a vegetable orchard and a greenhouse as well as to a vegetable processing enterprise were organized to show guests the local traditions in growing vegetables and greens and processing technologies applied in the food industry.

The closing session was followed by a fair of Armenian processed vegetables and blind testing.

The event was aligned with the ISHS mission to foster the free flow of ideas, and promote the value of information and communication for the development of horticultural science for food security.

Alvina Avagyan

Closing session.

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Middle East Horticultural Summit

On March 26th-27th 2013, approximately 60 scientists, industry and higher degree research students participated in the 1st Middle East Horticultural Summit held at the Dubai World Trade Centre in Dubai, United Arab Emirates. The Middle East Horticultural Summit was developed by Informa Exhibitions and organised by the College of Food and Agriculture from the United Arab Emirates University (Dr. Elke Neumann Gabriel) under the aegis of the International Society for Horticultural Science (Dr. David Aldous). With a theme of "Horticulture in the Middle East: challenges and directions for future research", participants were welcomed by Dr. Ghaleb Ali Al Hadrami, Dean of the College of Food and Agriculture of the United Arab Emirates University (UAEU), Al Ain, UAE. International keynote speaker Dr. Errol Hewett, from New Zealand, spoke on "A profile of world horticulture: harvesting the sun" and "Research into quality assurance and postharvest horticulture" with Dr. Abdulaziz R. Al-Harbi, from Saudi Arabia, speaking on "Improving the performance of horticultural crops in the Middle East through research". Other keynote speakers included Dr. Hanafi Abdelhaq, from Morocco, who spoke on "Best horticultural practices for greenhouse production in the Middle East", Dr. Heiner Lieth, from the United States of America, who spoke on "Photovoltaic shade houses for the Gulf Region", and Dr. David Aldous, from Australia, who spoke on "Research opportunities into horticulture and green space management for the Middle East".

Other regional speakers included Dr. Faisal Awawdeh, who spoke on the "Role of research in enhancing food security for dry areas", Dr. Ajay Kumar Garg, who spoke on "Biotechnology research opportunities for arid land horticulture", Dr. Mohammad M. Al-Oun, on "Strategies of the Ministry of Environment and Water to develop organic plant production and certification in the UAE", Drs. Ibrahim H. Belal and Jean-Yves Mevel, on "Aquaponics for arid lands", Dr. Nanduri K. Rao, on "Neglected and under-utilized species (NUS) for food and income security in marginal environments",

Co-Conveners Drs. David Aldous and Elke Neumann presented with ISHS medallions from Dr. Errol Hewett, ISHS Board Member for Innovation-Industry-Insight.

Keynote speaker Dr. Errol Hewett spoke on the significance of postharvest horticulture opportunities for the Middle East.

Middle East Summit speakers from left to right – Dr. Ajay Kumar Garg, Dr. Kenneth Marcum, Dr. Faisal Awawdeh, Dr. Errol Hewett, Dr. Weiner Lieth, Dr. Hanafi Abdelhaq, Dr. David Aldous, Dr. Shyam Kurup, Dr. Mohammad Al-Oun, Dr. Elke Neumann, Dr. Nanduri Rao and Dr. Abdulaziz Al-Harbi.

Speakers came from (left to right) the United States of America (Dr. Weiner Lieth), Morocco (Dr. Hanafi Abdelhaq), College of Food and Agriculture, UAE (Dr. Gahaleb Ali Al Hadrami), New Zealand (Dr. Errol Hewett), Australia (Dr. David Aldous), Department of Aridland Agriculture, College of Food and Agriculture, UAE (Dr. Elke Neumann and Dr. Ibrahim Belal).

Dr. Kenneth K. Marcum, on "Tolerance mechanisms of halophytic turfgrasses" and Dr. Shyam S. Kurup, on the "Identification of salinity tolerant turfgrass species with optimum turf quality for urban landscaping in the United Arab Emirates". This was followed by a round-table discussion under the moderation of Dr. Errol Hewett.

Day two was spent at the Al Foah Experimental Farm and new aquaculture research facility of the UAEU, followed by an overview of horticultural research presented by various faculty members and their students on biotechnology and molecular biology, the medicinal properties of plants native to the Gulf Region, irrigation technology and water management, and plant nutrition and mycorrhiza. This was followed by discussion on future ideas for collaboration in research and education in the UAE, and a tour of the UAEU Maquam Campus and the agricultural research facilities. The proceedings of the Middle East Horticultural Summit will be brought together in an *Acta Horticulturae* which will be made available mid 2013.

David Aldous

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Commission Horticultural Engineering – Commission Protected Cultivation

Fourth Int'l Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation (HORTIMODEL2012)

The Fourth International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation (HORTIMODEL2012) was held during November 4-8 2012 at Nanjing, China. This symposium was hosted by the Nanjing Agricultural University and sponsored by the Nanjing Agricultural University (CN); the National Natural Science Foundation of China (CN); the National Engineering and Technology Center for Information Agriculture, of the Nanjing Agricultural University (CN); the University of Jiangsu (CN); the Shandong Yinxiang Weiye Group Co. Ltd. (CN); the Phyto-IT (BE); and the Institute of Environment and Sustainable Development in Agriculture, of the Chinese Academy of Agricultural Sciences (CN). Sixty participants from 15 countries attended the symposium. The proceedings (*Acta Horticulturae* 957) were available at the start of HORTIMODEL2012.

There were 24 oral and 21 poster presentations during HORTIMODEL2012. They focused on the following 8 topics: crop and climate management; water, nutrient and energy management; product quality; systems biology, gene-plant-crop modeling; 3D-models, architectural models; calibration and self-learning/tuning models; methodological issues, aggregation and scale; combination of models and sensors. Modeling greenhouse ecosystem processes and model based decision support algorithms were intensively discussed during the conference. Those presentations and discussions will be beneficial to generalize knowledge and to evaluate conflicting priorities for sus-

Invited keynote presentation by Dr. Xinyou Yin.

Business meeting and ISHS presentation by Dr. Ep Heuvelink.

Asking questions during discussion.

tainable greenhouse horticulture production. Compared to the previous symposium in the series (HORTIMODEL2006), HORTIMODEL2012 placed greater emphasis on gene-plant-crop modeling. The application of this system-biology-approach to greenhouse crop modeling will make greenhouse crop models sufficiently comprehensive to quantitatively analyze the interactions between gene and environment in order to establish specific breeding goals and to optimize crop management.

During the business meeting of the Working Group on Modelling Plant Growth, Environmental Control, Greenhouse Environment, it was announced that Dr. Nadia Bertin (INRA Avignon, France) is willing to organize the next meeting in 2015 or 2016. The Working Group members happily accepted this proposal. Dr. Ep Heuvelink announced that he is stepping down as Working Group Chair (after 9 years) and that Prof. Luo Weihong is willing to take over. This nomination was welcomed by the Working Group members with applause.

Weihong Luo

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From the Secretariat

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Argentina: Malvina Paloni, Dr. Roberto Adrián Rodríguez Ghezzi; **Australia:** Ass. Prof. Colin Birch, Dr. Roger Burgess, Mr. John Drummond, Dr. Bob Ikin, David Lawry, John McPhee, Dr. Greg Moore, Mr. Trevor Ranford, Dr. Karen Sommerville, Mr. Gary Spink, Mr. Tim Tay, Dr. Lucy Tran-Nguyen, Ms. Erica Turner, Mr. Bob Williams; **Belgium:** Mr. charles de wulf, Prof. Dr. Frédéric Lebeau; **Brazil:** Prof. Dr. Amauri Alvarenga; **Canada:** Mr. James Garrett, Pascale Harster, Mr. Paul Huntington, Mr. Shalin Khosla, Ms. Alice Klamer, Megan MacEachern, Daniel Pouliot, Michael Prince; **Chile:** Mr. Alejandro Fernandez, Mr. Leon Garcia, Benita Gonzalez, Mr. brian mace; **China:** Prof. Ding Mu, Caixi Zhang; **Chinese Taipei:** Dr. Roland Schafleitner, Dr. Jaw-Fen Wang; **Colombia:** Dr. Victor Rivera; **Cyprus:** Ms. Sotiroula Ioannidou; **Czech Republic:** Miroslav Dorazil, Tomas Kopta, Jarmila Neugebauerova, Jindriska Vabkova; **Denmark:** dorthe varning poulsen; **France:** Ms. Murielle Philippot; **Germany:** Dr. Markus Schmidt; **Greece:** Mr. Dimitrios Dikaios; **Hungary:** Dr. Gabor Boronkay, Dr. Marietta Petroczy; **India:** Satya Sundar Bhattacharya, Dr. Wangkheirakpam Radhapiyari Devi; **Indonesia:** Ms. Irni Hindaningrum, Sunardi Sunardi; **Italy:** Prof. Dr. Ettore Barone, Prof. Dr. Francesco Di Iacovo, Dr. Angela Fanigliulo, Dr. Luigi Guarino, Dr. Gian Luca Malvicini, Dr. Francesca Massetani, Dr. Massimiliano Natali, Dr. Damiano Remorini, Dr. Makiko Taguchi; **Japan:** Mr. Scott Harp, Mr. Yasuyuki Hayashi; **Jordan:** Dr. Raid Lutfi; **Kenya:** Dr. Lucy Kananu Murungi; **Korea (Republic of):** Dr. KrishnaKumar Sugumaran; **Libya:** Dr. zuher bensaad; **Liechtenstein:** Mr. Jakob Schierscher; **Malaysia:** Farahzety Ms. Abdul Mutalib, Dr. Alice De Cruz; **Malta:** Mr. Mario Victor Balzan; **Netherlands:** René Knoppert; **New Zealand:** Dr. Bruce Searle; **Panama:** Mr. Hannu Hietavirta; **Philippines:** Ms. Girlie Banana, Dr. Violy Villegas; **Romania:** Ms. Irina Culda; **Saudi Arabia:** Assist. Prof. Abdulrahman Almoshileh; **Slovak Republic:** Jan Zatko; **Slovenia:** Dr. Manca Pirc; **South Africa:** Mr. Ben Burger, Sarah Nanyonga, Andrew Opoku; **Switzerland:** Ms. Phally Nguon; **Tanzania:** Mr. Hubert Coffi; **Thailand:** Nanteetip Limpeanchob, Dr. Suthep Nimsai, Anan Ounaroon, Dr. Wasan Pongsomboon; **Tunisia:** Mr. Mohamed Sahbi Mahjoub; **Turkey:** Prof. Dr. Mehmet Atilla Askin, Ms. Ozge Secmeler, Dr. Emine Tanriver; **Ukraine:** Mr. Oleh Bazyuk; **United Arab Emirates:** Mr. Edriss Ali, Mr. Haleem Syed; **United Kingdom:** Mr. Ayman Almerei, Mr. Simon Ball, Mr. Peter Bevan, Mr. Thierry Croze, Mr. Dale Dempsey, Dr. Jon Heuch, David Marks, Ms. Yuuka Mori, Dr. Alan Simson, Dr. Angela Stafford, Mr. Paul Tomlinson; **United States of America:** Dr. Jinhe Bai, Prof. James Bradeen, Ms. Hebe Bradley, Dr. Stephen Brown, Chris Claussen, Alice Ann Crown, Dr. Sasha Eisenman, Dr. Barbara Fair, Jonathan Frantz, Dr. Jose Garzon, Mr. Richard Ha, Dr. Harlene Hatterman, Charles Hayes, Roxanne Heintz, Dr. David Hensley, Mr. Andrew Hubbard, Dr. Dewayne L. Ingram, Mr. Andrew Kieniksman, Kayla Kody, Dr. Dan MacLean, Dr. Sasha Marine, Ms. Demie Moore, Ms. Allison Oakes, Dr. Kauahi Perez, Ms. Kaylan Roberts, Dwight Rowe, Dr. Teresa Salame-Donoso, george schnackenberg, Dr. Mary Lynn Shayne, Prof. Dr. Fedora Sutton, Dr. Judith Taylor, Dr. Jeff Warren, David Wiebe, Dr. Richard Woodward, Dr. Cecilia Zapata; **West Indies:** Dr. Clare Bowen O'Connor.

Calendar of ISHS Events

For updates and extra information go to www.ishs.org and check out the calendar of events. Alternatively use the "science" option from the menu for a comprehensive list of meetings for each Section, Commission or Working Group.
To claim reduced registration for ISHS members your personal membership number is required when registering - ensure your ISHS membership is current before registering. When in doubt sign in to your membership account and check/renew your membership status first: www.actahort.org or www.ishs.org

YEAR 2013

- June 2-7, 2013, Coimbra (Portugal): **VIII International Symposium on In Vitro Culture and Horticultural Breeding.** Info: Prof. Dr. Jorge Canhoto, Department of Life Sciences, University of Coimbra, Arcos Do Jardim, Ap. 3046, 3001-401 Coimbra, Portugal. Phone: (351)239855210, Fax: (351)239855211, E-mail: jorgecan@ci.uc.pt E-mail symposium: IVCHB2013@uc.pt Web: http://www.uc.pt/en/congressos/IVCHB2013/
- June 3-7, 2013, (Dominican Republic): **X International Mango Symposium.** Info: Juan Jose Espinal, Jose Amado Soler No. 50, Ensanche Paraiso, Santo Domingo, Dominican Republic. Phone: (1)809-5655603, Fax: (1)809-5444727, E-mail: jespinal@cedaf.org.do E-mail symposium: xmango2013@gmail.com Web: http://www.cedaf.org.do/eventos/xmango2013/en/index_en.html
- June 3-7, 2013, Trani (Italy): **XI International Controlled and Modified Atmosphere Research Conference - CaMa2013.** Info: Dr. Giancarlo Colelli, Dip. Pr.I.M.E. Univ. Di Foggia, Via Napoli 25, 71100 Foggia, Italy. Phone: (39) 320 4394535, E-mail: g.colelli@unifg.it Web: http://www.cama2013.org
- June 4-7, 2013, Gent (Belgium): **IX International Workshop on Sap Flow.** Info: Dr. Kathy Steppe, Laboratory of Plant Ecology, Ghent University, Coupure links 653, 9000 Ghent, Belgium. Phone: (32)9-2646126, Fax: (32)9-2244410, E-mail: kathy.steppe@ugent.be E-mail symposium: secretariat@sapflowworkshop.info Web: http://www.sapflowworkshop.info
- June 9-14, 2013, Columbia, Missouri (United States of America): **I International Symposium on Elderberry.** Info: Mr. Andrew Thomas, University of Missouri, Southwest Research Center, 14548 Highway H, Mt. Vernon, MO 65712, United States of America. Phone: (1)417-466-2148, Fax: (1)417-466-2109, E-mail: thomasal@missouri.edu Web: http://muconf.missouri.edu/elderberrysymposium
- June 17-21, 2013, Leiden (Netherlands): **International Symposium on Growing Media and Soilless Cultivation.** Info: Erik Van Os, Aan de Rijn 2, 6701 PB Wageningen, Netherlands. Phone: (31)317483335, Fax: (31)317425670, E-mail: erik.vanos@wur.nl or Wim Voogt, Violierenweg 1, 2665MV Bleiswijk, Netherlands. Phone: (31)174 485687, E-mail: wim.voogt@wur.nl or Mr. Chris Blok, Wageningen UR Greenhouse Horticulture, Violierenweg 1, 2665 MV, Bleiswijk, Netherlands. Phone: (31)317485606, E-mail: chris.blok@wur.nl E-mail symposium: Grosci2013.symposium@wur.nl Web: http://www.grosci2013.wur.nl/
- June 17-19, 2013, Montreal, Quebec (Canada): **International Symposium on Medicinal Plants and Natural Products.** Info: Dr. Jalal Ghaemghami, PO Box 320172, West Roxbury, MA 02132, United States of America. Phone: (1)3393686838, Fax: (1)3393686838, E-mail: jalal@shmen.org or Prof. Dr. Alain Cuerrier, 4101, rue Sherbrooke Est, Montréal Québec, Canada. E-mail: alain_cuerrier@ville.montreal.qc.ca E-mail symposium: antigua-ishs@shmen.org Web: http://www.montrealishs.org/
- June 17-20, 2013, Matera (Italy): **VIII International Peach Symposium.** Info: Prof. Cristos Xiloyannis, Dip. Scienze dei Sistemi Colt., For., Amb., Viale dell'Ateneo Lucano, 10, 85100 Potenza, Italy. Phone: (39)3293606262, Fax: (39)0971205378, E-mail: cristos.xiloyannis@unibas.it or Prof. Dr. Paolo Inglese, Department DEMETRA, Università degli Studi di Palermo, Viale delle Scienze, ED. 4, 90142 Palermo, Italy. Phone: (39)09123861234, Fax: (39)09123860820, E-mail: paolo.inglese@unipa.it Web: http://www.unibas.it/peach2013/home.html
- June 23-27, 2013, Plasencia (Spain): **VII International Cherry Symposium.** Info: Dr. Margarita López Corrales, SIDT, Finca La Orden, Guadajira, 06187 Badajoz, Spain. E-mail: margarita.lopez@juntaextremadura.net or Dr. Manuel Serradilla Sanchez, Finca la Orden - Valdesequera, A-V KM 372, 06187 Badajoz, Spain. E-mail: manuel.serradilla@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 E-mail symposium: cherrysymposium2013@gmail.com Web: http://www.cherry2013.com/
- June 24-27, 2013, Orlando, Florida (United States of America): **IV International Symposium on Tomato Diseases: Economically, Environmentally, and Socially Sustainable Tomato Disease Management.** Info: Assist. Prof. Mathews L. Paret, Plant Pathology Department, North Florida Research and Education Center, University of Florida, 155 Research Road, Quincy Florida FL-32351, United States of America. Phone: (1)8508757154, Fax: (1)8508757188, E-mail: paret@ufl.edu Web: http://nfrec.ifas.ufl.edu/4istd/index.shtml
- July 1-5, 2013, St. Augustine (Trinidad and Tobago): **III International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions.** Info: Dr. Majeed Mohammed, 22 Pine Drive, Homeland Gardens, Cunupia, Trinidad and Tobago. Phone: (1)868-671-2332, Fax: (1)868-645-0479, E-mail: mohd2332@hotmail.com E-mail symposium: ISHS.PostHarvest2013@sta.uwi.edu Web: http://sta.uwi.edu/conferences/13/postharvest/index.asp
- July 2-5, 2013, Zürich (Switzerland): **XIII International Workshop on Fire Blight.** Info: Dr. Brion Duffy, Agroscope Changins-Wädenswil, Schloss 1, Postfach, 8820 Waedenswil, Switzerland. Phone: (41)447836111, Fax: (41)447836341, E-mail: brion.duffy@acw.admin.ch E-mail symposium: fireblight2013@agroscope.admin.ch Web: http://www.fireblight2013.org
- July 15-19, 2013, Beijing (China): **VI International Symposium on the Taxonomy of Cultivated Plants.** Info: Prof. Zhang Qixiang, Nat'l Engineering Res.Center Floriculture, Beijing Forestry University, No.35, Qinghua East Road-Haidian Dist., Beijing 100083, China. Phone: (86)1062338005, Fax: (86)1062336321, E-mail: zqx@bjfu.edu.cn or Dr. Xiaobai Jin, Institute of Botany, Chinese Academy of Sciences, 20 Nanxincun, Xiangshan, 100093 Beijing, China. Phone: (86)1062591431, Fax: (86)1062590348, E-mail: jinxiaobai@hotmail.com E-mail symposium: istcp2013@gmail.com Web: http://www.istcp2013.org
- July 17-20, 2013, College Station, TX (United States of America): **I International Symposium on Pecans and Other Carya in Indigenous and Managed Systems.** Info: Dr. L.J. Grauke, USDA ARS, Pecan Breeding & Genetics, 10200 FM 50 Rd., Somerville, TX 77879-5764, United States of America. Phone: (1)979-272-1402, Fax: (1)979-272-1401, E-mail: lj.grauke@ars.usda.gov or Dr. Leonardo Lombardini, Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843-2133, United States of America. Phone: (1)9794588079, Fax: (1)9798450627, E-mail: l-lombardini@tamu.edu Web: http://www.ars.usda.gov/meetings/pecans2013/index.htm
- July 20-23, 2013, Taiyuan, Shanxi Province (China): **VII International Walnut Symposium.** Info: Prof. Jianbao Tian, Pomology Institute

of Shanxi, Academy of Agricultural Sciences, Shanxi, Taigu, 030815, China. Phone: (86)0351-7073034, Fax: (86)0354-6215001, E-mail: tianjb-001@163.com Web: http://www.iws2013.org/English/en_index.aspx

- NEW July 28-31, 2013, Orlando, FL (United States of America): **XII International Symposium on Plant Bioregulators in Fruit Production.** Info: Dr. Steven McArtney, NCSU, 455 Research Drive, Mills River, NC 28759, United States of America. Phone: (1)8286843562x115, Fax: (1)8286848715, E-mail: steve_mcartney@ncsu.edu or Dr. Timothy Spann, California Avocado Commission, 12 Mauchly, Suite L, Irvine CA 92618, United States of America. Phone: (1)9493411955, Fax: (1)9493411970, E-mail: tspann@avocado.org Web: http://www.pgrsa.org/index.php/conference
- August 11-14, 2013, Fort Collins, Colorado (United States of America): **II International Symposium on Plant Cryopreservation.** Info: Dr. Steve Wallner, Colorado State University, Dept of Hort LA CSU, Ft. Collins CO, 80525-1173, United States of America. E-mail: swallner@colostate.edu or Dr. David Ellis, International Potato Center, CIP, Avenida La Molina 1895, Lima, Peru. Phone: (51)13175337x3056, Fax: (51)13175326, E-mail: d.ellis@cgiar.org or Dr. Maria M. Jenderek, USDA-ARS, NCGRP, 1111 S. Mason Street, Fort Collins, CO 80521, United States of America. Phone: (1)970 495 3256, Fax: (1)970 221 1427, E-mail: maria.jenderek@ars.usda.gov Web: http://col.st/RlEtRA
- August 19-21, 2013, Portland, OR (United States of America): **I International Symposium on Horticulture Economics, Marketing and Consumer Research.** Info: Dr. Jennifer Dennis, 625 Agriculture Mall Dr., 320 Horticulture Building, West Lafayette, IN 47906, United States of America. Phone: (1) 765-494-1352, Fax: (1) 765-494-0391, E-mail: jhdennis@purdue.edu E-mail symposium: tgoodale@purdue.edu Web: http://tulip.hort.purdue.edu/ismcrh
- August 25-30, 2013, Hannover (Germany): **VI International Symposium on Rose Research and Cultivation.** Info: Prof. Dr. Thomas Debener, Leibniz University of Hannover, Institute for Plant Genetics, Herrenhäuser Straße 2, 30419 Hannover, Germany. Phone: (49)5117622672, Fax: (49)5117629292, E-mail: debener@genetik.uni-hannover.de E-mail symposium: roses2013@genetik.uni-hannover.de Web: http://www.rosesymposium2013.uni-hannover.de/
- August 28-30, 2013, Villenave d'Ornon, Bordeaux (France): **VI International Phylloxera Symposium.** Info: Nathalie Ollat, INRA, Institut des Sciences de la Vigne et du Vin, 210, chemin de Leysotte, 33883 Villenave d'Ornon, France. Phone: (33)5 57 57 59 30, Fax: (33) 5 57 57 59 03, E-mail: ollat@bordeaux.inra.fr E-mail symposium: phyllox2013@bordeaux.inra.fr Web: https://colloque.inra.fr/phyllox2013
- September 2-5, 2013, Cranfield (United Kingdom): **VI International Conference on Managing Quality in Chains MQUIC2013.** Info: Prof. Dr. Leon Terry, Plant Science Laboratory, Cranfield University, Bedfordshire, MK43 0AL, United Kingdom. Phone: (44) 7500766490, Fax: (44) 1525 863277, E-mail: l.a.terry@cranfield.ac.uk E-mail symposium: mquic-2013@cranfield.ac.uk Web: http://www.mquic2013.com
- September 2-6, 2013, Queretaro (Mexico): **59th Annual Meeting of Interamerican Society for Tropical Horticulture.** Info: Dr. Carlos Alberto Núñez Colín, Inst. Nacional de Investigaciones Forestale, Agrícolas y Pecuarias (INIFAP), KM 6,5 Carr Celaya-San M. de Allende, Aprdo postal 112, Guanajuato, Celaya, 38110, Mexico. Phone: (52)4616115323x113, E-mail: lit007a@gmail.com E-mail symposium: lixam2013@iasth.org Web: http://www.horticultura2013.org.mx/
- September 3-6, 2013, Olomouc (Czech Republic): **II International Symposium on Plum Pox Virus.** Info: Dr. Milan Navratil, Dept of Cell Biology and Genetics, Faculty of Science, Palacký University, Slechtitelu 11, 78371 Olomouc, Czech Republic. Phone: (420)685227646, Fax: (420)685221357, E-mail: milan.navratil@upol.cz Web: http://www.isppv2013.upol.cz
- September 9-13, 2013, Naivasha (Kenya): **I International Symposium on Ornamentals in Africa.** Info: Dr. Arnold Opiyo, Horticultural Association of Kenya (HAK), PO Box 562, 20100 Nakuru, Kenya. Phone: (254)723119044, Fax: (254)512111113, E-mail: aopiyo@hotmail.com Web: http://hakenya.net/index.php/ishs-symposium
- NEW September 12-14, 2013, Kolkata (India): **IV International Conference on Landscape and Urban Horticulture: Impact of Landscape Horticulture on Development of Urban Economy with Green Environment.** Info: Nilimesh Royhowdhury, Faculty of Horticulture, BCKV, PO Mohanpur, Nadia, West Bengal 741252, India. E-mail: nilimesh59@rediffmail.com or P.K. Chattopadhyay, Faculty of Horticulture, BCKV, PO Drishiviswavidyalaya, Mohanpur, West Bengal, 741252, India. E-mail: profpkc@rediffmail.com or Prof. Dr. Sisir Kumar Mitra, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741252, West Bengal, India. Phone: (91)3325823017, Fax: (91)3325828460, E-mail: sisirm@vsnl.net Web: http://www.icluh.in/
- September 20-24, 2013, Taian (Shandong Province) (China): **III International Symposium on Pomegranate and Minor Mediterranean Fruits.** Info: Prof. Dr. Zhaohe Yuan, Shandong Institute of Pomology, 64 Longtan Rd., Tai'an, Shandong Province 271 000, China. Phone: (86)538-8334070, Fax: (86)538-8225563, E-mail: zhyuan88@hotmail.com Web: http://www.pomegranate2013.com
- NEW September 25-27, 2013, Riva del Garda (Italy): **III International Symposium on Molecular Markers in Horticulture.** Info: Dr. Riccardo Velasco, Genomics & Biology of Fruit Crop Dept., Fondazione Edmund Mach, Via E. Mach, 1, 38010 S. Michele all'Adige, Italy. Phone: (39)0461 615 257, E-mail: riccardo.velasco@fmach.it E-mail symposium: events@fmach.it Web: http://eventi.fmach.it/Molecular-markers-2013
- October 6-11, 2013, Jeju (Korea (Republic of)): **Greensys 2013 - New Technologies for Environment Control, Energy-saving and Crop Production in Greenhouse and Plant Factory.** Info: Prof. Jung-Eek Son, Department of Plant Science, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul 151-921, Korea (Republic of). Phone: (82)28804564, Fax: (82)28732056, E-mail: sjeenv@snu.ac.kr or Prof. Dr. Yong-Beom Lee, Dept.Environmental Hortic., The University of Seoul, Jeonnong Dong Dongdaemun Ku, 130-743 Seoul, Korea (Republic of). Phone: (82)2-2210-2385, Fax: (82)2-2217-0158, E-mail: hydropo@uos.ac.kr E-mail symposium: info@greensys2013.org Web: http://www.greensys2013.org
- October 9-12, 2013, Debrecen (Hungary): **II European Congress on Chestnut.** Info: Dr. László Radócz, 138 Böszörmenyi Street, 4032 Debrecen, Hungary. Phone: (36)52508459, Fax: (36)52508459, E-mail: radocz@agr.unideb.hu or Dr. Milan Bolvansky, Institute of Forest Ecology SAS Zvolen, Branch of Woody Plants Biology, Akademická 2, 949 01 Nitra, Slovak Republic. Phone: (420)376943368, E-mail: milan.bolvansky@sav.savzv.sk or Prof. Dr. Mihai Botu, University of Craiova, SCDP Valcea, Str. Calea Traian nr. 464, 240273 Rm. Valcea, Romania. Phone: (40)250740885, Fax: (40)250740885, E-mail: stpomvl@onix.ro Web: http://www.chestnutdebrecen.eu
- NEW October 14-16, 2013, Lima (Peru): **International Symposium on Medicinal Plants and Natural Products.** Info: Dr. Jalal Ghaemghami, PO Box 320172, West Roxbury, MA 02132, United States of America. Phone: (1)3393686838, Fax: (1)3393686838, E-mail: jalal@shmen.org or Prof. Dr. Roberto Ponugal, Universidad Global Peru, Av. Camina Real L126, Urb. Quispicanchis, Cuzco, Peru. E-mail: antigua-ishs@shmen.org Web: http://www.ISMPNP2013.org
- NEW October 17-19, 2013, Nanchang (China): **XIII International Asparagus Symposium.** Info: Prof. Chen Guangyu, Jiangxi Academy of Agricultural Sciences, 330200 Nanchang, Jiangxi Province, China. Phone: (86)7917090308, Fax: (86)7917090001, E-mail: genebksh@hotmail.com E-mail symposium: asparaguschina@vip.sina.com Web: http://www.ias2013China.com
- October 20-25, 2013, Santiago (Chile): **II International Symposium on Organic Matter Management and Compost Use in Horticulture.** Info: Dr. Rodrigo Ortega, Avenida Santa Maria 6400, Vitacura, Santiago, Chile. Phone: (56)2-3531330, Fax: (56)2-3531228,

E-mail: rodrigo.ortega@usm.cl E-mail symposium: ishs2013chile@usm.cl Web: http://www.compost-for-horticulture.com

- October 28-31, 2013, Avignon (France): **II International Symposium on Organic Greenhouse Horticulture.** Info: Nicolas Sinoir, ITAB, 149 rue de Bercy, 75595 Paris Cedex 12, France. Phone: (33)467062370, E-mail: nicolas.sinoir@itab.asso.fr or Jérôme Lambion, GRAB, BP 11283, 84911 Avignon Cedex 9, France. Phone: (33)490840170, Fax: (33)490840037, E-mail: jerome.lambion@grab.fr Web: http://www.amiando.com/OGH_Symposium2013.html

- NEW October 28-31, 2013, Palermo (Italy): **VIII International Congress on Cactus Pear and Cochineal.** Info: Prof. Dr. Paolo Inglese, Department DEMETRA, Università degli Studi di Palermo, Viale delle Scienze, ED. 4, 90142 Palermo, Italy. Phone: (39)09123861234, Fax: (39)09123860820, E-mail: paolo.inglese@unipa.it or Prof. Dr. Innocenza Chessa, Dept. Of Economic & Woody Plants, University of Sassari, Via E. de Nicola 9, 07100 Sassari, Italy. E-mail: chessa_i@uniss.it E-mail symposium: cactus2013@unipa.it Web: http://www.soishs.org/cactuspear/

- NEW November 4-8, 2013, Tbilisi (Georgia) and Yerevan (Armenia): **International Symposium on Fruit Culture and its Traditional Knowledge along Silk Road Countries.** Info: Dr. Gagik Santrosyan, National Agrarian University, 74 Teryan Street, Yerevan, Armenia. Phone: (374)10528677, E-mail: g.santrosyan@asau.am or Dr. Aleksandr Kalantaryan, Head of Development Division, Raed Piu, 37 Mamikonyants street. ap.49, 00010 Yerevan, Armenia. Phone: (374)94 237805, E-mail: alikjan@gmail.com or Dr. David Bedoshvili, Agricultural University of Georgia, 13.Km Alley David Aghmashenebeli, Tbilisi 0131, Georgia. Phone: (995)577210905, E-mail: d.bedoshvili@agruni.edu.ge Web: http://www.silksym.com

- NEW November 19-22, 2013, Mt Maunganui (New Zealand): **I International Symposium on Bacterial Canker of Kiwifruit (Psa).** Info: Dr. David J. Tanner, General Manager - Science & Innovation, ZESPRI International, PO Box 4043, Mt Maunganui South, New Zealand. Phone: (64)75727665, Fax: (64)75748031, E-mail: david.tanner@zespri.com Web: http://www.psa2013.co.nz/

- December 4-7, 2013, Vientiane (Laos): **II Southeast Asia Symposium on Quality Management in Postharvest Systems.** Info: Dr. Antonio Acedo Jr, Postharvest Technology Division, Department of Horticulture, Visayas State University, 6521 Leyte Baybay, Philippines. Phone: (63)53-5637135), Fax: (63)53-3352752, E-mail: junacedo@yahoo.com or 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: sea2013.ishs@gmail.com Web: http://www.kmutt.ac.th/SEAsia2013

YEAR 2014

- February 19-21, 2014, Bangkok (Thailand): **II International Orchid Symposium.** Info: Assist. Prof. Apiradee Uthairatanakij, 83 M.8 Tientalay Rd., Bangkhuntien, Bangkok 10150, Thailand. Phone: (66)02 470 724, E-mail: apiradee.uth@kmutt.ac.th or Chin-An Chang, Chaoyang Technology University, 168 Jifong E. Rd.,, Wufong Township Taichung County, 413 Taichung, Chinese Taipei. Phone: (886)423331089, E-mail: cachang@cyut.edu.tw or Prof. Dr. Fure-Chyi Chen, 1 Hsue-fu Rd, National Pingtung University of Sci & Tech, Department of Plant Industry, 91201 Pingtung, Nei-pu Town, Chinese Taipei. Phone: (886)8-7740371, E-mail: fchen@mail.npust.edu.tw Web: http://www.kmutt.ac.th/IOS2014/

- NEW March 17-21, 2014, Wuhan, Hubei Province (China): **I International Symposium on Vegetable Grafting.** Info: Prof. Dr. Zhilong Bie, Huazhong Agricultural University, College of Horticulture & Forestry, Wuhan 430070, Hubei Province, China. Phone: (86)27-87286908, Fax: (86)27-87282010, E-mail: biezhilong@hotmail.com Web: http://www.grafting2014.com

- NEW April 1-3, 2014, Zhangzhou, Fuijan (China): **III International Symposium on the Genus Lilium.** Info: Dr. J.M. Van Tuyl, Plant Breeding, Wageningen University & Research Center, Droevendaalse steeg 1, 6708 PB Wageningen, Netherlands. Phone: (31)317481085, Fax: (31)317483457, E-mail: jaap.vantuyl@wur.nl or Dr. Wangzhao Zhu, No. 1 Wageningen Road, Zhangzhou, Fujian, 363105, China. Phone: (86)5966859258, E-mail: zhu@seadc.com Web: http://www.lilium2014.org

- April 7-12, 2014, Baku (Azerbaijan): **II International Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops.** Info: Dr. Zeynal Akparov, Genetic Recources Institute ANAS, 155 Azadlig Ave, 1106 Baku, Azerbaijan. Phone: (994)125639171, Fax: (994)124499221, E-mail: akparov@yahoo.com

- NEW May 12-15, 2014, Palermo (Italy): **IV International Symposium on Loquat.** Info: Dr. Francesca Barone, Università degli Studi di Palermo, Dept.of Agricultural & Forestry Sciences, Viale delle Scienze, 90128 Palermo, Italy. E-mail: baronefr@unipa.it or Dr. Riccardo Lo Bianco, Università degli Studi di Palermo, Dept.of Agricultural & Forestry Sciences, Viale delle Scienze 11, 90128 Palermo, Italy. Phone: (39) 09123896092, Fax: (39) 09123860813, E-mail: riccardo.lobianco@unipa.it Web: http://www.loquatsymposium2014.org/

- June 8-11, 2014, Lake Garda (Italy): **XIII International Symposium on the Processing Tomato - XI World Processing Tomato Congress.** Info: Dr. Adriano Battilani, c/o Consorzio di Bonifica di, 2°Grado Canale Emiliano Rom., Via E. Masi 8, 40137 Bologna, Italy. Phone: (39)0514298811, Fax: (39)051390422, E-mail: battilani@consorziocer.it 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 E-mail symposium: wptc2014@tomate.org Web: http://www.worldtomatocongress.com

- NEW June 10-13, 2014, Lemesos (Cyprus): **V International Conference Postharvest Unlimited.** Info: Assist. Prof. George Manganaris, Anexartisias 33, P.O. Box 50329, 3603 Lemesos, Cyprus. Phone: (357)25002307, Fax: (357)25002804, E-mail: george.manganaris@cut.ac.cy or Dr. Panagiotis Kalaitzis, Mediterranean Agronomic Inst. Of Chania, 85, Macedonia Str. P.O. Box 85, 73100 Chania, Greece. E-mail: panagiot@maich.gr E-mail symposium: a.orphanides@cut.ac.cy Web: http://web.cut.ac.cy/postharvest/

- July 13-18, 2014, Torino (Italy): **VIII International Symposium on Chemical and Non-Chemical Soil and Substrate Disinfestation.** Info: Prof. Maria Lodovica Gullino, Univ.delgi Studi di Torino, Patologia Vegetale, Via Leonardo da Vinci 44, 10095 Grugliasco (TO), Italy. Phone: (39)0116708539, Fax: (39)0116708541, E-mail: marialodovica.gullino@unito.it or Prof. A. Garibaldi, Univ.degli Studi di Torino, Patologia Vegetale, Via Leonardo da Vinci 44, 10095 Grugliasco (TO), Italy. Phone: (39)0116708539, Fax: (39)0116708541, E-mail: angelo.garibaldi@unito.it E-mail symposium: SD2014@unito.it Web: http://www.sd2014.org

- NEW July 28 - August 8, 2014, Beijing (China): **XI International Conference on Grapevine Breeding and Genetics.** Info: Dr. Li Shao-Hua, Institute of Botany, Chinese Academy of Sciences, Beijing, 210095, China. Phone: (86)0162836026, Fax: (86)0162836026, E-mail: shhli@ibcas.ac.cn or Dr. Chen Zong-Ming, Institute of Botany, Chinese Academy of Sciences, Beijing, 210095, China. Phone: (86)0162836026, Fax: (86)0162836026, E-mail: zmc@njau.edu.cn Web: http://www.grapebreeding2014.com/publish/portal4/tab164

- August 17-22, 2014, Brisbane (Australia): **XXIX International Horticultural Congress: IHC2014.** Info: Prof. Dr. Roderick A. Drew, Griffith University, Nathan Campus, Nathan Q4111, Australia. Phone: (61)737357292, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au or Prof. Dr. Ian J. Warrington, Emeritus Professor, Massey University, Private Bag 11 222, Palmerston North, New Zealand. Phone: (64)63505243, Fax: (64)63575619, E-mail: ianjw@xtra.co.nz or Luseane Taufa, Senior Plant Pathologist, Ministry Agric., Food, Forests

& Fisheries, P.O Box 14, Nuku'alofa, Tonga. Phone: (676) 23038, Fax: (676) 24271, E-mail: luseane.taufa@mafff.gov.to E-mail symposium: info@ihc2014.org Web: http://www.ihc2014.org/

SYMPOSIA AT IHC BRISBANE 2014

- August 17-22, 2014, Brisbane (Australia): **IV International Symposium on Papaya.** Info: Dr. Maureen Fitch, Hawaii Agriculture Research Center, P.O. Box 100, Kunia, HI 96759, United States of America. E-mail: mfitch@harc-hspa.com or Dr. Yun Judy Zhu, Hawaii Agriculture Research Centre, P.O. Box 100, Kunia, HI 96759, United States of America. E-mail: jzhu@harc-hspa.com or Prof. Dr. Roderick A. Drew, Griffith University, Nathan Campus, Nathan Q4111, Australia. Phone: (61)737357292, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au Web: http://www.ihc2014.org/symposium_34.html

- August 17-22, 2014, Brisbane (Australia): **IV International Symposium on Tropical Wines and International Symposium on Grape and Wine Production in Diverse Regions.** 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 Web: http://www.ihc2014.org/symposium_10.html

- August 17-22, 2014, Brisbane (Australia): **VII International Symposium on Education, Research Training and Consultancy.** Info: Dr. Alan Hunter, School of Agr., Food Sci and Vet Medicine, Agriculture and Food Science Centre, University College Dublin, Belfield, Dublin 4, Ireland. Phone: (353)1 716 7754, Fax: (353)1 716 1104, E-mail: alan.hunter@ucd.ie or Associate Professor Dr. David Aldous, 37 McCartney Street, Ormiston, QLD 4160, Australia. Phone: (61)07 3821 2082, E-mail: dealdous@gmail.com Web: http://www.ihc2014.org/symposium_20.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Eco-efficiency in the Lifecycle of Horticultural Production.** Info: Brent Clothier, Plant & Food Research, Climate Lab, Batchelar Road, PO Box 11-600, 4442 Palmerston North, New Zealand. Phone: +64 (6) 953-7687, E-mail: brent.clothier@plantandfood.co.nz or Dr. Ian Goodwin, Senior Research Scientist, Department of Primary Industries, Private Mailbag 1, Tatura, VIC 3616, Australia. Phone: (61)358335222, Fax: (61)358335299, E-mail: ian.goodwin@dpi.vic.gov.au Web: http://www.ihc2014.org/symposium_31.html

- August 17-22, 2014, Brisbane (Australia): **V International Conference on Landscape and Urban Horticulture.** Info: Prof. Dr. Gert D. Groening, Universitaet der Kuenste Berlin Institut GTG, Gartenkultur und Freiraumentwicklung, Postfach 12 05 44, 10595 Berlin, Germany. Phone: (49)3031852278, Fax: (49)3031852499, E-mail: groening@udk-berlin.de or Associate Professor Dr. David Aldous, 37 McCartney Street, Ormiston, QLD 4160, Australia. Phone: (61)07 3821 2082, E-mail: dealdous@gmail.com Web: http://www.ihc2014.org/symposium_28.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Plant Breeding in Horticulture.** 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 or Dr. Alastair Currie, Plant and Food Research, 55 Old Mill Rd, RD3, Motueka 7198, New Zealand. E-mail: alastair.currie@plantandfood.co.nz Web: http://www.ihc2014.org/symposium_23.html

- August 17-22, 2014, Brisbane (Australia): **II International Berry Fruit Symposium: Interactions! Local and Global Berry.** Info: Dr. Chad E. Finn, USDA ARS, Hort. Crops Lab., 3420 NW Orchard Ave., Corvallis, OR 97330, United States of America. Phone: (1)541738-4037, Fax: (1)541738-4025, E-mail: chad.finn@ars.usda.gov or Prof. Dr. Bruno Mezzetti, Dip.di Scienze Amb. e delle Prod.Veg., Università Politecnica delle Marche, Via Brecce Bianche, Ancona 60100, Italy. Phone: (39)0712204933, Fax: (39)0712204856, E-mail: b.mezzetti@univpm.it Web: http://www.ihc2014.org/symposium_12.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Tropical Fruit.** Info: Mr. Robert Nissen, 3 Maheno Court, Tin Can Bay, QLD 4580, Australia. Phone: (84) 838254457, Fax: (84) 838254457, E-mail: robertnissenahi1@gmail.com or Prof. Dr. Sisir Kumar Mitra, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741252, West Bengal, India. Phone: (91)3325823017, Fax: (91)3325828460, E-mail: sisirm@vsnl.net or Dr. Songpol Somsri, Senior Export Office, Horticulture Research Institute, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)25790583, Fax: (66)25614667, E-mail: songpolsom@yahoo.com Web: http://www.ihc2014.org/symposium_37.html

- August 17-22, 2014, Brisbane (Australia): **VI International Symposium on Human Health Effects of Fruits and Vegetables - FAVHEALTH2014.** Info: Dr. Tim O'hare, Gatton Research Station, Locked Bag 7, MS 437, Gatton Q4343, Australia. E-mail: t.ohare@uq.edu.au or Prof. Dr. Olaf Van Kooten, Wageningen University, Horticultural Production Chains Group, PO Box 630, 6700 AP Wageningen, Netherlands. Phone: (31)317-484091, E-mail: olaf.vankooten@wur.nl or Dr. Bhimanagouda Patil, VFIC, Texas A&M University, Department of Horticulture, 1500 Research Parkway Ste A120, College Station, TX 77845, United States of America. Phone: (1)9794588090, Fax: (1)9798624522, E-mail: bpatil@ag.tamu.edu Web: http://www.ihc2014.org/symposium_1.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Micropropagation and In Vitro Techniques.** Info: Dr. Maurizio Lambardi, IVALSA/Trees and Timber Institute, National Research Council (CNR), Polo Scientifico, via Madonna del Piano 10, I-50019 Sesto Fiorentino, Firenze, Italy. Phone: (39) 055 5225685, Fax: (39) 055 5225656, E-mail: lambardi@ivalsa.cnr.it or Sharon Ms. Hamill, Maroochy Research Facility, PO Box 5083 SCMC, Nambour Q4560, Australia. Phone: (61)754535942, Fax: (61)754535901, E-mail: sharon.hamill@daff.qld.gov.au or Prof. Dr. Roderick A. Drew, Griffith University, Nathan Campus, Nathan Q4111, Australia. Phone: (61)737357292, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au Web: http://www.ihc2014.org/symposium_26.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Molecular Biology in Horticulture.** Info: Prof. Dr. Rosario Muleo, Dept.. Crop Production, Università dellea Tuscia, Via S.C. De Lellis snc, Viterbo 01100, Italy. Phone: (39)0761357532, Fax: (39)761357531, E-mail: muleo@unitus.it or David Chagne, The NZ Institute for Plant & Research Ltd., Private bag 92169, Auckland Mail Ctr,, 1142 Auckland, New Zealand. E-mail: david.chagne@plantandfood.co.nz Web: http://www.ihc2014.org/symposium_24.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Organic Waste to Horticultural Resource.** Info: Dr. W.R. Carlile, Bord na Móna (Horticulture), Main Street, Newbridge, Co.Kildare, Ireland. E-mail: bill.carlile@bnm.ie Web: http://www.ihc2014.org/symposium_30.html

- August 17-22, 2014, Brisbane (Australia): **International Symposium on Plants, as Factories of Natural Substances, Edible & Essential Oils.** Info: Prof. Dr. Ákos Máthé, Borbély Street 5, 1132 Budapest, Hungary. Phone: (36)13204007, Fax: (36)13204007, E-mail: akos.mathe@upcmail.hu or Dr. Vera Sergeeva, 15/2 Hilts road, Strathfield NSW,2135, Australia. E-mail: sergeeva@tpg.com.au Web: http://www.ihc2014.org/symposium_42.html

- August 17-22, 2014, Brisbane (Australia): **IV International Symposium on Plant Genetic Resources: Genetic Resources for Climate Change.** Info: Dr. Hannah Jaenicke, Burghof 26, Schloss Gelsdorf, 53501 Grafschaft-Gelsdorf, Germany. Phone: (49)2225-8389895, E-mail: hannah.jaenicke@t-online.de or Dr. Sarah Ashmore, Griffith University, School of BBS, Kessels Rd. nathan, Brisbane, QLD 4111, Australia. Phone: (61)37357346, Fax: (61)37357656, E-mail: s.ashmore@griffith.edu.au or Dr. Luigi Guarino, The Global Crop Diversity Trust, c/o FAO, Viale delle Terme di Caracalla, 00153 Rome,

Italy. E-mail: luigi.guarino@croptrust.org Web: http://www.ihc2014.org/symposium_27.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Global Development and World Food Production.** Info: Dr. Alistair Gracie, Univ. of Tasmania TIAR, Private Bag 98, Hobart, Tasmania 7001, Australia. Phone: (61) 3 6226 7468, E-mail: alistair.gracie@utas.edu.au or Dr. Makiko Taguchi, FAO, Plant Production and Protection Division, Viale delle Terme di Caracalla, 00153 Rome, Italy. E-mail: makiko.taguchi@fao.org or Mr. Francis Appiah, Kwame Nkrumah University, Faculty of Agriculture, Department of Postharvest Technology, Knust, Kumasi, Ghana. Phone: (233)242070556, Fax: (233)5163769, E-mail: fappiah_sp@yahoo.com Web: http://www.ihc2014.org/symposium_3.html
- NEW August 17-22, 2014, Brisbane (Australia): **XVII International Symposium on Horticultural Economics and Management & V International Symposium on Improving the Performance of Supply Chains in the Transitional Economies.** Info: Dr. Peter J. Batt, Horticulture, Curtin University of Technology, GPO box U1987, Perth, WA 6845, Australia. Phone: (61)8 9266 7596, Fax: (61)8 9266 3063, E-mail: p.batt@curtin.edu.au or Prof. Dr. Peter P. Oppenheim, 3 Brooke Drive, Doncaster East, Victoria 3109, Australia. Phone: (61)3 9842 0145, E-mail: peter.oppenheim@ymail.com Web: http://www.ihc2014.org/symposium_21.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on the Impact of Asia-Pacific Horticulture - Resources, Technology and Social Welfare.** Info: Prof. Dr. Ki Sun Kim, Department of Plant Science, CALS, Seoul National University, Seoul 151-921, Korea (Republic of). Phone: (82)2-880-4561, Fax: (82)2-873-2056, E-mail: kisun@snu.ac.kr or Prof. Dr. Rifei Sun, Inst. of Vegetables and Flowers, Chinese Academy of Agric. Sci., 12 Zhongguancun Nandajie, Beijing 100081, China. Phone: (86)1082109511, E-mail: rifei.sun@caas.net.cn or Prof. Dr. Ryutaro Tao, Lab. Pomology, Fac. Agric., Kyoto University, Kitashirakawa Oiwake-cho, Sakyo-ku Kyoto 606-8502, Japan. Phone: (81)757536053, Fax: (81)757536497, E-mail: rtao@kais.kyoto-u.ac.jp Web: http://www.ihc2014.org/symposium_4.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Mango.** Info: Dr. Chitose Honsho, Faculty of Agriculture, University of Miyazaki, 1-1, Gakuenkibanadai Nishi, Miyazaki 889-2192, Japan. Phone: (81)985-58-7988, Fax: (81)985-58-7988, E-mail: chitose@cc.miyazaki-u.ac.jp or Dr. Wasan Pongsomboon, Phichit Agric. Res. & Develop. Center, Rongchang, Muang, Phichit 66000, Thailand. E-mail: wasan_psb@hotmail.com Web: http://www.ihc2014.org/symposium_39.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Innovative Plant Protection in Horticulture.** Info: Dr. Chris Hale, 83 Edmonton Road, Henderson, Auckland, New Zealand. Phone: (64)98387956, E-mail: hale@actrix.co.nz Web: http://www.ihc2014.org/symposium_18.html
- NEW August 17-22, 2014, Brisbane (Australia): **XII International People Plant Symposium: Horticulture and Human Communities: People, Plants and Places.** Info: Dr. Candice Shoemaker, 2021 Throckmorton, Department of Hort, Forestry, Rec Res, Kansas State University, Manhattan, KS 66506, United States of America. Phone: (1)7855321431, Fax: (1)7855326849, E-mail: cshoemak@ksu.edu or Prof. Dr. Francesco Di Iacovo, Dept. of Veterinary Science, University of Pisa, Vle Piagge 2, Pisa, Italy. E-mail: francovo@vet.unipi.it or Dr. Erja Rappe, Agricultural and Food Science, Editorial office, Department of Agricultural Sciences, PO Box 27, FI-00014 University of Helsinki, Finland. E-mail: erja.rappe@helsinki.fi Web: http://www.ihc2014.org/symposium_2.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on the Non-destructive Assessment of Fruit Attributes.** Info: Prof. Guglielmo Costa, Full Professor of Arboriculture, Dept. of Fruit Trees and Woody Plant Sci., Via G. Fanin 46, 40127 Bologna, Italy. Phone: (39)051 20 9 6443, Fax: (39)051 20 9 6401, E-mail: guglielmo.costa@unibo.it or Assist. Prof. Kerry Walsh, Plant Sciences Group, Central Queensland University, Bruce Highway, North Rockhampton QLD 4702, Australia. Phone: (61)749309707, Fax: (61)749306536, E-mail: k.walsh@cqu.edu.au Web: http://www.ihc2014.org/symposium_17.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Postharvest Knowledge for the Future.** Info: Prof. Julian Heyes, Inst of Food, Nutrition & Human Health, Massey University, Private Bag 11222, Palmerston North, New Zealand. Phone: (64)63505963, Fax: (64)63517050, E-mail: j.a.heyes@massey.ac.nz or Dr. John Golding, NSW DPI, Gosford Horticultural Institute, Locked Bag 26, Gosford NSW 2250, Australia. Phone: (61) 02-43481926, Fax: (61) 02-43481910, E-mail: john.golding@dpi.nsw.gov.au or Dr. Peter A. Toivonen, Ag. & Agri-Food Canada, Summerland, British Columbia, V0H 1Z0, Canada. Phone: (1)2504946386, Fax: (1)2504940755, E-mail: peter.toivonen@agr.gc.ca Web: http://www.ihc2014.org/symposium_19.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Abscission Processes in Horticulture and their Manipulation to Improve Crop Growth, Development and Quality.** Info: Dr. Shimon Meir, Dept.Postharvest Sci.Fresh Pr., The Volcani Center, ARO, PO Box 6, Bet Dagan 50250, Israel. Phone: (972)39683667, Fax: (972)39683622, E-mail: shimonm@volcani.agri.gov.il or Jeremy Roberts, University of Nottingham, School of Biosci. Sutton Bonington Campus, LE12 5RD Loughborough, United Kingdom. E-mail: jeremy.roberts@nottingham.ac.uk or Prof. Dr. Jens N. Wuensche, University of Hohenheim, Department of Crop Science, Section: Crop Physiology of Specialty Crops, 70599 Hohenheim, Emil-Wolff-Str. 25, Germany. Phone: (49)711-459-22368, Fax: (49)711-459-22351, E-mail: jnwuensche@uni-hohenheim.de Web: http://www.ihc2014.org/symposium_9.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Mechanisation, Precision Horticulture, and Robotics in Fruit and Vegetable Production.** Info: Dr. Matthew Whiting, Washington State University, IAREC, 24106 N. Bunn Road, Prosser, WA 99350, United States of America. E-mail: mdwhiting@wsu.edu or John McPhee, Vegetable Centre, Tasmanian Institute of Agriculture, Private Bag 3523, Burnie Tasmania 7320, Australia. E-mail: john.mcphee@utas.edu.au or Dr. Qin Zhang, Washington State University, Dept. Biological Systems Engr., Prosser Campus, Prosser WA 99350-9370, United States of America. Phone: (1)509-786-9360, E-mail: qinzhang@wsu.edu Web: http://www.ihc2014.org/symposium_16.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Ornamental Horticulture in the Global Greenhouse.** Info: Dr. Ed Morgan, Plant & Food Research, Private Bag 11600, Palmerston North 4442, New Zealand. Phone: (64) 6 3568300, Fax: (64) 6 3517050, E-mail: ed.morgan@plantandfood.co.nz or Prof. Dr. Richard A. Criley, Dept. of Tropical Plant & Soil Sci., University of Hawaii, 3190 Maile Way, No. 102, Honolulu, HI 96822, United States of America. Phone: (1)808-956-8492, Fax: (1)808-956-3894, E-mail: criley@hawaii.edu or Prof. Dr. Margrethe Serek, Leibniz University of Hannover, Faculty of Natural Sciences, Herrenhäuser Str. 2, 30419 Hanover, Germany. Phone: (49)511 762 2657, Fax: (49)511 762 2654, E-mail: serek@zier.uni-hannover.de Web: http://www.ihc2014.org/symposium_15.html
- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on New Technologies in Protected Cultivation.** Info: Prof. Stefania De Pascale, University of Naples, Department of Agricultural Eng. & Agronomy, Via Universita 100, 80055 Portici (Naples), Italy. Phone: (39)0812539127, Fax: (39)0817755129, E-mail: depascal@unina.it or Mr. Geoff Connellan, 372 Main Road, Lower Plenty Lower PLenty 3093, Australia. Phone: (61) (3) 9439 9830, Fax: (61) (3) 9431 2829, E-mail: geoffc@unimelb.edu.au or Prof. Weijie Jiang, Institute of Vegetables and Flowers, Chinese Academy of Agric. Sciences, 12 Zhongguancun S. Street, Beijing 100081, China. Phone: (86)1068918797, Fax: (86)1062174123, E-mail: jiangwj@mail.caas.net.

cn Web: http://www.ihc2014.org/symposium_22.html

- NEW August 17-22, 2014, Brisbane (Australia): **III International Conference on Turfgrass Management and Science for Sports Fields.** Info: Prof. Dr. Panayiotis Nektarios, Dept. of Floriculture and Landscape Archite, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)210 5294554, Fax: (30)210 5294553, E-mail: pan@aua.gr Web: http://www.ihc2014.org/symposium_29.html

- NEW August 17-22, 2014, Brisbane (Australia): **III International Genetically Modified Organisms in Horticulture Symposium - Past, Present and Future.** Info: Dr. Bart Panis, Lab. Tropical Crop Improvement, Willem de Croylaan 42, bus 2455, 3001 Leuven, Belgium. Phone: (32)16-321690, Fax: (32)16-321993, E-mail: bart.panis@biw.kuleuven.be or Dr. Trine Hvoslef-Eide, Norwegian University of Life Sciences, UMB, Boks 5003, 1432 Aas, Norway. Phone: (47) 64 96 50 04, Fax: (47) 64 96 60 24, E-mail: trine.hvoslef-eide@umb.no or Dr. Violy Villegas, Syngenta Philippines, 12th F, Two World Square, 22 Upper McKinley Rd., Fort Bonifacio, 1630 Taguig City, Philippines. E-mail: violeta.villegas@syngenta.com Web: http://www.ihc2014.org/symposium_25.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Water Scarcity, Salinization and Plant Water Relations for Optimal Production and Quality.** Info: Dr. Richard L. Snyder, University of California, 1 Shields Avenue, 243 Hoagland Hall, Davis, CA 95616-8627, United States of America. Phone: (1)5307524628, Fax: (1)5307521552, E-mail: rlsnyder@ucdavis.edu or Dr. Samuel Ortega-Farias, Casilla 747, Talca, Chile. Phone: (56)71200214, Fax: (56)71200214, E-mail: sortega@utalca.cl Web: http://www.ihc2014.org/symposium_5.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Sustainable Management in the Urban Forest.** Info: Dr. Greg Moore, University of Melbourne, Burnley Campus, Swan Street, Richmond Victoria 3121, Australia. E-mail: gmmoore@unimelb.edu.au or Mr. Neville Fay, The Old Rectory, Pilgrims Way, Chew Stoke, BS408TT Somerset Bristol, United Kingdom. Phone: (44)7968489588, E-mail: nevfay@treeworks.co.uk or David Lawry, Chair, TREENET, Director, Lawrys Landscapes & Nurseries, 580 Cherry Gardens Road, Cherry Gardens SA 5157, Australia. E-mail: david@treenet.org Web: http://www.ihc2014.org/symposium_33.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Tropical Ornamentals.** Info: Ms. Doris Marcsik, GPO Box 3000, Darwin Northern Territory 0801, Australia. Phone: (61) 8 89992017, E-mail: doris.marcsik@nt.gov.au or Dr. Vivian Loges, Univ.Federal Rural de Pernambuco, Rua José Bezerra de Albuquerque 38a, Recife, 54315-580, Brazil. Phone: (51)8134624552, Fax: (51)8133206250, E-mail: vloges@yahoo.com Web: http://www.ihc2014.org/symposium_38.html

- NEW August 17-22, 2014, Brisbane (Australia): **III 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. Guijun Yan, School of Plant Biology MO84, The University of Western Australia, 35 Stirling Hwy, Crawley WA 6009, Australia. Phone: (61) 8 6488 1240, Fax: (61) 8 6488 1108, E-mail: guijun.yan@uwa.edu.au Web: http://www.ihc2014.org/symposium_43.html

- NEW August 17-22, 2014, Brisbane (Australia): **VIII International Pineapple Symposium.** Info: Dr. Garth Sanewski, Maroochy Research Station, PO Box 5083, SCMC, 47 Mayers Rd, Nambour Queensland 4560, Australia. Phone: (61)7 54535949, Fax: (61)7 54535901, E-mail: garth.sanewski@daff.qld.gov.au Web: http://www.ihc2014.org/symposium_35.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Consumer and Sensory Driven Improvements to the Quality of Fruits and Nuts.** 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 Dr. Damiano Avanzato, International Horticulturist Consultant, Via Casaserena, 42, 00040 Pomezia (Roma), Italy. Phone: (39)3381109542, E-mail: damiano.avanzato@gmail.com or Dr. Roger Harker, Hort. Research, Mt. Albert Research Ctr Private Bag 92169, Auckland, New Zealand. E-mail: roger.harker@plantandfood.co.nz Web: http://www.ihc2014.org/symposium_11.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Indigenous Vegetables.** Info: Dr. Dyno Keatinge, AVRDC-The World Vegetable Ctr., P.O. Box 42, 741 Tainan Shanhua, Chinese Taipei. Phone: (886-6) 583 7401, Fax: (886-6) 583-0009, E-mail: dyno.keatinge@worldveg.org or Dr. Jaw-Fen Wang, 60 Yi Ming Liao, Shanhua, Tainan, Chinese Taipei. Phone: (886)6-5837801, E-mail: jaw-fen.wang@worldveg.org Web: http://www.ihc2014.org/symposium_13.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Unravelling the Banana's Genomic Potential.** Info: Dr. Inge Van den Bergh, Bioversity International, 1990 Boulevard de la Lironde, Parc Scientifique Agropolis II, 34397 Montpellier, France. Phone: (33)4-67611302, Fax: (33)4-67610334, E-mail: i.vandenbergh@cgiar.org or Dr. Mike Smith, QDPI, Maroochy Research Station, PO Box 5083, SCMC, Nambour, QLD 4560, Australia. Phone: (61)754412211, Fax: (61)754412235, E-mail: mike.smith@deedi.qld.gov.au Web: http://www.ihc2014.org/symposium_36.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on High Value Vegetables, Root and Tuber Crops and Edible Fungi - Production, Supply and Demand.** Info: Ass. Prof. Colin Birch, PO Box 3523, Burnie Tasmania 7320, Australia. E-mail: colin.birch@utas.edu.au or Dr. Bruce Searle, Plant & Food Research, Private Bag 11600, 4442 Palmerston North, New Zealand. E-mail: bruce.searle@plantandfood.co.nz Web: http://www.ihc2014.org/symposium_14.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Biosecurity, Quarantine Pests and Market Access.** Info: Dr. Bob Ikin, 25 Mayfair Place, Boondall, Queensland 4034, Australia. E-mail: bobikin@bigpond.net.au or Dr. Peter Whittle, 81 Diamond Street, Holland Park, Queensland 4121, Australia. Phone: (61)732393953, Fax: (61)732113253, E-mail: peter.whittle@qut.edu.au Web: http://www.ihc2014.org/symposium_32.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Physiology of Perennial Fruit Crops and Production Systems in a Changing Global Environment.** Info: Dr. Stuart Tustin, HortResearch, Havelock N-Res.C, Private Bag 1401, Havelock North, New Zealand. Phone: (64)68778196, Fax: (64)68774761, E-mail: stuart.tustin@plantandfood.co.nz or Dr. Ben van Hooijdonk, Plant and Food Research, Hawkes Bay, Private Bag 1401, Havelock North, 4130, New Zealand. E-mail: ben.vanhooijdonk@plantandfood.co.nz Web: http://www.ihc2014.org/symposium_8.html

- NEW August 17-22, 2014, Brisbane (Australia): **International Symposium on Horticulture to Improve the Livelihoods of Communities in Developing Countries.** Info: Prof. Dr. Gordon Rogers, University of Sydney, Biomedical Building 1 Central Ave, Eveleigh, NSW 2015, Australia. Phone: (61) 2 8627 1040, Fax: (61) 2 9544 3782, E-mail: gordon@ahr.com.au or Dr. Steven Underhill, 32 Stanley Terrace, Taringa Queensland 4068, Australia. Phone: (61)7 3371 6429, E-mail: s.underhill@uq.edu.au Web: http://www.ihc2014.org/symposium_6.html

- September 18-22, 2014, Dujiangyan city, Chengdu (China): **VIII International Symposium on Kiwifruit.** Info: Prof. Dr. Hongwen Huang, Director South China Inst. of Botany, Chinese Academy of Sciences, Xingke Road #723, Tianhe District, Guangzhou 510650, China. Phone: (86)20-37252778, Fax: (86)20-37252711, E-mail: huanghw@mail.scbg.ac.cn

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