Chronica Horticulturae

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Horticultural Highlights

Natural Capital, Footprints and Eco-Credentials • The History and Current Status of Cucurbit Grafting in Israel • Innovating together for Sustainable Horticulture • An Overview of Horticulture in Turkey • Vegetable Production in India: an Overview

Symposia and Workshops

Carrot and other *Apiaceae* • Kiwifruit • Grapevine Roots

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CHRONICA HORTICULTURAE

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Cover photograph: Kiwifruit orchards bordering Tauranga Harbour in the Bay of Plenty, New Zealand, with Mt Maunganui in the background. © Plant & Food Research. See article p. 4.

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eJHS – It's Here and it Looks Good...

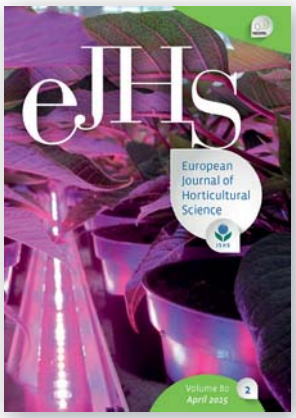
Yves Desjardins

Yves Desjardins, ISHS Board Member Responsible for Publications

I do not know if you are like me, but it is always a nice feeling when you see one of your projects taking shape and coming to fruition. Indeed, in my free time, when I am not revising articles and *Chronica*'s symposium reports, I like spending time wood working and renovating my house. The hobbies are rewarding because you end up with a tangible achievement after your hard work. The same is true when you publish your research at the conclusion of a project or when you graduate one of your students. All these give you a feeling of accomplishment and purpose, which encourage you to start new projects.

Well, I must say that I felt a great sense of pride and achievement when I received in February the first issue of our new ISHS publication, the European Journal of Horticultural Science, eJHS. The new journal really looks great and even surpasses what we expected in our dreams a year ago when ISHS acquired the journal. I must congratulate the Editor-in-Chief, Dr. Jens Wünsche, and all the staff at the Secretariat who have done nothing short of an exceptional job establishing, in a very tight timeframe, what is essentially a new scientific journal. The result of this team effort is in my mind breathtaking as you can see for yourself in the first issue available in open-access on-line (www.ishs.org/ejhs).

Looking at the other horticulture journals, eJHS really stands out on many levels. First, the new layout and style is modern and attractive. The cover page is distinctive with its background photo and the new logos, which follow the new visual signature of ISHS. It invites the reader to dig-in at once. The layout of the articles also attracts the eye. While being uncluttered and refined, it provides all the necessary information you are to expect from a high-end scientific journal. A top banner highlights the type of article being published, a review, an original article or a short note. The title and authors are prominent and the summary is singled-out in a shadowed box. Most distinctively, the title page includes a new section that was borrowed from many clinical medicine journals where the significance of a study is highlighted in a framed section. In eJHS, one can rapidly skim through articles by reading the answers to three main questions: 1- What is already known on this subject? 2- What are the new findings? and 3- What is the expected impact on horticulture? These questions should be answered in less than 140 characters and be Tweettable with the proper hash tags. The eJHS web site has also been fully redesigned and integrated to the PubHort section (www.pubhort.org/ejhs/). Readers can have full access to the PDF articles but also the cross-referenced bibliography, a great tool for rapidly accessing the sources of an article. The journal also takes advantage of the integration of color in manuscripts.



Cover of the April issue of eJHS.

WHAT'S UNDER THE HOOD?

The changes to eJHS are not only cosmetic and many new features have been implemented at the root of the system. The submission starts with a new set of specific guidelines elaborated by the editorial committee and the ISHS Secretariat. The flow of articles between the Editor-in-Chief, the Associate Editors, the reviewers and the authors have clearly been established and can readily be tracked on-line. The editors will have access to the database of ISHS active members from which to select competent reviewers. Using the on-line manuscript management system Editorial Manager™ from Aries, the review process should be efficient and swift. Technical editing will be done within the ISHS Secretariat using state-of-the-art technical editing tools like eXtyles editing software and will include full cross-referencing, DOI assignment, anti-plagiarism and computer assisted technical editing. The page layout will also be done in Leuven using standard software like Adobe InDesign™.

Everything is thus in place to receive your manuscripts. eJHS is accepting original articles right now but also review articles and research notes. The new ISHS Science Editor is also overlooking those articles from *Acta Horticulturae*, which could be upgraded and published in eJHS. We are thus awaiting with anticipation your contributions and count that you will support "YOUR" journal.

CHANGE TO *CHRONICA* EDITORSHIP

On a final note, I would like to inform all ISHS members that I will be passing over the editorship of *Chronica Horticulturae* to my Board colleague Jill Stanley who will continue the task of bringing you the tri-monthly edition of the ISHS magazine. Considering the many tasks I have ahead, including implementation of the transition of *Acta* 2.0 and the ISHS journal strategy, the Board has agreed, on my suggestion, to transfer the reins of the publication to Jill. I am sure she will continue publishing the magazine in the spirit and tradition of our mentor, Jules Janick, but will inject a new vision to continue the legacy of this popular communication tool for the Society. I wish good luck to Jill and stand behind her during the transition.

Significance of this article

What is already known on this subject?

- ISHS has just acquired a new scientific journal: #eJHS. The first issue was published online through PUBHORT and on paper in February (www.ishs.org/ejhs)

What are the new findings?

- eJHS has a fresh new modern look. It is published by a competent editorial team led by @Jens_Wünsche using state-of-the-art technological editing tools.

What is the expected impact on horticulture?

- eJHS, a full open-access journal, should have a deep impact on horticulture research through the publication of significant findings by ISHS members.

Natural Capital, Footprints and Eco-Credentials

Brent Clothier

Our soils and their carbon stocks, our waters, our biodiversity and our climate are prime natural-capital stocks. Ecosystem services, which benefit mankind, flow from natural-capital stocks. Horticulture is vitally dependent on natural capital but the stocks are finite and they are under growing pressures as a result of the intensification of land uses and population growth. There are burgeoning concerns about mankind's over-consumption of natural resources. As a result, there is increased interest in informing consumers about the environmental footprint of the products they purchase. Carbon and water footprints are the first to have formal protocols developed for their determination. However, we show here that carbon cycling and water cycling are not well represented in these protocols. We note that supermarkets are currently emerging as a powerful vehicle for public education concerning the consumption of natural capital during product development. They are leading the creation of easily understood environmental declarations about the negative impact of the production footprint of goods and services. These supermarkets have publicly declared their plans for not only enhancing the sustainability of their own operations, but also those upstream through the suppliers of their goods and services. Fruit and fruit products will receive eco-premium pricing when they exhibit the eco-credentials to reach the best shelves of these discerning supermarkets.

NATURAL CAPITAL AND ECOSYSTEM SERVICES

The natural-capital concept attempts to integrate economic thinking with ecological principles by considering nature's stocks of materials and energy as capital. In economics, interest, or rents, flows from financial or built capital; in nature, ecosystem services, which benefit mankind, flow from natural-capital stocks. Our soils and their carbon stocks, our waters, our biodiversity and our climate are prime natural-capital stocks. Horticulture is critically dependent on natural capital.

Around the turn of the century, frameworks for quantifying natural capital and valuing ecosystem services were proposed (Costanza et al., 1997; Daily, 1997). In 2001, the United Nations sponsored a major initiative called the Millennium Ecosystem Assessment aiming to assess the state of the world's ecosystem services and to consider the consequences of the diminution of ecosystem services due to the increasing degradation of the world's ecological infrastructures. Their findings (Millennium Ecosystem Assessment, 2005) classified ecosystem services into four broad, and often overlapping categories:

- *Supporting services:* Those necessary for production of the other services, such as soil formation.
- *Provisioning services:* Production of food, fuel, and fibre. We well know the economic value of the provisioning services provided by horticulture.
- *Regulating services:* The buffering and filtering of water, gases, and chemicals.
- *Cultural services:* Heritage, recreation, aesthetics, and spiritual well-being.

In a seminal paper in *Nature*, Costanza et al. (1997) estimated the annual value of 17 terrestrial ecosystem services, all involving the soil-plant-atmosphere system, to reach US$5.74 trillion. When oceanic services were added in, the global value of the earth's natural capital and ecosystem goods and services, amounted to US$33 trillion per year. Yet we receive these services for free. Gross global economic productivity sums to only $18 trillion per year. The problem is that our natural-capital stocks are finite and they are under growing pressures as a result of the intensification of land uses and population growth. Through intensification we could, as Hawken et al. (1999) assert in their very interesting book *Natural Capitalism, "… temporarily exceed the carrying capacity of the earth, but put our natural capital into decline"*. This is a fool's paradise, for they warn that *"… the ability to accelerate a car that is low on gasoline does not prove the tank is full"*.

"Much has changed in the last century" write Kubiszewski and Costanza (2012). They add that *"... when the world was still relatively empty of humans and their built infrastructure, natural resources were abundant …[but now] the human footprint has grown so large that in many cases real progress is constrained more by limits on natural resources and ecosystem services than by limits on built capital infrastructure"*.

There are burgeoning concerns about mankind's over-consumption of natural resources. As a result, there is increased interest in informing consumers about the footprint of the products and services they purchase. The goal is to encourage green consumerism by declaring to prospective purchasers the environmental footprint of the products and services they might wish to buy.

Our carbon stocks (and their associated greenhouse gas emissions) and the natural assets of our waters are the fundamental assets that are critical for delivering horticultural ecosystem services. Unfortunately they are the two assets that are under greatest threat due to the footprint of food production. It is not surprising then that carbon and water footprints are the first to have formal protocols developed for their determination, so as to avoid green-washing by the publication of false claims. This is admirable!

FOOTPRINTING PROTOCOLS

The first, formal footprint-protocol was for carbon and it was published in 2008 by the British Standards Institute. It was the Publicly Available Specification PAS 2050:2008 for the *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.* This was updated in 2011, and a specification for supplemental information for horticultural products was then published in 2012 (British Standards Institute, 2012).

Despite soil carbon being the largest terrestrial pool of carbon, soil-carbon dynamics are poorly treated in the PAS 2050. In Section 5.7, the **Treatment of soil carbon change in existing systems,** it states

that *"... where not arising from land use change, changes in the carbon content of soils including both emissions and removals shall be excluded from the assessment of GHG emissions under this PAS"*. This is unfortunate!

In 2013, the International Standards Organisation (ISO) ratified a Technical Standard on carbon footprinting. Agreement could not be reached to pass it as an International Standard. The ISO/TS 14067:2013 is about **Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification and communication** (International Standards Organisation, 2013). Soil carbon fares a little better in ISO/TS 14067, than it did in the PAS 2050. In Section 6.4.9.5, **Soil carbon change,** it is noted that *"... if not calculated as part of land-use change, the GHG emissions and removals occurring as a result of soil carbon change should be assessed and should be included in the life cycle inventory carbon footprint."* Soil carbon change is therefore a 'should', not a 'shall'. Its inclusion is optional. This is also unfortunate. Later, we evaluate the impact of including soil carbon changes in the carbon footprint of New Zealand kiwifruit.

Water footprinting was the next protocol to be formally addressed. The Water Footprint Network (WFN) was the first to develop a formal protocol, and this directly focussed on water consumption, rather than the full hydrological cycle. Details can be found at: http://www.waterfootprint.org/?page=files/home.

Recently the ISO has ratified an international standard on water footprinting (http://www.iso.org/iso/catalogue_detail?csnumber=43263). The ISO 14046:2014 is about **Environmental management – Water footprint – Principles, requirements and guidelines.** This standard is not prescriptive as to how the hydrologic cycle should be addressed, and various examples of how this might be done are provided as examples. All tend to focus on the consumptive side of the water balance equation. They tend not to consider drainage, for it is taken to be 'lost'. We show how referencing the full hydrological cycle can enable a footprint to be calculated on the basis of the net balance between the consumptive (evapotranspiration - ET) losses and the recharge (rainfall - RF and drainage - DR) components of the water balance (Deurer et al., 2011). This is applied to the water footprint of a bottle of wine (Herath et al., 2013).

Figure 1. The headlines from a recent blog by The Sustainability Consortium.

Because of the 'highly technical', and often the 'non-prescriptive' nature of these recent protocols, they have yet to be fully 'road-tested'. So their use to encourage public awareness and foster sustainable developments is considered to be somewhat limited at present. Rather, supermarkets are emerging as a force in the education of the public about the over-consumption of natural capital. Also, they are leading the creation of easily understood environmental declarations about the negative impact of the production footprint of goods and services.

ECO-CREDENTIALS AND SUSTAINABLE SUPPLY CHAINS

There are positive flip sides to these production footprints that need to be highlighted. One is that the sum of all of the ecosystem services flowing from vineyards and orchards provides a 'hidden' bounty to the whole community through delivering provisioning, supporting, regulating and cultural services. We can add another perspective to the provisioning service for the grower – that of an eco-premium return from the marketplace for these fruit and fruit products. Premium horticultural products are destined for the shelves of the world's top supermarkets. Increasingly, environmentally conscious consumers are seeking out supermarkets[1] that sell only eco-verified products that have been sustainably produced. These supermarkets have publicly declared their plans for not only enhancing the sustainability of their own operations, but also those upstream, in other words the supply chain of their goods and services. Products, including horticultural produce, will receive eco-premium pricing when they have the eco-credentials to be on the best shelves in these discerning supermarkets.

But there is also a new and emerging dynamic that is linking producers and supermarkets. Recently, we have seen the development of formal networks and quangos that are linking producers, supermarkets and consumers so as to encourage sustainable developments in supply chains and the use of correct environmental product declarations. One example of such a formal network is The Sustainability Consortium (http://www.sustainabilityconsortium.org/). They report that *"The Sustainability Consortium© (TSC©) is an organization of diverse global participants that work collaboratively to build a scientific foundation that drives innovation to improve consumer product sustainability. We develop transparent methodologies, tools, and strategies to drive a new generation of products and supply networks that address environmental, social, and economic imperatives."* A recent blog on their news page (http://www.sustainabilityconsortium.org/news/) on 8 December 2014 highlights the issue with footprints, and outlines their proposed solution (Fig. 1).

There, Tim Greiner notes that *"… a whopping 97 percent of environmental impacts in the retail sector comes from the product itself – from raw materials, transportation and product manufacturing. With impacts so heavily weighted in the supply chain, retailers are increasingly and creatively wading upstream to partner with their suppliers on their greatest impacts. The key to success lies in selecting the appropriate supplier engagement method and then using that approach as a vehicle to deeper collaboration."*

Another network initiative is the European Union's programme to develop footprint metrics of product sustainability (http://ec.europa.eu/environment/eussd/smgp/product_footprint.htm). On 3 June 2014 they noted that there had been

[1] Walmart: http://www.walmartsustainabilityhub.com/; Marks & Spencer: http://plana.marksandspencer.com/; Tesco: http://www.tescoplc.com/assets/files/cms/Water.pdf; Sainsbury's: http://www.j-sainsbury.co.uk/responsibility/our-values/sourcing-with-integrity/; Carrefour: http://www.carrefour.com/cdc/responsible-commerce/sustainability-report/

"…selection of proposals for the 2nd wave of Environmental Footprint pilots. The selection was based on criteria such as the capacity of the proponents to involve a representative percentage of the market, the diversity of product groups and the sectors covered.

- *Beer, proposed by Brewers of Europe*
- *Coffee, proposed by the European Coffee Federation*
- *Dairy, proposed by the European Dairy Association*
- *Feed for animals, proposed by the European Feed Manufacturers' Federation*
- *Fish for human consumption, proposed by the Norwegian Seafood Federation*
- *Meat, proposed by the European Livestock and Meat Trades Union*
- *Pasta, proposed by the Organisations of Manufacturers of Pasta Products in the EU*
- *Packed water, proposed by the European Federation of Bottled Waters*
- *Pet food (cats & dogs), proposed by the European Pet Food Industry Federation*
- *Olive oil, coordinated by CO2 Consulting S.L.*
- *Wine, proposed by the Comité Européen des Entreprises Vins"*

Horticultural products feature highly on this list. Of greatest concerns are the footprints of carbon and the associated greenhouse gas (GHG) emissions, plus that due to water consumption.

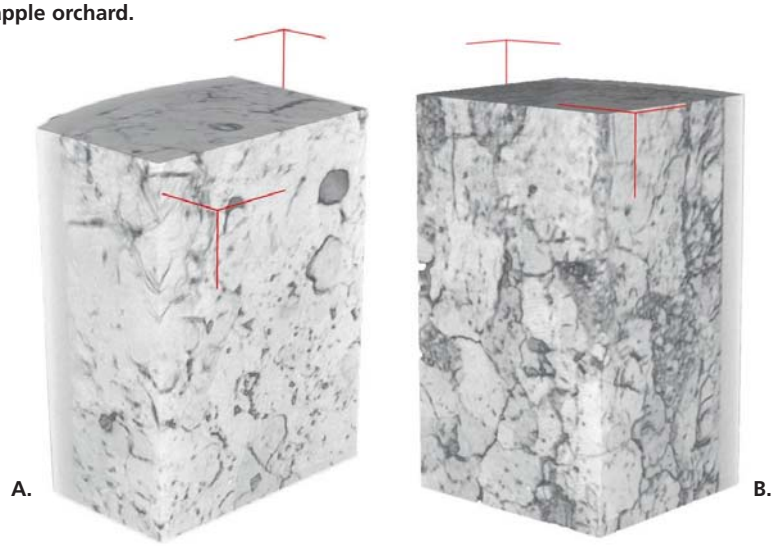
CARBON SERVICES AND GHG FOOTPRINTS

Soil carbon stocks are the largest global pool of terrestrial carbon. Soil carbon is absolutely essential for delivering soil ecosystem-services for two different purposes. Firstly, maintaining soil-carbon stocks, or preferably sequestering more carbon in the soil, will help mitigate climate change by limiting GHG emissions to the atmosphere. Secondly, soil is soil because of carbon. We call soil without carbon rock or desert. Carbon is the life force of the biological and biophysical processes in soil. It is important that we recognise the value of carbon in delivering the myriad of valuable ecosystem services from soil stocks.

Deurer et al. (2009) quantified the carbon status and carbon-related services of two neighbouring apple orchards in the Hawke's Bay of New Zealand. The orchards were planted at the same time about 10 years earlier. Whereas one orchard embarked on a certified organic programme of orchard management, the other employed certified integrated fruit production (IFP) practices. In the organic orchard some 5-10 t ha^{-1} of compost were applied annually to provide for the trees' nutrient requirements, whereas small amounts of inorganic fertiliser were used in the other. As a result of these quite different carbon-management processes, the soil carbon stocks of the top 0.1 m in the tree rows of the two orchards had become quite different: 3.8 kg-C m^{-2} for the organic orchard of which 110 g-C m^{-2} was the labile carbon found using hot-water extraction; and 2.6 kg-C m^{-2} for the IFP orchard, of which 60 g-C m^{-2} was of the hot-water extractable labile form of C.

But this carbon investment provides other returns. Deurer et al. (2009) and Clothier et al. (2011) reported on the impact on the soil's macropore structure of the different soil carbon management practices between these two apple orchards. The porous structure of the 43 mm long soil cores from these two orchards was resolved using 3D X-ray computed tomography, and macropores were defined as being pores of diameter greater than 0.3 mm. For the two cores shown in Figure 2, the volumetric average macroporosity in the core from the organic orchard was 9.4 (± 1.7) %, whereas it was just 3.1 (± 1.4) % in that from the IFP orchard. Thus the anthropogenic driver of different carbon investment strategies between the two orchards has not only had an impact on the soil's manageable properties of its macroporosity, but also the connectedness of its macroporous network (Fig. 2). These have, in this case, affected the natural-capital value of the two soils through altering their respective supporting and regulating processes of aeration, infiltration, leaching, niche locations for microbial activity, and nutrient cycling (Robinson et al., 2013).

Figure 2. X-ray tomographic images of soil determined at the SIMBIOS Centre of the University of Abertay (Dundee, Scotland) (adapted from Deurer et al., 2009).
A. An undisturbed soil core (70 mm diameter, 100 mm length) taken from the row of the integrated apple orchard where the top of the column is the soil surface.
B. As for Figure 2A, but for an undisturbed soil core from the row of the organic apple orchard.



The supporting processes of nutrient cycling are closely linked to the supporting functions of biological activity, which will be related, *inter alia,* to the manageable property of the soil's organic matter content.

Kim et al. (2008) obtained a number of samples from both orchards and carried out 40-day incubations to determine the nitrogen mineralisation rate in the soil. Their results are reproduced in Figure 3. A strong and positive relationship was found between the soil's hot-water carbon (HWC) content and the rate of nitrogen mineralisation.

The investment of compost into the ecological infrastructure of the soil has led to a change in the soil's manageable property of its carbon content and this has enhanced the supporting process of the nutrient cycling of nitrogen. The value of the supporting services coming 'free of charge' from the soil's natural-capital stock of labile carbon has been enhanced through the investment of carbon into the soil's ecological infrastructure.

The perennial tree and vine crops of horticultural plants can also generate valuable ecosystem services for the atmosphere to assist in the mitigation of climate change by sequestering carbon deep in the soil of the rootzone – despite the weak recognition this currently receives in carbon footprinting protocols such as the PAS 2050 and ISO/TS 14067. Beyond soil ecosystem services, soil carbon can assist in the delivery of ecosystem services to the atmosphere to mitigate climate change. Investment in soil carbon can indeed reduce the carbon footprint of horticultural products.

Figure 3. The correlation between hot-water carbon (HWC) content of the soil's carbon stocks and the ecosystem services of net nitrogen-mineralisation (from Kim et al., 2008).

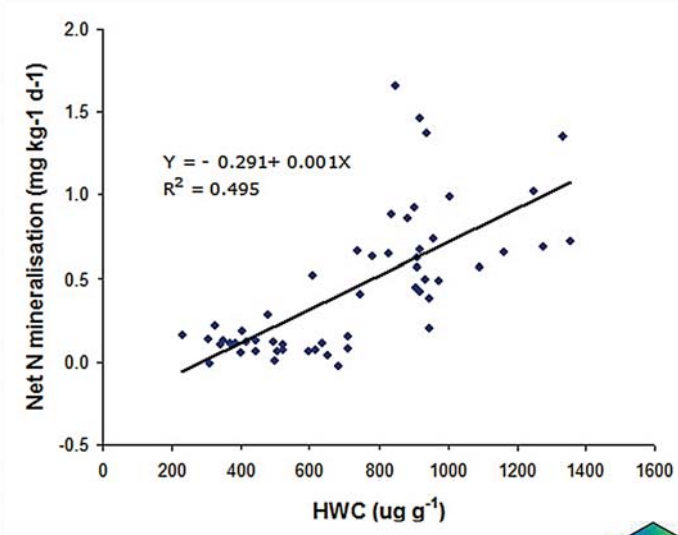
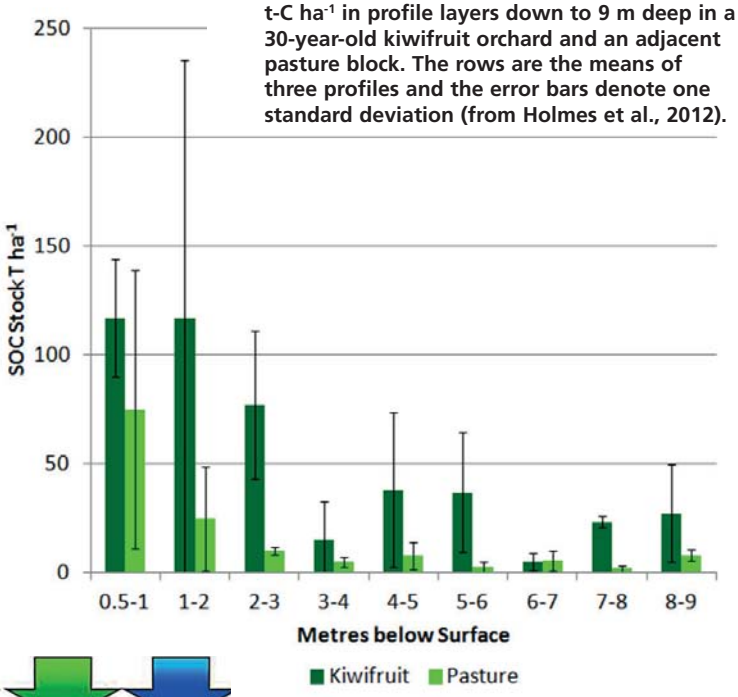


Figure 4. Soil organic carbon (SOC) stocks in t-C ha^{-1} in profile layers down to 9 m deep in a 30-year-old kiwifruit orchard and an adjacent pasture block. The rows are the means of three profiles and the error bars denote one standard deviation (from Holmes et al., 2012).



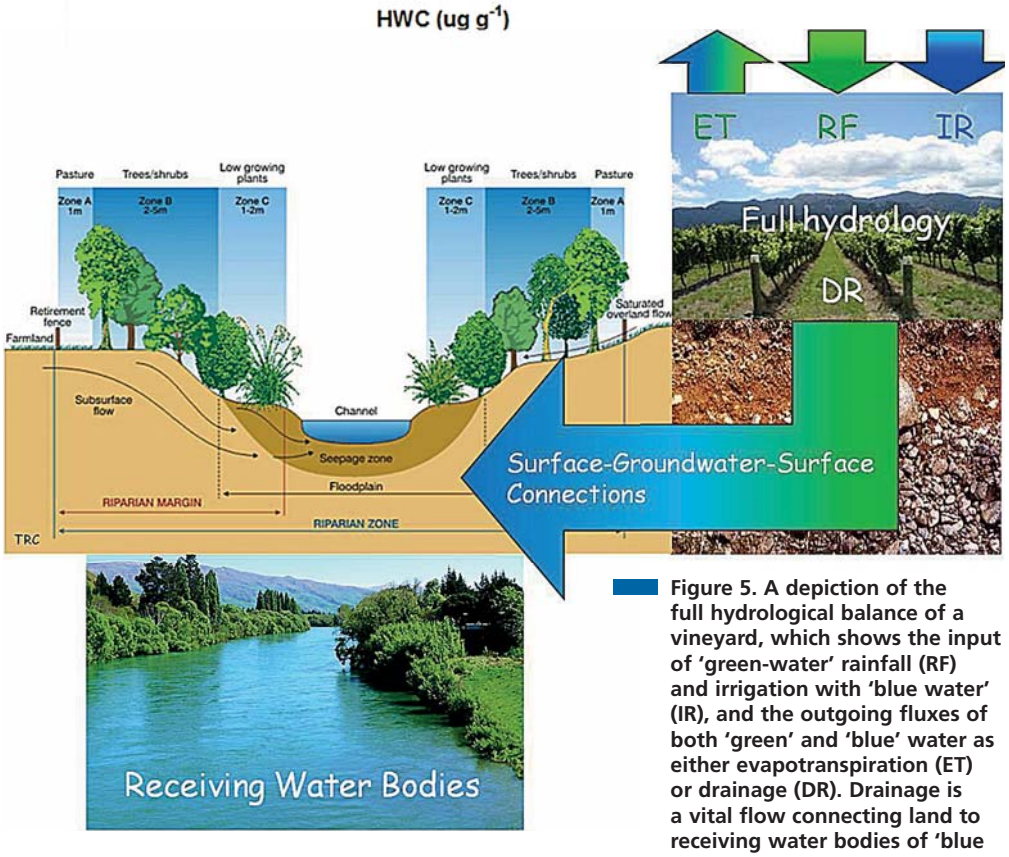


Figure 5. A depiction of the full hydrological balance of a vineyard, which shows the input of 'green-water' rainfall (RF) and irrigation with 'blue water' (IR), and the outgoing fluxes of both 'green' and 'blue' water as either evapotranspiration (ET) or drainage (DR). Drainage is a vital flow connecting land to receiving water bodies of 'blue water'. Drainage is not 'lost'. It recharges 'blue-water' resources.

Holmes et al. (2012) extended the soil carbon sequestration work of Deurer et al. (2010) by deep-C drilling down to 9 m under a kiwifruit orchard. They compared that carbon profile with the equivalent profile down to 9 m in the neighbouring pasture, which was the antecedent land-use some 30 years earlier. Their measured profiles of soil carbon are reproduced in Figure 4, and they show that kiwifruit have extended the zone of carbon well down through the soil profile. Chabbi et al. (2009) noted that deep soil organic matter is an important yet poorly understood component of the terrestrial C cycle. The sequestration rate of soil carbon in this 'growing' soil described in the kiwifruit study of Holmes et al. (2012) was 6.3 t-C ha^{-1} y^{-1}.

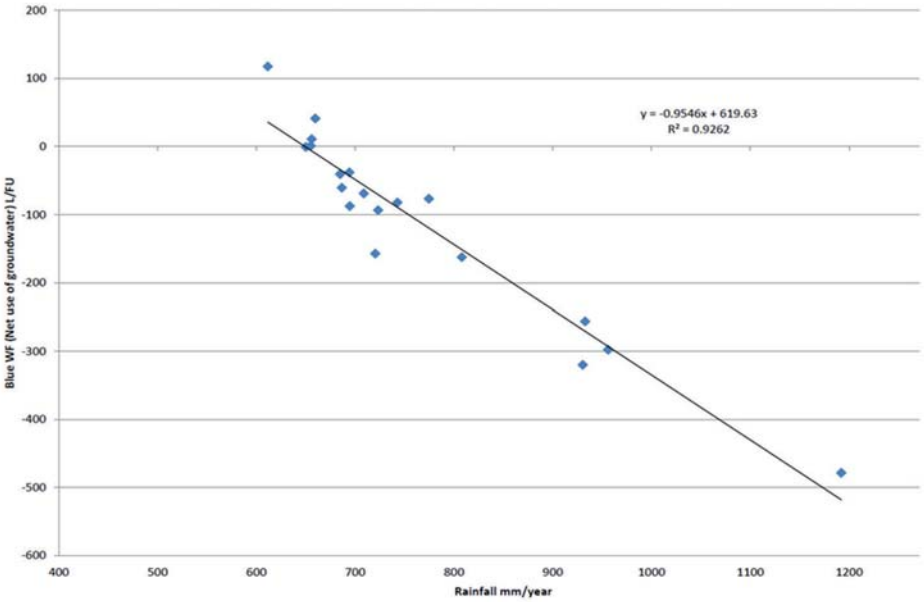
This carbon sequestration is providing a regulatory service to the atmosphere by sequestering a fraction of the carbon captured through the vine's photosynthesis. Indeed, if this carbon capture was able to be used in the schema for carbon footprinting, it would reduce the carbon footprint of a tray of New Zealand kiwifruit landed in Europe to 42% of that specified in the 'weak' PAS 2050 protocol of the British Standards Institute. Thankfully, soil carbon is now able to be considered in the recent ISO Technical Standard, albeit optionally, despite the twofold impact it would have in this instance!

It is important that perennial tree and vine crops are recognised for the valuable ecosystem services they provide, not only for food provision and nutrient cycling, but also for their value in mitigating climate change through sequestering or maintaining carbon in the soil.

HYDROLOGY AND WATER FOOTPRINTS

The carbon-fuelled soil of the rootzone of horticultural crops is the nexus between rainfall inputs, rootzone water storage, root water and nutrient uptake, and the drainage recharge of underlying aquifers. Water stored in the soil is referred to as green water (Deurer et al., 2011). Water drawn from aquifers, lakes or rivers for irrigation, frost fighting and processing is referred to as blue water. Our groundwaters are a vital blue-water resource, and they are recharged by drainage flows through the soil, and through the beds of our rivers and lakes. It is important that water footprint protocols take into account not only the upward flows of water vapour

Figure 6. A scatter plot showing the relationship of the blue-water footprint calculated from the hydrological approach across the local climatic regions of vineyards within Marlborough, New Zealand, referenced to the local annual rainfall rates (from Herath et al., 2012).



as in the consumptive approach of the WFN, but also the downward liquid flows of drainage that recharge aquifers (Deurer et al., 2011; Herath et al., 2012) (Fig. 5). Valuable regulating services flow from the interactions between the natural-capital stock of rainfall and the natural-capital stock of the soil.

Herath et al. (2013) assessed the water footprint of a bottle of Marlborough wine using a hydrological approach to water footprinting, unlike the consumptive-only approach advocated by the WFN (www.waterfootprint.org). Herath et al. (2012) found that every bottle of Marlborough wine (the functional unit, FU) packed and ready for despatch at the winery gate has a negative water footprint of -66.8 L FU^{-1}.

In other words, as a result of the production of the average bottle of wine from Marlborough there is a contribution of 66.8 litres of water to underlying groundwaters. This is because, on average, the natural-capital stock of annual rainfall exceeds the evaporative consumption of water. There is variation, nonetheless, in the net recharge across the region due to variation in the rainfall and the hydraulic properties of the soil (Fig. 6). Where the natural-capital stock of rainfall is high, groundwater recharge is high, as evidenced by the large and negative water footprints towards the right of Figure 6.

The high variability displayed in Figure 6 underlies the essence of terroir. So, in general, care needs to be exercised when generalising the value of the water-regulation services provided by orchards and vineyards.

CONCLUSIONS

We gain greater insight into the true value of natural assets when we use the ecological economics concepts of natural capital and ecosystem services. These analyses, however, highlight concerns about the consumption of irreplaceable natural capital during the production of goods and services. Carbon and water are the two natural-capital stocks of greatest concern. Horticulture is vitally dependent on carbon and water. As a result of these concerns, formal footprinting protocols have been developed to provide environmental declarations about the consumption of natural capital in products. The greatest concerns are for food products. These formal footprinting protocols currently have difficulties in rationally representing soil carbon dynamics and the hydrological cycle. Meanwhile, supermarket chains are developing metrics for sustainability that they use as entry requirements for their prime shelf-spaces. Those products that can meet these requirements will receive eco-premium prices, as they can be sold in the most discerning of market places. In return, these requirements will act to hasten the development of more sustainable land-management practices in horticulture. It is a virtuous circle: eco-credentials, eco-premium prices and sustained natural capital.

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The History and Current Status of Cucurbit Grafting in Israel

Menahem Edelstein, Amnon Koren, Shimshon Omer and Roni Cohen

Grafting is the practice of uniting two parts (root and shoot) of living plant tissue so that they will grow as a single plant (Fig. 1). Cucurbit grafting was first introduced into Israeli agriculture in 1995. Up until that time, soil fumigation with methyl bromide prior to seeding or planting, was extensively used for managing soilborne diseases of annual crops (Klein, 1996). With the phase-out of methyl bromide (Ristaino and Thomas, 1997) and the lack of available farmland for appropriate crop rotation, growers began looking for alternative pest-management tools. Today, watermelon, melon and cucumber are grafted to various extents, mostly on *Cucurbita* rootstocks (interspecific grafting). The grafting is performed to reduce damage caused by various pathogens (Edelstein et al., 1999; Cohen et al., 2002, 2012) in different growing seasons year-round (Table 1).

Figure 1. Melon grafted onto *Cucurbita* rootstock.

Figure 2. Performance of non-grafted (front) and grafted (back) watermelons irrigated with saline water (EC = 4.5 dS/m).

WATERMELONS

Watermelons are grafted mainly to overcome the vine decline phenomenon, which commonly occurs after repeatedly cultivating watermelons in the same field without using crop rotations. Decline is characterized by a reduction in plant vigor, smaller fruit size and an overall reduction in total yield. The causal agents of vine decline are unclear, but the fungus *Macrophomina phaseolina*, which causes vine decline and yield loss in muskmelon (Bruton and Wann, 1996), is commonly isolated from such plants, alone or with *Fusarium solani*.

Grafted watermelons now account for more than 90% of the total cultivated area of this crop (Koren and Edelstein, 2004). Watermelon growers commonly reduce the stand of grafted transplants in the field by 50% as compared to non-grafted transplants. This reduction to one grafted plant per two meters as compared to one plant per meter is often accompanied by a compensatory increase in plant productivity, such that total yields are maintained and the crop is still profitable despite the higher cost of the grafted transplants. Moreover, the rootstocks of the grafted plants are protected from *Melon necrotic spotted virus* (MNSV), which is not controlled by methyl bromide fumigation.

The cultivation of mini watermelons is on the rise in Israel. About 20% of this crop is grafted. To obtain good fruit quality, the mini watermelons are grafted onto less vigorous rootstocks. Grafting such watermelons onto vigorous stocks might result in undesirable enlargement of the fruits, a reduction in fruit quality and even deformation of the fruit shape. In addition, grafted watermelons can overcome salinity stresses (Fig. 2) via exclusion and retention of salt by the *Cucurbita* rootstock.

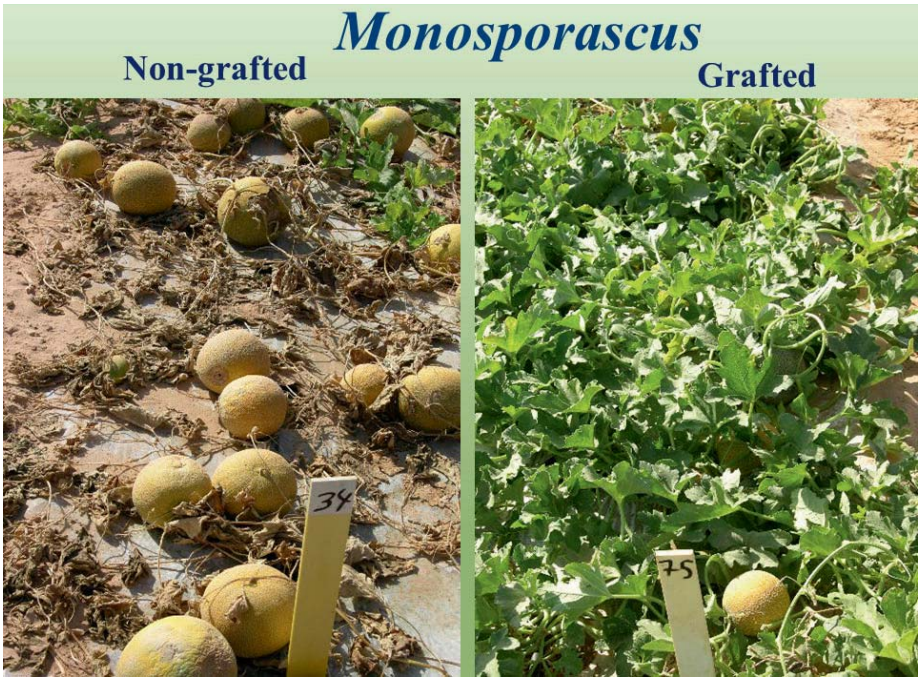
MELONS

The extent of grafted melons is estimated at 15-20% of the whole crop area. Grafting is used mainly to overcome soilborne diseases such as Fusarium wilt, which is common in the northern valleys of Israel. Vine decline of melons caused mainly by *Macrophomina phaseolina* occurs in northern and central Israel, and sudden wilt caused by *Monosporascus cannonballus* (Fig. 3) is a destructive disease affecting melons in the Arava Valley of southern Israel. The relatively limited use of grafted melons is

Table 1. The status of grafted plants in Israel.

Crop	Disease or abiotic stress	Season	Percent of total area	Alternatives
Large watermelon	Vine decline and soil tiredness phenomena, high and low soil temperatures, salinity, CGMMV, nematodes	Spring, summer	< 90	None – most watermelons are grafted
Mini and midi watermelon	Vine decline and soil tiredness phenomena, CGMMV, low soil temperatures	Summer, fall	~20	Non-grafted transplants
Outdoor summer "Ananas" type melons	Fusarium wilt, *Macrophomina phaseolina*, salinity, *Fusarium solani*, CGMMV	Summer, spring	20	Non-grafted transplants, fungicides
Greenhouse winter/ spring "Galia" type melons	*Monosporascus* vine decline, *Fusarium solani*, Fusarium crown rot, salinity, CGMMV	Spring, summer, fall	15	Fungicides used as soil drench for fungal pathogen management
Greenhouse summer cucumber	CGMMV, Fusarium wilt, Fusarium crown rot, nematodes	Summer	5	Short growing season, feasibility is currently being tested
Greenhouse winter cucumber	Fusarium crown rot, CGMMV, *Didymella*, low soil temperatures, salinity, nematodes	Winter, spring, fall	< 90	Fungicides used as soil drench for fungal pathogen management

Figure 3. Monosporascus wilt of non-grafted melon plants (left), compared with healthy melon plants grafted onto *Cucurbita* rootstock (right).



the result of the deployment of chemical alternatives that contribute to lowering disease damage. The fungicide azoxystrobin (trade name Amistar®, manufactured by Syngenta) is used successfully to control both *Macrophomina* and *Monosporascus* in melons. This solution is significantly cheaper than the use of grafted transplants. Nevertheless, since there is always the risk of prohibition of a fungicide's use, even on short notice, grafting research is ongoing and knowledge related to melon grafting is ready as an available alternative for combating these soilborne diseases.

Since grafted plants are more expensive than non-grafted ones, attempts are being made to lower their price. One way of achieving this is to reduce the number of plants per unit area. The ability to reduce transplant numbers by 50% without any reduction in yield (Fig. 4) indicates that growing grafted melons can be profitable despite the high price of grafted transplants.

In addition, grafting is used to induce resistance against different abiotic stresses (Schwarz et al., 2010), and especially to salinity (Colla et al., 2010). The mechanism involved in resistance to salinity can be explained by the exclusion and retention of salt (Fig. 5) by the *Cucurbita* rootstock (Edelstein et al., 2011).

THE LATEST REVOLUTION – GRAFTED CUCUMBERS: COST AS A KEY FACTOR

The phase-out of methyl bromide and the lack of crop rotation in cucumber greenhouse cropping have posed serious problems for cucumber growers. Two diseases that threaten the monoculture of greenhouse cucumbers are the fungal disease Fusarium crown rot caused by *Fusarium oxysporum* f. sp. *radices-cucumerinum* and *Cucumber green mottle mosaic virus* (CGMMV). The virus can persist in the soil, and is transmitted by seeds and mechanically by touching infected plants. Use of grafted plants can completely prevent Fusarium crown rot and resistant rootstocks can reduce CGMMV by preventing plant infection through the soil. In addition to disease management, grafted plants are more tolerant to low soil temperatures, enabling safer cropping during cold periods in the winter. Moreover, grafted plants enable lengthening of the harvest period; thus two cucumber crops are grown per year instead of three, contributing to significant monetary savings. However, the feasibility of using grafted transplants is hindered by their high price.

To remedy the situation, nurseries recently lowered the price of grafted plants

Figure 4. Yields of grafted and non-grafted melon '6405' (HaZera Seeds, Israel) plants at different transplant spacings. The experiment was conducted in *Macrophomina phaseolina*-infested soil. Yield values above columns with the same letter are not significantly different. (After Cohen et al., 2012).

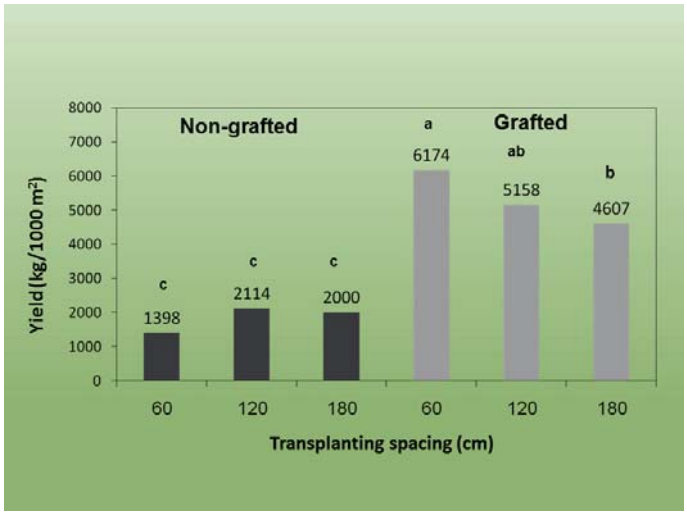


Figure 5. Concentrations of Na in the exudates for non-grafted pumpkins (P), non-grafted melons (M), self-grafted melons (M/M), self-grafted pumpkins (P/P), melons grafted on pumpkins (M/P), and pumpkins grafted on melons (P/M).

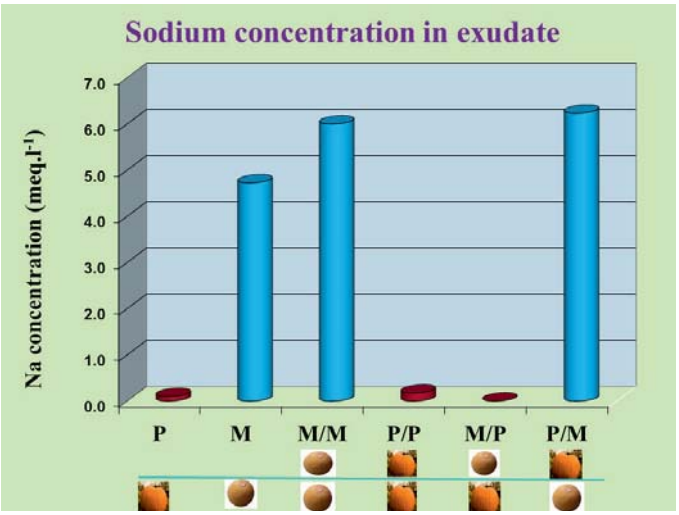


Table 2. Grafted cucumber – estimated expenses and income for grafted and non-grafted plants in New Israeli Shekels (1 NIS = $0.26). Each 1000 m² contains 2500 transplants.

Expenses				
Transplant type	Single plant price (NIS)	Number of plants/1000 m²	Price (NIS/1000 m²)	Difference (NIS) between plant types
Non-grafted	0.7	2500	1750	3500
Grafted	2.1	2500	5250	
Income				
Transplant type	Yield (kg/1000 m²)	Price (NIS/kg)	Income (NIS/1000 m²)	Difference (NIS) between plant types
Non-grafted	10,000	2.5	25,000	5000
Grafted	12,000	2.5	30,000	

dramatically. This resulted in a marked shift to the use of grafted plants by growers (Table 2). This change raised new questions, such as the selection of rootstock with compatibility to different scions and growing seasons and the need to thoroughly study the effects of the rootstocks on yield quantity and quality.

CONCLUSIONS

The use of grafted *Cucurbita* in Israel is on the rise, due to benefits such as resistance to soilborne diseases, better adaptation to low temperature and yield increase. Despite these advantages, however, there are some open questions related to graft incompatibility, which commonly seems to cause physiological disorders, and sometimes reduction in fruit quality, especially in watermelon. The interactions between rootstock and scion can vary and there is no such thing as a 'universal rootstock' that suits every crop in all growing seasons. Therefore, rootstocks must be carefully chosen for each crop and for different growing conditions. The applied research should be accompanied with fundamental studies aimed at understanding the physiological barriers, toward the rational use of grafted vegetables.

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Innovating together for Sustainable Horticulture

Kai Wirtz and Albert Schirring

The Bayer CropScience group and colleagues were major sponsors at the IHC2014 in Brisbane, and are committed to collaborate again with the IHC2018 in Istanbul. Obviously the Society's magazine 'Chronica Horticulturae' is an open forum for our partners and corporate members. However, the content of the communications resulting from these partners are information for the members but do not necessarily reflect the official views of the Society. We share independent views and communication.

Sincerely,
the ISHS Board of Directors

MarBran farm manager Juan Ramón Camacho (left) and Gustavo Martinez Barbosa (Bayer) inspecting the broccoli harvest in a field of "Rancho Granjenal" in Villagran, Mexico.

Science for a better life. That's what is required to support the global horticultural industry to address the challenges of the future. Increasing global population, a growing middle class conscious of healthy food, and change in diets drive the demand for more quality food in an environment with limited resources.

HIGH QUALITY FRUIT & VEGETABLES ARE AT THE HEART OF WHOLESOME NUTRITION

In addition to staple cereals like wheat and rice, a year-round variety of high quality fruit and vegetables is an essential requirement for any healthy diet. Vegetables and fruits offer diversity and variety in tastes and flavors, in local and regional preferences and in health benefits. They provide essential vitamins, minerals, phyto-nutrients and dietary fibers. Fruit and vegetable crops are grown worldwide in almost all climatic zones. Most fruit crops such as apple, citrus, banana and coffee are permanent crops, whereas vegetable crops are planted seasonally. All horticultural crops share important features: sophisticated cultivation systems, high production intensity and significant investments in risk management.
Consumers expect fruit and vegetables to look attractive, be convenient to process and prepare, to taste good and contribute to health and wellness. Adding to the challenge, consumers expect fresh produce to be available year-round in a broad diversity and at affordable prices. On top of that, consumers want increasing transparency and want to be assured that their fruit and vegetables have been grown in a sustainable manner. As a result, the horticultural industry is challenged to secure supplies in the desired quantity, quality and diversity throughout the year. International fruit and vegetable trade is strong and growing – evidence of a food value chain that spans the globe and is becoming more and more complex. On the farm, producers are increasingly applying sustainable agricultural principles to ensure long term growth.

BAYER CROPSCIENCE – COMMITTED TO INNOVATION TO ADDRESS THE FUTURE

Bayer CropScience is one of the world's leading innovative crop science companies in the area of seeds, crop protection and non-agricultural pest control. As a subgroup of Bayer AG, the company supports farmers and growers around the world with integrated solutions designed to meet the growing demand for high-quality food and feed, fiber and renewable raw materials. The core competencies of Bayer CropScience lie in developing and supplying tailored agricultural technologies and solutions that are focused on improving crop productivity and quality. To create integrated crop solutions the company can build on an outstanding range of products including high-value seeds, innovative chemical and biological crop protection products, as well as an extensive service backup for modern, sustainable agriculture. Bayer CropScience is represented in more than 120 countries with major Research and Development facilities located in Europe, Brazil, USA, India and China. According to the group mission "Bayer: Science For A Better Life", Bayer CropScience is committed to delivering innovative concepts and solutions that help to promote sustainable agriculture. Closely focused on innovation, Bayer CropScience is a leading company in its industry with one of the biggest R&D budgets. Sustainability is an integral part of the company's business strategy. In this

context, Bayer CropScience supports its customers in balancing their economic success with environmental and social responsibility. The company's product innovations aim to improve the resource efficiency of agriculture (water, soil, agricultural inputs). Proactive stewardship measures target the human and environmental safety of Bayer CropScience's products along their life cycle.

To assist horticultural growers on a daily basis, Bayer CropScience can call upon a global network of 7,400 agronomists to provide expertise in production practices. This way, the company helps ensure that quality standards in fruit and vegetable production remain high and are further improved. Dedicated teams with a deep understanding of specific regional growing conditions provide tailored agronomic

Peter Keunen harvesting new chilli varieties at the vegetable breeding center in Nunhem, The Netherlands.

Stefan Dreyer (left) works on Ambrosia Citrus Estate, a citrus farm near the Kruger National Park. He and Riaan Maartens from Bayer CropScience are delighted by the high-quality fruit harvested on the farm.

To contribute to sustainable horticultural production, Bayer CropScience is committed to strengthen customer proximity and insight into their needs through dedicated crop teams for horticultural crops. support and training on safe use and good agricultural practices to local growers and assist them to acquire specialist know-how and skills to better serve the needs of the value chain.

LEADERSHIP IN INNOVATION: FROM SEED TO SHELF

From seed to shelf. It is the company's mission to offer products and services that create superior customer value. Elements include improved seeds, highly effective seed treatment solutions, chemical and biological crop protection products, growth regulators and new formulation technologies, complemented by expertise and services.
Modern marker-assisted breeding technologies, coupled with an increasingly sophisticated understanding of plant biochemistry and metabolic pathways, lead to innovative seed varieties that satisfy the grower's needs and benefit partners along the value chain, all the way to the end consumer.

Bayer employee Tang Zhong Liang and farmer Qin Kai survey tomato plants at a field in the province of Guilin in South China.

At the 29th International Horticultural Congress in Brisbane, August 2014, experts from the company presented recent product novelties and new solutions that underline the role of Bayer CropScience as the innovation leader in its field with the aim of supporting the horticultural industry's efforts to produce premium quality fruits and vegetables in a sustainable way. Among the key innovations presented were integrated solutions based on a combination of biological and chemical solutions.
Nematode control in horticultural crops will be eased with the breakthrough nematicide Velum™ and the biological nematicide BioAct™. When applied in combination or in rotation, the new modes of action form a foundation for efficient root protection and soil pest management. Bayer CropScience's broad spectrum fungicide Luna™ extends the vitality of produce beyond harvest, thus giving it a prolonged shelf life, better storability and increased marketability. It is effective in many crops including apple, stone fruits, potatoes, tomatoes and grapes. The biological products Serenade™ and Requiem™ are new, powerful tools for efficient crop management of integrated

Searching for new biological compounds: Bayer CropScience employee Melanie Röpcke tests the growth of fungi in a fermenter in Wismar, Germany.

Testing biological crop protection agents: Bayer CropScience researcher Dr. Varghese Thomas checks the roots of tomato plants in a laboratory in Davis, California.

cropping systems. Serenade™ is effective against a range of aggressive fungal and bacterial pathogens as well as against several soil diseases. Requiem™ effectively controls sucking insect pests such as white fly and thrips. Both products enhance Integrated Pest Management (IPM) systems. When used in combination or in rotation with chemicals, biological products provide new tools in resistance management. Another important benefit of these biological products is their short pre-harvest and re-entry intervals, providing higher flexibility of application timing for the grower.

Sivanto™ is the latest addition to the insecticide solutions of Bayer CropScience. This innovative product for the control of major sucking pests like aphids, whiteflies, and other key insects, has an outstanding safety profile and a high compatibility with many beneficial insects. Due to its selectivity Sivanto™ can be used in IPM programs in fruit and vegetables together with biological products and beneficial insects.

FOODCHAIN PARTNERSHIPS – REACHING ACROSS THE VALUE CHAIN TO DELIVER SUPERIOR CUSTOMIZED SOLUTIONS

Bayer CropScience is committed to creating value across the entire fruit & vegetable value chain, offering enhanced vegetable varieties with beneficial agronomic and quality traits and, through specialized crop consultancy, service and support. With Food Chain Partnership Bayer CropScience has developed an innovative business model in which growers, traders, processors and retailers work together on integrated crop solutions incorporating sustainable agricultural principles for the benefit of all value chain partners involved. As a facilitator, the company strives to create win-win situations that support the food industry and its grower base around the world. By forming Food Chain Partnerships the company fosters closer links between growers, traders, processors and retailers and shares its agronomic knowledge and value chain expertise. Partners benefit from projects in terms of safety, quality, yield and traceability. The common goal is the sustainable production of high-quality and affordable food.

Currently, Bayer Crop Science is running 240 Food Chain Partnership projects in 30 countries around the globe focusing on 40 different crops, mainly fruit and vegetables. In the Partnership programs Bayer CropScience offers customized, integrated solutions based on high-quality seeds, effective chemical and biological crop protection products, and complementary services and know-how in environmental protection, efficiency and safety. The integrated solutions are backed by proactive stewardship measures in order to ensure product integrity, the protection of people and environmental preservation.

WORKING TOGETHER FOR SUSTAINABLE AGRICULTURE

In 2013, the fruit and vegetable business represented roughly one fourth of the sales of Bayer CropScience. The leading R&D platform and the superior customer proximity through dedicated crop teams, as well as recognized crop specialists and food chain partners, are driving Bayer CropScience towards a sales goal of more than EUR 3 billion in fruits and vegetables by 2020.

Sustainable agriculture is at the core of the business model of the company. Bayer CropScience's strategic focus on horticultural crops will be further enhanced by partnerships. By closely working with partners the company aims to support bringing healthy and affordable nutrition to all, to fulfill the mission of the Bayer Group: Science for A Better Life.

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An Overview of Horticulture in Turkey

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Uygun Aksoy and Rüstü Efe Oksar

INTRODUCTION

Turkey lies between Asia and Europe. The rectangular Anatolia Peninsula protrudes from Asia towards Europe. The European part, known as Thrace, is separated from the Asian Anatolia Peninsula by two straits, the Dardanelles and Bosphorous. There is a long coastline providing mild climates and fertile land, especially in the south and north due to mountains running parallel to the coast. In the western Aegean region, the mountains run perpendicular to the coastline, with fertile valleys around the rivers flowing in between. The center of Turkey is a semi-arid plateau and high mountains cover the eastern part. The geography and topography create different climatic zones varying from cold temperate to subtropical, which in turn contribute to a rich natural flora and land suitable for plant production. Consequently, agriculture has been an important contributor to the region's development from times immemorial.

HISTORY

Turkey hosts many archaeological sites that have special significance in the history of agriculture, the best known being Çatalhöyük and Gobeklitepe. Çatalhöyük is cited as one of the earliest sites of plant domestication nearly 10,000 years ago. Archeobotanical, environmental, population and settlement studies show that Çatalhöyük, in today's Konya province, was a very large Neolithic and Chalcolithic proto-city settlement that existed from approximately 7500 to 5700 BC. By 6000 BC, there were more than 1000 houses where people collected wild grasses and used the seeds for food, while also planting some for the next year's crop. Food exchange was then an integral part of the social tradition between Çatalhöyük and nearby contemporary settlements (Fairbairn, 2005). As can be seen in Table 1, as new sites are explored, new clues, features and knowledge unfold (Karagöz et al., 2010). Gobeklitepe, located further east in Şanlıurfa province, has only recently been explored and is believed to reveal the first signs of a common belief among hunter-gatherers. This area is thought to have been settled during the Pre-Pottery Neolithic A phase (9600-7300 BC), almost 11,600 years ago (Özdöl, 2011).

Geographical regions in Turkey.

Archaeological sites in Turkey where plant specimen were found.

Table 1. Plant specimen found at excavation sites in Turkey and the period to which they date (Karagöz et al., 2010, based on Harlan, 1995 and Van Zeitz and De Roller, 1995).

Estimated date (BC)	Archaeological site	Plant specimen
7500	Aşıklı Höyük	Durum wheat, einkorn, lentil, pea, chickpea, ervil, emmer wheat
7200-6500	Çayönü	Wild and cultivated einkorn, lentil, pea, vetch, flax, wild barley
6750	Hacılar	Wild einkorn, cultivated emmer wheat
6500	Can Hasan	Wild and cultivated einkorn, wheat, barley, pea, vetch
6000-6500	Çatalhöyük	Cultivated einkorn, emmer wheat, barley, pea, vetch
6000-5000	Erbaba	Cultivated einkorn, emmer wheat, barley, pea, lentil, vetch

Geophyte garden and the glasshouse at Yalova Ataturk Central Horticultural Research Institute.

Table 2. Number of endemic species found in bio-geographic regions of Turkey (Anonymous, 2007).

Plant bio-geographic regions	Number of species, subspecies and cultivars
Europe	1325
Irano-Turanian	1250
Euro-Siberian	320
Others	1030
Total	**3925**

Agriculture has played a leading role in the history of the region, not only during the early stages of history but also in later millennia. The first railway was constructed between Aydın and Izmir in 1860 and was further extended in 1865 to Kasaba in order to transport agricultural goods such as dried figs, grapes, tobacco and cotton from the production region to the port of Izmir for export.

GENETIC RESOURCES

Turkey is the natural and cultural bridge between Europe and Asia and lies at the crossroads of the two gene pool centers identified by Vavilov: the Mediterranean and the Near East. Owing to its climatic and geographic variations, Turkey has a rich biodiversity. The three major bio-geographic regions are the Mediterranean, Euro-Siberian and Irano-Turanian. Based on a broad survey done in 2007, the number of plant taxa present in Turkey was calculated to be 12,476, of which 32.7% or 4,080 grow widely throughout the country (Karagöz et al., 2010). Additionally, Turkey hosts two genetic centers for wild relatives of agricultural plants.

Table 3. Micro gene pool centers and major species (Karagöz et al., 2010).

Micro gene center	Species
Thrace-Aegean	Wheat, melon, lentil, chickpea, common vetch, lupine, clover
Southeast Anatolia	Emmer wheat, spelt, zucchini, melon, watermelon, cucumber, grape, bean, lentil, leguminous fodder crops
Samsun-Tokat-Amasya	Fruit genera and species, beans, broad bean, leguminous fodder crops
Kayseri and surroundings	Apple, almond, pear, grape, lentil, clover, other fruit species
Ağrı and surroundings	Apple, sour cherry, cherry, melon, leguminous fodder crops

Table 4. Development of plant production (MT) in Turkey (Anonymous, 2013).

Product groups	2002	2010	2011	2012
Field crops	58,119,719	60,663,948	61,711,796	58,791,495
Fruit	13,273,350	16,385,745	16,993,476	17,810,942
Vegetables	25,823,567	25,997,195	27,547,462	27,752,706
Total	**97,216,636**	**103,046,888**	**106,252,734**	**104,355,143**

Turkey has a long experience in the study and evaluation of genetic resources. Collections and investigation were started in 1929 by Gökgöl and have continued until today by scientists at different institutions. Studies on fruit genetic resources were initiated in 1933 at Ankara University targeting major species such as grapes, figs, apricots, hazelnuts and pistachio nuts. Later in the 80s, an inventory was conducted for fruit species including grapes (Balkaya and Yanmaz, 2001). Currently, there are two gene banks, in Izmir and Ankara, for ex situ collections. The first gene bank was established in 1974 and the second, which is the third largest in the world after USA and China, was created in 1987 and further enlarged in 2010. This gene bank hosts 60,000 specimen in the herbarium and 107,000 different seeds belonging to 3,650 plant species. The perennial collections are kept mainly at the National Research Institutes with additional collections in agricultural faculties. The newly established 'Turkish Geophyte Garden' hosts 250,000 plants representing 5,800 populations of 1,000 species (www.tarim.gov.tr). Additionally, the government conducts an in situ preservation project that covers 3,749,673 ha (Karagöz et al., 2010).

PRODUCTION

Turkey is one of the world's leading countries in terms of horticultural production with an ever increasing market share (Table 4). According to figures for 2013, the total area under cultivation is 15,618,000 ha comprising 66% of the total agricultural land. Vegetables occupy 808,000 ha corresponding to 3.4% of the cultivated area. The area devoted

Figure 1. Proportion of different fruit species in total fruit production in 2013 (Dumanoğlu et al., 2015).

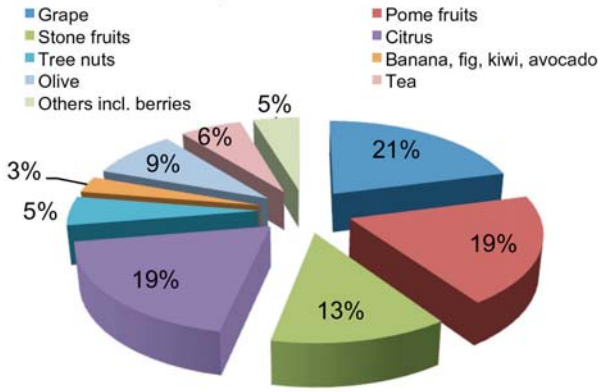
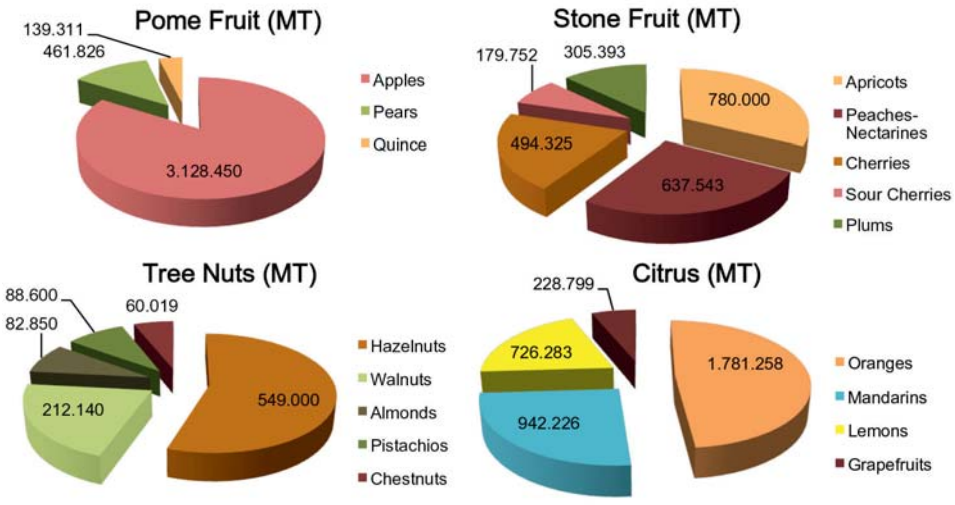


Table 5. Major horticultural crops of Turkey that constitute a significant proportion of world production.
Source: Ministry of Food, Agriculture and Livestock (www.tarim.gov.tr).

World rank and share (%) in total production								
1	**%**	**2**	**%**	**3**	**%**	**4**	**%**	**5-10**
Hazelnut	72.0	Sour cherry	16.0	Chickpea	4.0	Walnut	6.0	Tea
Cherry	21.0	Chestnut	2.9	Pistachio nut	15.0	Olive	11.0	Eggplant
Fig	25.0	Melon	5.3	Pepper	6.6	Tomato	7.0	Mandarin
Apricot	19.0	Watermelon	3.8	Apple	3.8	Beans	3.0	Onion
Quince	23.0	Cucumber	2.7			Spinach	1.0	Grapefruit
						Lentil	10.0	Lemon
								Potato

Figure 2. Proportion of different fruit species and production volumes (MT) in 2013 in Turkey (Dumanoğlu et al., 2015).



to vineyards is 438,000 ha (1.8%), to fruit orchards 1,968,000 ha (8.2%) and to olive groves 826,000 ha (3.5%). In total, 46.4 million tons of fruit and vegetables (www.tarim.gov.tr) are grown on four million ha of open field and 62,000 ha under protection. In terms of production volume, Turkey ranks amongst the top in many fruit and vegetable species as shown in Table 5.

According to the figures of 2013 (www.tuik.gov.tr, 2014), total fruit production in Turkey amounted to 19,172,803 MT. The proportion of major crops in decreasing order are: grapes (21%), pome fruit (19%), citrus (19%), stone fruit (13%), olive (9%), tea (6%), tree nuts (5%) and others (Fig. 1).

Vineyards occupy the largest surface area among all horticultural crops. The total production is estimated at 4,011,409 MT according to 2013 figures. Of this production, 53.2% goes directly to the fresh market, 35.5% is sundried and 11.3% is utilized in the food processing industry to make wine, juice, concentrate or vinegar (Söylemezoğlu et al., 2015). The drying of grapes is concentrated in the western Aegean region and uses mainly seedless grapes.

Olives are among the major fruit species and are grown along the coastline and in the southeastern region of Turkey. There has been a steady increase in the area of olive groves as a result of the subsidies provided by the government. However, olive oil consumption per capita is still low. Olives are harvested at green, pink or black stages and processed for table consumption. Bread and olives are the basics of the Turkish breakfast. According to 2013 figures (www.tuik.gov.tr, 2014), 23% of the production is processed for table consumption, whereas 77% is used for oil extraction.

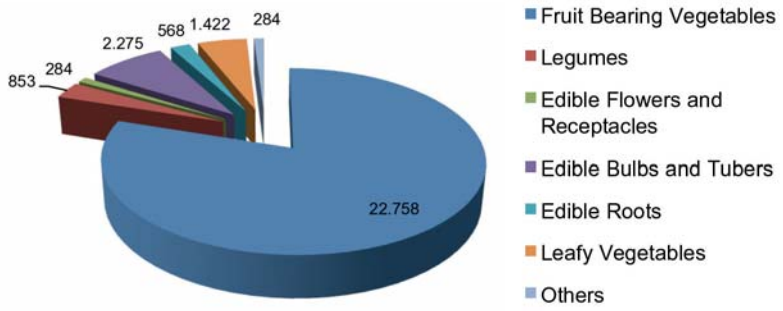
A grape vine on trellis.

The total number of trees varies according to the planting density of the species. With respect to the area covered, the area of fruit species other than olives and grapes decreased in 2013. In the following order they are: hazelnuts (702,144 ha), pistachio nuts (281,355 ha), apples (173,096 ha), sweet cherries (76,460 ha), apricots (76,459 ha), tea (76,426 ha), walnuts (63,902 ha), oranges (54,759 ha), and figs (49,000 ha). Within Turkish fruit production, there is a wide range from bananas and tea to walnuts and strawberries (Fig. 2).

Sundried fruit and vegetables play a significant role in rural development. One peculiarity of Turkish horticultural production arises because of the historical importance of agriculture. Sundrying of apricots, grapes and figs has been a commercial practice in specific regions for centuries. The success of this practice results from long-term selection by farmers for the best adapted types and high quality cultivars for sundrying (e.g. 'Hacıhaliloglu', 'Sultana Seedless', 'Sarılop')

A. Scenery from an olive grove in Marmara Region. B. Olive fruit harvested at black maturity stage.

Figure 3. Proportion of production (1000 MT) of different vegetable groups in 2013 (Yanmaz et al., 2015).



and there has been further extension in acreage. Sundrying is an energy-efficient method of preservation and receives utmost attention at local level with new crops.

Turkey is among the major vegetable producing countries and displays an increasing trend with respect to area and production values. Fruit bearing vegetables constitute 80% of total production. The leading vegetables are tomato, pepper, melon, watermelon, cucumber, eggplant, beans, onion, carrot and cabbage (Fig. 3). Species belonging to *Solanaceae* and *Cucurbitaceae* families are the most highly consumed in Turkey. Due to the climatic advantages, coastal regions have a more prominent place in vegetable production. The Mediterranean region ranks first, followed by Marmara and Aegean regions (Yanmaz et al., 2015). Protected cultivation started after the 1960s and reached 61,512 ha in 2013 and is still increasing. Vegetables are the main crops with a share of 95.3%, followed by cut flowers (3.5%) and fruit species (1.2%). In 2013, almost half of vegetables grown under cover were tomatoes (3,200,930 MT), followed by cucumber (1,001,940 MT). In parallel to the rapidly increasing vegetable sector, supporting sub-sectors, such as seed and commercial seedling production, have also grown very rapidly. Soilless culture is becoming widely practised, especially around geothermal sources. Among fruit species, strawberry (160,026 MT) and banana (172,006 MT) are the two species grown in plastic houses (Tüzel et al., 2015).

In Turkey, medicinal and aromatic plants are grown and picked from the wild. Among those cultivated, sundried or mechanically dried pepper is the leading species (Table 6). Species like laurel leaves, *Prunus mahalep* fruit, linden flower, rosemary and Juniper bark are collected from wild flora (Çakal, 2013). Both cultivated and wild plants are exported. Restrictions govern wild-harvesting and sustainable harvesting techniques are being implemented (Faydaoğlu and Sürücüoğlu, 2011).

Turkey has a very rich natural flora, yet the economic importance of ornamentals is still low and the supply does not fully meet the demand. In 2013, in terms of area covered, outdoor plants, mainly used in urban landscaping, occupied first place with 3,242 ha. Cut flower production is dominated by carnations, grown on 1,105 ha, mostly under protection (Kazaz et al., 2015).

FOREIGN TRADE

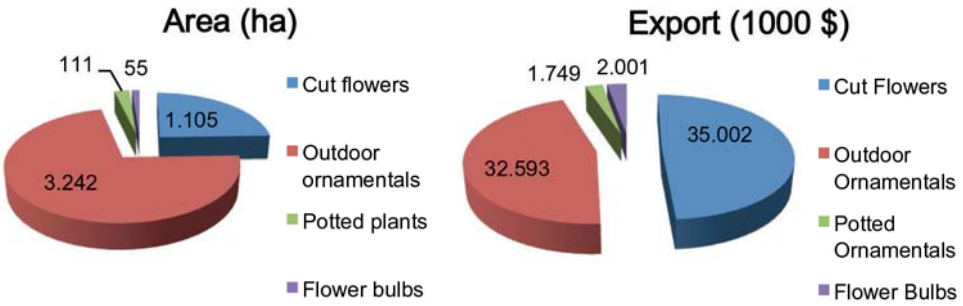
In Turkey, horticultural production results in a direct export value of $5.5 billion per annum without taking into account export of processed products, e.g. fruit juices, canned food, and deep-frozen products. It supports the livelihoods of 4 million people. Agricultural policies focus on traceable quality assurance systems and provide support to certified production in order to create added value. Currently, 75% of organic production is directed to the export market, mainly the EU. Dried fruit, nuts and medicinal herbs comprise a large share of the commodities produced organically. The farms certified as organic (including those in transition) reached to 61,000 and covered a surface area of 769,000 ha in 2013. Fruit and vegetable farmers who enter into the good agricultural practices (GAP) certification scheme receive higher subsidies than field crop farmers. Currently, there are 8,100 farms where GAP is applied. In addition to this figure, there are farms that apply GLOBALGAP standards mainly for the export market (www.tarim.gov.tr).

Table 6. Medicinal and aromatic plants cultivated in Turkey (Anonymous, 2013).

Plant species	Area (ha)	Production (MT)
Dried pepper	11268	165,527
Anise	19443	11,023
Cumin	22629	13,900
Thyme	9428	11,598
Black cumin	230	161
Fennel	1578	1862
Heather	1906	2798
Coriander	1.1	1
Poppy (capsule)		3497
Hops		1752

A. Apricot trees in full bloom. B. Apricot fruit ready for harvest.
C. Apricot fruit spread on canvas for sundrying.

Figure 4. Area (ha) devoted to ornamentals in Turkey and the export value (1000 US$) of ornamentals in 2013 (Kazaz et al., 2015).



Turkey is a net exporter of fresh and dried fruit, especially to European Union member states, Russia and the Middle East. The demand and the total value vary significantly among the markets. The major market for dried fruit and nuts is the EU. However, US is the leading destination for dried apricots. Turkey is the major supplier of sweet cherry to the EU market. Russia and the eastern European countries are the major destination for table grapes and citrus. Export of pomegranate and fresh fig displays an increasing trend. Even if grown in Turkey, fruit species that are imported in order to meet the demand are banana, almond, walnut, kiwi and tea. Other species imported are generally from the southern hemisphere to provide year-round availability as in the case of apples, oranges, lemon and grapefruit (Dumanoğlu et al., 2015).

Contrary to fruit, vegetables are primarily consumed within the country. The different species show fluctuations in terms of exported volume or value. Tomato is always the leader in exports. Between 2009 and 2013, tomato constituted 39% of all vegetables exported from Turkey and generated 57% of the export value among vegetables. In terms of quantity, the other species exported are onion (136,487 MT), cucumber (73,741 MT), pepper (67,987 MT), carrot (52,517 MT) and watermelon (22,927 MT). Vegetables are exported to Russia (33%), Iraq (19%), Bulgaria (5%), and Ukraine (5%). Based on 5 year values, 10,000-33,000 MT of vegetables are imported into Turkey. Watermelon and garlic occupy the first two places in importation of vegetables (Yanmaz et al., 2015).

Ornamentals produced in Turkey are exported to more than 35 countries. Cut flowers have the highest share with their main markets in The Netherlands, Turkmenistan, Iraq, Germany, Azerbaijan and Russia. They are exported to The Netherlands (53.5%), Kenya (12.2%), China (11.9%) and Ecuador (7.8%) (Fig. 4). Turkey also exports bulbs, especially *Galanthus* sp. and *Leucojum aestivum*, to The Netherlands. The country is an importer of some ornamental outdoor plants and certain cut flowers. For the former, Italy is the major supplier (51.1%) followed by The Netherlands (17%) and Germany (17%) (Kazaz et al., 2015).

RESEARCH AND EDUCATION

Horticultural research is carried out mainly in state institutions. A few private research groups focus on specific areas such as breeding, seed production or propagation methods. The Ministry of Food, Agriculture and Livestock has 23 research institutes involved in horticultural research. The Atatürk Central Horticultural Research Institute is the main institute, in addition to 11 regional centers and 11 specialized centers. These specialized centers conduct research on viticulture, fig, hazelnut, pistachio, apricot, olive, and fruit production. The thematic research institutes are located within the major production regions. An annual meeting is organized by the Ministry to discuss research findings, not only with Ministry staff but also with all stakeholders. The Ministry is also responsible for extension services to all producers – large and small – and recently started supporting farmers in the hiring of private consultancy services.

Among the existing 35 agricultural faculties, 31 have horticulture departments that provide higher education, research and vocational training activities. Since 1999, horticultural congresses and symposia on specific species or groups have been organized at regular intervals. These events help to disseminate research results and exchange experiences at national level. Being a Council member of the International Society for Horticultural Science (ISHS), various symposia are organized under the umbrella of ISHS. The Turkish Society for Horticultural Science, together with the Ministry of Food, Agriculture and Livestock, will host the upcoming 30th International Horticultural Congress in 2018 in Turkey (www.ihc2018.org).

Fig fruit on drying trays in the drying yard.

CONCLUSION

Agriculture is a vital sector of Turkish society. It provides employment opportunities, generates income and uses natural resources sustainably. Farms are generally small and dispersed. Horticulture provides additional opportunities for small farmers, especially those in suitable climatic conditions, to produce high value crops multiple times a year to sustain the increasing demand for fresh fruit and vegetables from local markets. However, smaller farm sizes, can be counterproductive by lowering productivity per unit area and reducing quality while increasing production costs. Currently, the aging of rural populations is becoming a limiting factor. Climate change, as in the 2014 season, may be a threat in the future and requires site-specific research. There is an urgent need to develop new fruit cultivars to meet changing consumer preferences. In ornamentals, the problem of supplying propagation material needs to be addressed.

Many private companies are investing in different stages of the value chain. Best practices are well-known in crops like cherries, figs, grapes and tomatoes. The provision of infrastructure that affects the success of horticultural enterprises is being supported through government funding.

Despite the increasing trends seen in all sub-sectors of horticulture, there are many challenges ahead. However, Turkey, with its strategic location, rich genetic resources and skillful farmers, possesses an undeniable potential for a successful future in the world of horticulture.

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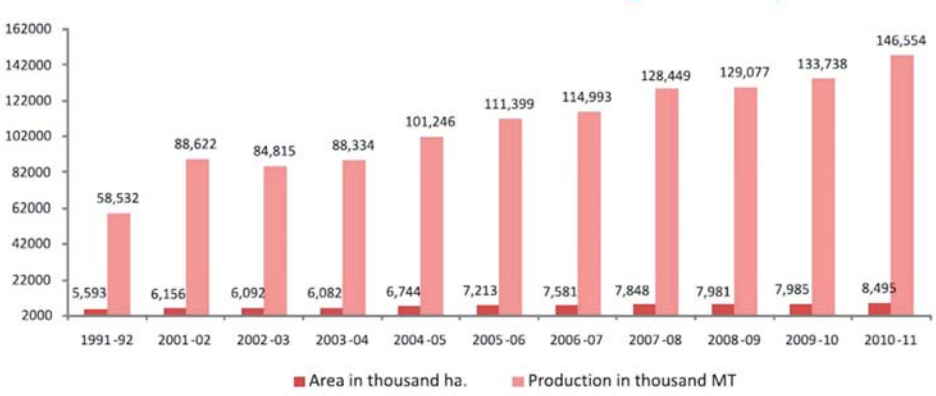
Vegetable Production in India: an Overview

Susheel Sharma, Akhilesh Sharma and Yogesh R. Parulekar

In a country like India, vegetables play an important role in the diet of its population. India has a wide range of tasty and nourishing cuisines and a large population of vegetarians, whose main source of protein comes from legumes (pulses and beans), dairy products and foodgrains. Currently, India prides itself as the second largest producer of vegetables in the world, next only to China, with an estimated production of about 146.55 million metric tons from an area of 8.50 million ha (Fig. 1) resulting in an average yield of 17.3 metric tons ha^{-1}. India produces about 15% of the world output of vegetables from about 2.8% of the country's cropped area (Anon., 2010). However, its per capita consumption is far below the recommended daily intake of vegetables. Varied agro-climatic conditions in India make it possible to grow a wide variety of vegetable crops all year round in one part of the country or another. Owing to this, India claims to grow the largest number of vegetable crops compared to any other country of the world and as many as 61 annual and 4 perennial vegetable crops are commercially cultivated. In addition, about 30 lesser known and underutilized vegetable crops are also cultivated sparsely in various regions of the country.

Figure 1. Area and production growth trends for vegetable crops. Source: Indian Horticulture Database, 2011 (www.nhb.gov.in).



HISTORY

The history of vegetables in India dates back to the pre-historic period. Before the arrival of Aryans in India (c. 1500-1000 BC), the Proto-Australoids (*Nisada*) used brinjal (eggplant), bottle gourd and watermelon as vegetables. In India, as in many other countries, most vegetables were collected from forests as a source of medicine rather than for human consumption. The two most important treatises on medicinal uses of plant species in India are *Charak Samhita*, written around 600 BC, and *Susruta Samhita*, written in the 3rd to 4th century AD. Among the vegetables like brinjal, bottle gourd, watermelon, peas and melon that were eaten during the pre-historic period, only brinjal has its origin in India while the others were brought from other countries long before the arrival of the Aryans. It is difficult to understand how a few important native vegetables, like cucumber, *Luffa* (smooth and ridged gourd), pointed gourd/*parwal* and Dolichos (*Lablab purpureus*) (lablab bean) were not known at that time. Similarly, okra (*bhindi*), which has a secondary centre of origin in India, is not mentioned in any Indian literature. However, a species of *Abelmoschus* (*A. moschatus*) (musk mallow), called *lata kasturika* in Sanskrit, is mentioned in *Charak Samhita* as a source of perfume (Swarup, 2006).

Invaders, travelers and traders all contributed to the introduction and spread of a large number of vegetables long used in Indian cuisine. The Mughals, who invaded in the 15th century and ruled until Britain took over, were lovers of good food and included liberal doses of onion and garlic to flavour their culinary delicacies, especially meat dishes. Colonising traders from Portugal, France, The Netherlands, Denmark and United Kingdom brought crops like cabbage and cauliflower, hot pepper, and potato, between the 14th and 17th centuries. Interestingly, the ubiquitous tomato, which today claims the largest production, came only about 200 years ago. Similarly, cauliflower, which was introduced by Europeans, not only claims substantial area today but is one crop that has undergone major genetic modification within a short period, thanks to voluntary selection by local cultivators, mostly during the early part of this century. The evolution of a new and distinct class – Indian cauliflower – is a fascinating story of unlocking hidden genetic potential by people who did not know much about the intricacies of plant breeding.

COLE CROPS

Cauliflower

(Brassica oleracea* var. *botrytis)

India is the second leading producer of cauliflower in the world next to China. China and India together have about 75% of the total cauliflower and broccoli area cultivated in the world and 36% of this is in India. There is a wide range of variability available in cauliflower in India. Besides being thermo-sensitive, Indian cauliflowers have very stable self-incompatibility and bear genes for resistance to many diseases (Ram, 2005). The states of West Bengal, Bihar, Orissa and Haryana contribute about 56% of India's cauliflower production. Recent production of cauliflower (2010-11) is about 6.745 million tons from 0.369 million ha.

Cabbage

(Brassica oleracea* var. *capitata)

Cabbage in India is no longer considered as purely a temperate vegetable crop and is produced almost year-round throughout the country. India is the second largest producer of cabbage in the world following China. India (13%) and China (42%) produce about 55% of the world's cabbage. In India, the major cabbage growing states are Uttar Pradesh, Orissa, Bihar, Assam, West Bengal, Maharashtra and Karnataka. There are now heat tolerant hybrids, which are early maturing and perform well at comparatively higher temperatures than the traditional cool season varieties. Most of the open pollinated and hybrid varieties are exotic, and seed is imported into the country by private companies, mostly from Japan, South Korea and China. India produces about 7.949 million tons of cabbage from about 0.369 million ha.

Knolkhol or Kohlrabi
(Brassica oleracea* var. *gongylodes)
The cultivation of knolkhol in India is limited to some specific parts of the northern states, like Jammu and Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, West Bengal and Assam, and some areas of southern states (Karnataka, Tamil Nadu), and Maharashtra. In India two old, open pollinated cultivars are commonly grown *viz.*, 'White Vienna' and 'Purple Vienna', and these produce flat round knobs. There are also some important hybrids that have been introduced by private seed companies.

Broccoli *(Brassica oleracea* var. *italica)*
In recent years, cultivation of broccoli has gained momentum in India. It has become an important commodity grown under protected cultivation during the off-season, especially around big cities and tourist destinations. It is not only a delicacy for foreigners but has become quite popular with Indians because of its high nutritive value. All broccoli can be grown well during the winter season in India. There is good scope for its export during this period to Gulf countries and also to developed countries. It is mostly cultivated in the hilly areas of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri hills and the northern plains of India.

Brussels Sprouts
(Brassica oleracea* var. *gemmifera)
Brussels sprouts are not grown on a large scale in India. Cultivation is limited to areas around metropolitan cities, like Delhi, Mumbai, Kolkata and Bangalore and in Himachal Pradesh, Jammu and Kashmir, and the hills of Uttar Pradesh, Kodaikanal, Nilgiris (Tamil Nadu) and Maharashtra. Similarly, other cole crops, *viz.* kale, collards, and Chinese cabbage, are not commercially grown in India. A form of kale known as *karam saag* or *haq saag* is quite popular and widely grown in Jammu and Kashmir region.

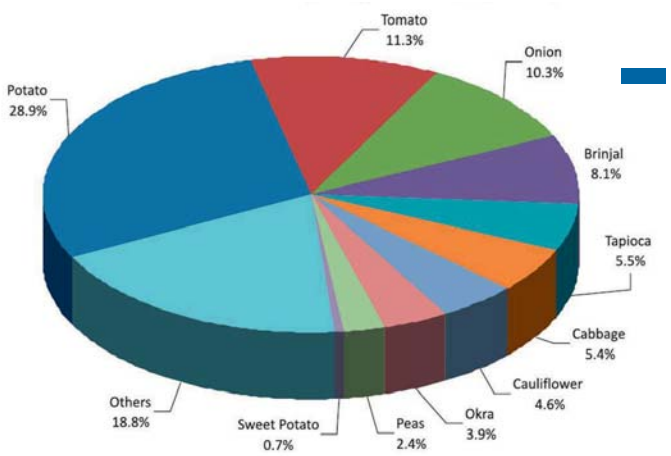


Figure 2. Production share of major vegetable crops (2010-2011). Source: Indian Horticulture Database, 2011 (www.nhb.gov.in).

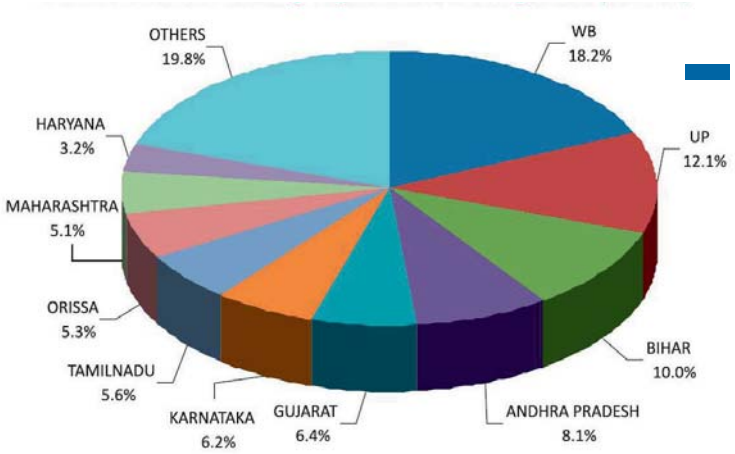


Figure 3. Production share of leading vegetable producing states (2010-2011). Source: Indian Horticulture Database, 2011 (www.nhb.gov.in).

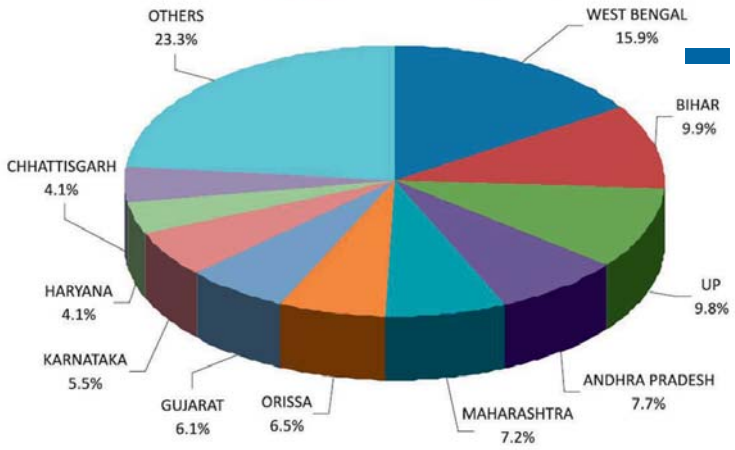


Figure 4. Area share of leading vegetable producing states (2010-2011). Source: Indian Horticulture Database, 2011 (www.nhb.gov.in).

SOLANACEOUS CROPS

Tomato *(Lycopersicon lycopersicum)*
Tomato is one of the major vegetable crops of India, being grown in almost all states in comparison to other vegetables for the fresh market. Only a small portion of the production is used for processing into paste, sauce, etc. India ranks second in tomato production (16.82 million tons) in the world but the productivity of tomato is lower (19.5 metric tons ha^{-1}) than the world average (32.0 metric tons ha^{-1}). Tomato is a warm season crop, however, there are cultivars/hybrids in India that will set fruit at temperatures as low as 6°C or as high as 30°C. Tomato is grown in India exclusively in open fields. There is no greenhouse production as in Western countries. The growing season for tomato varies in different parts of the country. In some regions, like northern and north-western India, severe incidence of leaf curl virus disease during the months of July-October prevents profitable production unless resistant hybrids/varieties are used. Tomato has also been identified as a potential crop for export to the Middle East and European countries by the Agricultural and Processed Foods Export Development Authority (APEDA) of India (Thamburaj and Singh, 2001). However, due to a lack of suitable varieties/hybrids for export, Indian tomatoes do not compete well in the global market.

Brinjal *(Solanum melongena)*
Brinjal, or eggplant or aubergine, is native to India and there are at least 33 names for eggplant in the ancient literature of India. Brinjal is a widely grown vegetable crop in Asian countries. A large number of cultivars are grown all over the country depending on regional preferences for colour, size and shape of the fruits. Among vegetables, brinjal has the widest distribution in the country. India is the second largest producer of brinjal (11.896

Table 1. List of major and minor cucurbits cultivated in India.

English name	Hindi name	Scientific name	English name	Hindi name	Scientific name
Major cucurbits			**Minor cucurbits**		
Cucumber	Khira	*Cucumis sativus*	Snake gourd	Chichinda (syn. *T. anguina*)	*Trichosanthes cucumerina*
Bitter gourd	Karela	*Momordica charantia*	Chow-chow	Chayote	*Sechium edule*
Bottle gourd	Lauki/Ghiya	*Lagenaria siceraria*	Ivy or Scarlet gourd	Kundru/Tondli	*Coccinia cordifolia*
Water melon	Tarbuz	*Citrullus lanatus* (syn. *C. vulgaris*)	Round melon	Tinda	*Praecitrullus fistulosus*
Musk melon	Kharbuza	*Cucumis melo*	Snapmelon	Phoot	*Cucumis melo* var. *momordica*
Ribbed or ridge gourd	Kali tori	*Luffa acutangula*	Bitterless bitter melon	Sweet gourd	*Momordica dioica*
Sponge gourd	Ghiya tori	*Luffa cylindrica*	Sweet gourd of Assam	Korila	*Cyclanthera pedata*
Pumpkin	Sitaphal/ Kashiphal	*Cucurbita pepo*	Bitter melon	Kachri	*C. callosus*
Summer squash	Chappan Kaddu	*Cucurbita maxima*	Long or serpent melon	Kakri	*Cucumis melo* var. *utilissimus* (syn. *C. melo* var. *flexuosos*)
Winter squash	Squash	*Cucurbita maxima*			
Ash gourd	Petha	*Benincasa hispida*			
Pointed gourd	Parwal	*Trichosanthes dioca*			

million tons) in the world and shares about 27% of the total world production. Major brinjal producing states of the country are Orissa, Bihar, Karnataka, West Bengal, Andhra Pradesh and Maharashtra.

***Capsicum* sp. (Chilli and Sweet Pepper)**
India is a major producer, exporter and consumer of chilli. Indian chillies are exported to nearly 90 countries in the world. The leading importing countries are Bahrain, Canada, Italy, Israel, Japan, Malaysia, The Netherlands, Philippines, Singapore, Spain, Srilanka, and Saudi Arabia. Chilli is a popular vegetable or spice crop grown commonly in all parts of the country and is consumed either when green or ripe red (dry condition) or in dry powder form. Andhra Pradesh has been the largest chilli growing state of the country followed by Karnataka and Maharashtra. In south India, chilli is grown throughout most of the year, while in other regions it is grown mainly as a spring and rainy season crop, extending to late autumn in some regions.
Capsicum, or sweet pepper or bell pepper, commonly called *Shimla Mirch*, is a relatively new entrant into India. It is cultivated mainly in Himachal Pradesh, Uttar Pradesh, parts of Gujarat, Maharashtra, Karnataka, Jharkhand, Jammu and Kashmir and in the hilly regions of Tamil Nadu. It grows well in the summer season in the hills and in cooler seasons on the plains.

TUBER CROPS

Potato *(Solanum tuberosum)*
India is the second largest potato producing country (42.339 million tons) following China. Potato is grown throughout the country and Uttar Pradesh, West Bengal and Bihar are the three most important potato producing states. These three states alone contribute about 77% of the country's production. About 90% of the potato growing area of India is in the Indo-gangetic plains of northern India, 6% in the hills and 4% in the plateau region of south-eastern, central and peninsular India. The Central Potato Research Station (CPRI) in Shimla is the only research institute where potato breeding is carried out and several improved varieties have been developed that are suitable for cultivation in different parts of the country.

Cassava/Tapioca *(Manihot esculenta)*
In India, cassava is an important tuber crop with a production of about 8.076 million tons. It is cultivated in the southern states of Tamil Nadu, Kerala, Andhra Pradesh and Karnataka. It is also grown in Assam and north-eastern states and is an important food in tribal areas. Tamil Nadu and Kerala together contribute about 94% of the country's cassava production. About 70% of the total cassava production is used as food, either directly or in processed form. 'Parboiled chips' is a method of processing cassava tuber for storage. These chips are harder than the plain sundried chips due to partial gelatinization. They can be stored for a longer period than sundried chips. *'Sago'* is an important food product derived from cassava starch.

Sweet Potato *(Ipomea batatas)*
India and China are the leading sweet potato growing countries of the world. In India, it is largely cultivated in Orissa, West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Tamil Nadu, Kerala, Karnataka and Andhra Pradesh. Asia is the largest producer of sweet potato sharing about 92% of world production and 80% of the area under cultivation worldwide.

Yams *(Dioscorea alata)*
The three yams grown in India are the Greater Yam (*ratalu*), Lesser Yam (*suthni*) and the White Yam. In India, Greater Yams are cultivated in Assam, Arunachal Pradesh, Nagaland, Meghalaya, Mizoram and other parts of the north-east, West Bengal, Tamil Nadu and Madhya Pradesh. Lesser Yams are grown in Bihar, eastern Uttar Pradesh, Madhya Pradesh, Orissa, West Bengal, Khasi Hills, Assam and other north-eastern states. Yams are commonly grown in homestead gardens and in tribal areas.

Taro or *Arvi (Colocasia esculenta)*
Taro is a commonly grown vegetable in tropical countries. In India, it is grown in Uttar Pradesh, Bihar, West Bengal, Madhya Pradesh, Maharashtra (Konkan region), Gujarat, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. It grows well in lowland and upland areas. Both tubers and leaves are eaten, and are either fried or cooked.

Elephant Foot Yam *(Amorphophallus paeoniifolius)*
Elephant foot yam, commonly known as *zaminkand* in India, is grown in tropical and subtropical regions. It is grown in eastern Uttar Pradesh, Bihar, West Bengal, north-eastern states, Maharashtra, Gujarat, Andhra Pradesh and Kerala.

OKRA *(ABELMOSCHUS ESCULENTUS)*

India is the largest producer of okra or *bhendi* (5.784 million tons) in the world, contributing about 73% of the world's total production. Okra originated in the Hindustani Centre, i.e. India, and great diversity exists throughout the country. It is a popular crop because it is easy to cultivate, has a dependable yield and is adaptable to varying moisture conditions. Okra is commonly grown in Andhra Pradesh, West Bengal, Bihar, Orissa, Gujarat, Jharkhand, Chhatisgarh, Assam, Maharashtra, Haryana, Punjab, and Uttar Pradesh. Tender pods are used as a fried vegetable or in curry and *sambhar*. The dried stems of okra are used for clarification of sugarcane juice. Okra has potential as an export product to the Gulf countries, Western Europe and USA.

CUCURBITS

Cucurbits form an important group of vegetable crops grown extensively in the country (Table 1). Most of the cucurbits exhibit a wide range of variability since they either originated in India or have been domesticated here. More than 20 types of cucurbits are grown in different parts of the country, varying with consumer preferences. Cucurbits are grown in village houses and thatches, on the banks of rivers and ponds and on a large scale for nearby cities. This group consists of a wide range of vegetables that are used for salads (cucumber, long melon, gherkin), for cooking (all gourds, pumpkin and squash), candied or preserved (ash gourd), as a sweet (bottle gourd, pointed gourd, pumpkin) or as pickles (bitter gourd, ivy gourd, gherkin, pointed gourd). In addition to fruits, tender shoots, flowers seeds and underground swollen fleshy roots of some cucurbits are also consumed in India. The average productivity (kg ha^{-1}) is lower than the world average for most cucurbits and far below the productivity achieved in developed countries.
The growing of cucurbitaceous vegetables in river-beds or river basins constitutes a distinct type of farming. It can be treated as a different type of vegetable forcing wherein different types of cucurbits are grown under sub-normal conditions, literally on sand, during winter months from November to February, especially in northern and north-western India. Cropping of several cucurbits like musk melon, watermelon, pumpkin, bottle gourd, and ridge and sponge gourds is practiced.

LEGUMINOUS VEGETABLE CROPS

Peas *(Pisum sativum* var. *hortense)*
India is the largest producer (3.52 million tons) of peas in the world. In India, peas are grown mainly as a winter vegetable on the plains of northern India and as a summer vegetable in the hills in other states. Maximum production of pea is in Uttar Pradesh state and accounts for 43.6%, followed by Jharkhand (9.4%) and Himachal Pradesh (7.2%). Off-season peas are produced in the higher hills of Himachal Pradesh during summer when the farmers earn lucrative returns for their produce. Off-season peas are sold throughout the country at a premium price. In India, the pods are generally hand-picked and several pickings are needed. This is in contrast to Western countries where whole plants are pulled with the help of a pea viner and the marketable pods are stripped.

French Bean *(Phaseolus vulgaris)*
In India, French beans are consumed as a tender vegetable, compared to Western countries where it is essentially grown for processing. They are also grown for dry beans commonly called *rajma.*

Cowpea *(Vigna unguiculata)*
In India, cowpea has been known since the Vedic period and is grown throughout the country. Its long green pods are consumed as a vegetable, seeds as pulse and foliage is either consumed as a vegetable or used as fodder. When grown for seeds it is also known as southern pea, black eye pea, Kaffir pea and China pea. The cultivars grown for their immature pods are variously known as asparagus bean, snake bean, and yard long bean.

The Field Bean or Lablab Bean *(Lablab purpureus)*
This crop, also known as Indian bean, hyacinth bean or dolichos bean, is a tropical bean grown mainly in South Asia (India, Bangladesh), Southeast Asia and Africa. In India it is a common bean in Madhya Pradesh, Maharashtra, some areas of Gujarat, Tamil Nadu, Andhra Pradesh, Haryana, eastern Uttar Pradesh, Bihar and West Bengal. The hyacinth bean originated in India and grows wild in India.

Cluster Bean *(Cyamopsis tetragonaloba)*
Cluster bean is commonly known as *guar* in India and is grown in Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh. It is also grown in northern parts of the country like Rajasthan, Haryana, Punjab, Uttar Pradesh, Bihar and Madhya Pradesh. The dwarf and the giant types are grown in India. Giant types are commonly grown in Gujarat and dwarf types in other areas. Cluster bean grows well in the arid regions of Rajasthan and Haryana.

Other Minor Beans
Other minor beans in the country include winged bean (*Psophocarpus tetragonolobus*), broad bean (*Vicia faba*) and sword bean (*Canavalia gladiata*).

ALLIUM CROPS

Onion *(Allium cepa)*
Globally, the country occupies second position after China in onion production with a production share of around 20% (15.12 million tons). Productivity, however, is low at around 14.2 metric tons ha^{-1}, which is lower than the world average of 19.4 metric tons ha^{-1}. Onions are produced for both domestic consumption and for export. India grows three types of onions – red, white and yellow. Although cultivated all over the country, the major onion growing states are Maharashtra, Karnataka, Gujarat, Bihar, Madhya Pradesh, Rajasthan and Andhra Pradesh. In the northern part of the country, onion is usually grown during winter (*rabi*). However, in the southern and western states of Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat and Maharashtra, it is grown in winter (*rabi*) as well as in the rainy (*kharif*) season.

Garlic *(Allium sativum)*
Major garlic producing states are Madhya Pradesh, Gujarat, Rajasthan, Orissa, Uttar Pradesh, Maharashtra, Punjab and Haryana. Garlic is used mainly as a condiment for its medicinal properties and green leaves. Planting times differ from region to region. In Gujarat, planting of garlic is done during October-November. In Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh, garlic is planted from August to October and in the northern part of India from September to November.

Since excessively hot, cool or long days are not conducive to proper development, the crop is usually planted in winter and harvested when the summer season sets in. However, garlic can also be planted during September-October. In West Bengal and Orissa, October-November is the best time for planting. In the Nilgiri hills, it is planted early in May and October.

Some varieties of vegetables released at state/national level in India.

ROOT CROPS

The most commonly grown root crops in India are carrot (*Daucus carota*), radish (*Raphanus sativus*), turnip (*Brassica rapa*) and beetroot (*Beta vulgaris*). Due to their short duration and high productivity, root crops fit well in sequential, inter and relay cropping, which enable maximum use of land.

Carrot *(Daucus carota)*
Carrot is grown throughout India and is consumed raw as well as in cooked form. Black carrot is used in the preparation of a beverage called *kanji* that is considered to be a good appetizer. The Asiatic types of carrot have more anthocyanin pigments and less carotene and are regarded as less nutritious. The main cultivation of carrot is done in Punjab, Haryana, Assam, Karnataka and Uttar Pradesh.

Radish *(Raphanus sativus)*
Radish is grown throughout India and particularly in Uttar Pradesh, Bihar, West Bengal, Assam, Punjab, Harayana, Himachal Pradesh and Gujarat. Radish roots are commonly used as salad and in pickles, but sometimes the entire plant (roots and leaves) is cooked. There are two types of radishes grown in India: Asiatic or tropical and European or temperate types. Asiatic radishes are suited to warm conditions and flower and form seeds on the plains of northern India without vernalization or low temperatures. European types require cool or winter conditions for root formation and vernalization for flower and seed production. Temperate varieties produce seeds only in the hills located in temperate areas. Because the two types of radish are cultivated in India, it is possible to produce this vegetable throughout the year.

Turnip *(Brassica rapa)*
Turnip is popular in Jammu and Kashmir, Himachal Pradesh, Punjab and Uttar Pradesh.

Beetroot *(Beta vulgaris)*
Beetroot is not as commonly grown as radish and carrot in India. All cultivars grown in the country are introductions from abroad and the two popular cultivars are 'Detroit Dark Red' and 'Crimson Globe'. In India, beetroot grows best during winter on the plains.

LEAFY VEGETABLES

Lettuce *(Lactuca sativa)*
In India, lettuce is grown in kitchen gardens and to meet the demand of continental hotels.

Amaranthus *(Amaranthus tricolor)*
Amaranthus is the most commonly grown leafy vegetable during the summer and rainy seasons in India. It fits well in crop rotations because of its very short duration and large yield of green matter per unit area. The amaranth leaf, popularly known as *chaulai*, is widely cultivated in southern regions (Tamil Nadu, Kerala, Karnataka, Andhra Pradesh). It is also grown in the hills in northern India, especially the grain amaranths. It is one of the cheapest leafy vegetables in tropical and subtropical parts of the country and is regarded as a valuable source for combating under- and mal-nutrition in India.

Spinach Beet
(Beta vulgaris* var. *bengalensis)
Spinach beet is commonly known as Indian spinach or *palak* and probably had its origin in the Indo-Chinese region. It is a very common leafy vegetable in India, particularly on the northern plains of Uttar Pradesh, Bihar, West Bengal, Rajasthan, Punnjab and Haryana. It is also grown in Maharashtra, Gujarat and Madhya Pradesh and is not so common in southern states. However, spinach, commonly known as *vilayati palak*, is not commonly grown in India except in the hilly areas.

Malabar Spinach or Malabar Nightshade *(Basella alba)*
This crop is also known as *poi*. It is cultivated in South India (Kerala, Tamil Nadu, Karnataka), West Bengal, Assam, north-eastern states, Uttar Pradesh and Punjab. However, it is more popular in southern, eastern and north-eastern states.

Fenugreek
(Trigonella foenum-graceum)
Fenugreek is commonly known as *methi* in India. The young leaves of *methi* are eaten as a vegetable and its dry seeds are popularly used as a spice and condiment. Its leaves are also dried and can be stored for about 10-12 months and used for garnishing curries. Other than common *methi, kasuri methi* (*T. corniculata*) is also cultivated in India. It is initially a slow grower and remains in a rosette condition during most of its vegetative growth and is generally a heavy yielder. Fenugreek is largely cultivated in Rajasthan, Punjab, Uttar Pradesh, Madhya Pradesh, Maharashtra and Gujarat. It is also grown in other parts of the country, like Andhra Pradesh, and Tamil Nadu. It is, however, mainly cultivated in northern India.

Drumstick *(Moringa oleifera)*
The tender leaves and immature or partially mature pods/fruits, as well as the flowers of drumstick are used as vegetables. This

plant had its origin in India and Pakistan from where it has spread to Southeast Asia. The drumstick is very popular in southern India where it is used almost every day in households in the preparation of *sambhar, rasam* or along with other vegetables. It is extensively grown in home gardens in Tamil Nadu, Karnataka, Kerala and Andhra Pradesh.

Coriander *(Coriandrum sativum)*
Coriander is also an important leafy vegetable used for flavouring soups and curries. It is widely cultivated in Rajasthan, Gujarat, Karnataka and Tamil Nadu.

Curry Leaf *(Murraya koenigii)*
Curry leaf, a large shrub or small tree, is used for flavouring *sambhar, rasam* (South Indian cuisines) and vegetable preparation and is very common in every household in southern states. It is cultivated on a commercial scale in Tamil Nadu, Karnataka and Andhra Pradesh.

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CONCLUSIONS

India is endowed with varied climatic conditions that allow cultivation of a large number of vegetables in various parts of the country. The strength of vegetable research and development in India is the rich biodiversity, potential markets, cheap labor and qualified scientific manpower. Overall growth rates of 2.0% in area, 2.2% in productivity and 4.4% in total production have been achieved during the last five years. However, considering national and international demand, India still has to go a long way to accelerate its vegetable production. There is a need to achieve the target of 225 million tons by the end of 2020 and 350 million tons by 2030 (Anon., 2011). Looking at the national scenario, vegetable production has tremendous strength in terms of natural resources and biological assets, especially genetic resources. Vegetables have great potential for export but so far there is no systematic research programme in the country focused on meeting international market standards. In addition, India must lay stress on research and development of underutilized vegetables to promote their cultivation under suitable climatic conditions.

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New Books, Websites

BOOK REVIEWS

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

Horticulture: Plants for People and Places. Geoffrey R. Dixon and David E. Aldous (eds.). 2014. Springer, Dordrecht. 1416p.

ISBN 978-94-017-8640-9

(3 volume-set, hardcover). € 369,94.
www.springer.com

The success of the Colloquium *Plants for People and Places* at the International Horticultural Congress in Lisbon, Portugal, 2010, inspired the conveners, Geoffrey R. Dixon and David E. Aldous, to invite a group of eminent scientists, international authorities in the worlds of horticulture and horticultural science, to write chapters on this subject. The result is a triad of books encompassing virtually all aspects of horticulture. Sadly, one of the editors, David Aldous, did not live to see the result of his work in print. His sudden death left the other editor, Geoffrey R. Dixon, with the gargantuan task of finishing the trilogy on his own. One can only admire the way he has acquitted himself of this task.
The 39 chapters of the trilogy, written by 108 authors in total, are grouped as Production Horticulture (Volume 1), Environmental Horticulture (Volume 2) and Social Horticulture (Volume 3). After a Preface, in which the editors elaborately explain the structure and contents of the trilogy and which in adapted form is also part of the other two volumes, the first volume begins with an Introduction by the two editors, setting horticulture in a wider context of cultivation, interaction with human activities and environmental aspects. In the next chapter ample attention is paid

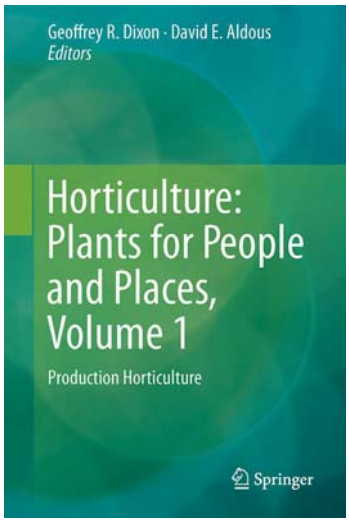
to the importance of many different fields of science in driving the development and innovation of horticulture and the wealth that has been created over the past century. The following eight chapters deal with the culture of vegetables, temperate fruits, tropical and subtropical fruits, citrus, wine, plantation crops, berries and protected crops, respectively. It is inevitable in a multi-author work like this that the degree of detail with which the various crops are dealt differs considerably. The relatively short chapter on vegetable crops gives a concise description of cultivation aspects followed by paragraphs on genetic improvement and marketing, whereas the long chapter on viticulture and wine science goes into great detail on the history, botany, vineyard management (including pests and diseases) and wine making (including microbiology and chemistry). Also, the chapter on protected crops deals in depth with a multitude of aspects, from greenhouse and glasshouse technology and climate to culture practices and pest management.

Ornamental crops are treated in a somewhat different way, with less attention to cultivation techniques. They are the subject of the next two chapters: The role of ornamentals in human life and New ornamental plants for horticulture. It is my impression that the former, a nicely illustrated treatise, would have been better placed in the volume on Social Horticulture as it, in agreement with its title, mainly deals with cultural, historical and environmental issues. The chapter on new ornamental plants deals with many aspects from prospecting to marketing but, like the chapters on medicinal plants in Volume 2 and on wildlife gardening in Volume 3, it does not mention the continuing discussions in the CITES Plants Committee about the threats to natural populations by uncontrolled wild-collecting of plants (this problem is dealt with in the chapter on biodiversity in Volume 2) or the issue of property rights on plants from developing countries.

The last three chapters in Volume 1 deal with postharvest care, supply chain networks and the environmental impact of production horticulture. One thing surprised me in the last chapter: while the chapter on protected cultivation explains that, by using the newest technologies, growers in moderate climates can reduce energy consumption by 80-90% and operate a greenhouse with minimal CO_2 emission, the chapter on the environmental impact of horticulture cites only articles from 2006 and 2008 stating that the CO_2 efficiency of growing roses in The Netherlands is poor.

The latter chapter, while forming a good transition to the first chapter of Volume 2 (on horticulture and the environment), at the same time illustrates the difficulty in deciding which chapter should be placed in which volume. In the case of these two chapters, I think the editors have made the right choice. The next chapter, however, on woody ornamentals, would in my opinion have been better placed in Volume 1 as it deals almost entirely with aspects related to cultivation.

A similar difficulty must have arisen for the chapter on medicinal and aromatic plants. It would perhaps have been more logical to place this next to the chapter on fruits and vegetables for health, which can be found in Volume 3. Both chapters contain a list of chemicals and deal in great detail with their pharmaceutical functions. Together these two chapters sketch an extensive picture of a field that has for centuries been and still is of great importance to many people's health and well-being.



Other chapters in this volume give an overview of various aspects of landscape horticulture and architecture in their broadest sense: urban greening (e.g., parks), urban trees, trees in the rural landscape, biodiversity and interior landscapes. Several subjects treated here are seldom found in books on horticulture, such as the management of sports turf and amenity grasslands. The chapter on this topic deals with a variety of issues related to this non-production-orientated branch of horticulture. The role horticulture plays in preserving biodiversity is highlighted in a chapter focussing on green open spaces, followed by a chapter on the effects of climate change on horticulture. This chapter is different in the way that here horticulture is not an activity, i.e. the subject that produces a result, but the object of the influence of another phenomenon. The impact of climate change on Indian horticulture is used as an example of the effects of rising temperatures and carbon dioxide concentrations. India is considered one of the countries most at risk from these effects.

Volume 2, which combines the environmental impact of horticulture with its role in embellishing the human environment, ends with a chapter on organic horticulture, which contains a clear description of the development of the concept and philosophy behind it from the 1840s on.

Volume 3 offers a valuable combination of horticulture and social sciences. After a chapter on the interaction between society and horticulture there are two chapters relating to health issues. The first one, already mentioned above, gives an overview on fruit and vegetables for health, with ample attention to the effect they may have on various diseases. The second one explains how horticulture can create possibilities that help improve health and well-being, for instance by offering therapy in 'care farms' or by providing green spaces for recreation.

To some people, horticulture means gardening, and they will not be disappointed by the attention paid to the arts in Volume 3. Besides the chapter already mentioned on wildlife gardening there is a chapter called Gardening and Horticulture, in which the authors clearly describe the contribution the science of horticulture makes to the art of gardening. This is also explained in the chapter dealing with the role of horticultural science in meeting the needs of urban populations, such as health, a sound environment, food security and economic stability.

Of course a chapter on education and training is an essential part of this trilogy. The chapter on this topic eloquently describes the development of horticultural skills and knowledge from ancient times until today, and the problems faced in 'western' countries with regard to the number of students opting for a career in horticulture. The changing organization of extension services is the topic of another chapter, which ends with models to support the requirements for innovation in modern horticulture.

In a world in which big enterprises play an increasingly significant part in horticulture, smallholder farmers are still of eminent importance to food security in many, in particular developing, countries. Illustrated by The Philippines as an example, their economic and social role is clearly sketched in the next chapter, which also provides useful models for the way to make this kind of horticulture prosper.

International trade in plants poses risks not only related to the spread of pests and pathogens, but also concerning the introduction of invasive aliens in vulnerable ecosystems. A chapter on this topic analyses these problems and discusses the regulations made to tackle them.

Readers of *Chronica Horticulturae* will immediately recognize some of the beautiful illustrations that accompany the chapter on horticulture and art, which gives an erudite overview of many centuries of using plants as inspiration for painters and sculptors all

over the world. The same qualifications can be given to the chapter on scholarship and literature in horticulture. This chapter not only deals with literature devoted to science, technology and the use of horticultural products, but also presents poetry and other forms of literature from ancient Mesopotamia to modern writers. Just as erudite as the former two chapters is the following one, on the history of scholarship in horticulture and pomology. This extensive chapter offers ample knowledge ranging from ancient Greece and Rome to the early twentieth century, and contains information otherwise not easily available to those who lack a classical education.

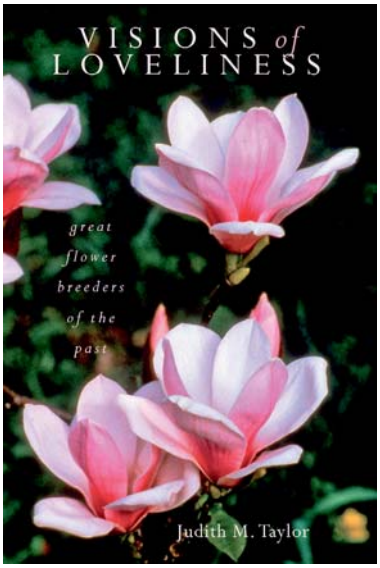
What I missed in this Volume is a thorough discussion of the role of multinational companies, e.g. seed companies, in enabling growers to make their own choices of cultivars they want to grow. The discussion of patent versus breeder's right is briefly mentioned in the chapter about new ornamentals in Volume 1, but is also, and maybe even more so, of great importance to vegetable growers all over the world.

There is of course overlap between social and environmental aspects of horticulture. The editors have obviously decided not to collect the chapters on these topics in one volume, but to highlight the evolution of horticultural philosophy by providing separate volumes on these two sectors of the discipline.

An author index is absent, but each of the three volumes contains an individual Preface plus overall lists of Contents and of Contributors as well as an Index containing 7,500 entries for the entire trilogy, together 85 pages in each volume. It must have taken a lot of time and effort to assemble such an extensive set of indices. In indices of this magnitude there are inevitably some illogicalities: for instance, the painter Cézanne is listed as Paul Cézanne under P, the author Montalbani is listed as O. Montalbani between Omnivore and Oncidium but the chemist A. Frank under F as Frank, A.; *Solanum pennellii* can be found under S for Solanum but *Solanum pimpinellifolium* as S. pimpinellifolium between Spiders and Spinach. Dioscorides (discussed on page 1218) is not mentioned in the Index, whereas 'Disocórides' (sic; page 160) is.

These critical notes are by no means meant to detract from the very high quality of this trilogy. The editors as well as the authors of all the chapters have produced a triad of books that for many years will keep its value as a standard work on horticulture in its broadest sense. We can only be grateful to Geoffrey R. Dixon, who by finishing this work has at the same time created a worthy memorial to David E. Aldous.

Reviewed by
Robert J. Bogers, The Netherlands



Visions of Loveliness; great flower breeders of the past. Judith M. Taylor. 2014. Ohio University Press/Swallow Press, Athens, Ohio, USA. 424p. ISBN 978-0-8040-4062-4 (electronic), 978-0-8040-1156-3 (hardcover), 978-0-8040-1157-0 (paperback). $52 (hardcover), $23.96 (paperback). www.ohioswallow.com

At long last an easily read, comprehensible and convenient publication has become available for those interested in the history of plant breeding. "Visions of Loveliness: great flower breeders of the past" is divided into three main sections: History of Plant Breeding in Europe and America, Important Plant Breeders in Europe and America and Plants by Genus.

The first section covers prior history and what was understood about cross breeding in the earlier period before the rediscovery of Mendel's work in 1900. Mendel's work is considered in the context of the very advanced Bohemian and Moravian ideas about improving sheep by cross breeding. The Augustinian Monastery of St Thomas was in Brno, Moravia and the wool industry was extremely important to the local landowners. It is not widely known that Gregor Mendel began his work by breeding black and white mice until the prudish bishop forced him to stop. It was only then that he took up garden peas.

The second section, Important Plant Breeders in Europe and America, is divided into two main subsections: Europe and America. Eleven signature European seedsmen and nurseries are described and discussed in some depth, examining their contributions and rise to prominence. The father of them all and the inspiration for this book was Victor Lemoine in France. The chances are that a good many of the shrubs and herbaceous plants in your garden were brought to their modern pitch of perfection by his toughness and intuitive vision. No one has written anything substantive about Lemoine before now.

Victor Lemoine was assisted first by his wife, then later his son and finally his grandson in completing this monumental achievement. The firm survived from 1843 to 1960. It was finally defeated by the encroachment of the post war modern world. The competition from warmer countries developing floral industries where costs were much lower destroyed them.

There have been many excellent plant breeders in the United States but five are examined more closely, including Claude Hope who brought the impatiens to the form in which we know it and Frank Reinelt who transformed the tuberous begonia. Other American plant breeders are discussed in the section on individual plants.

Here too there are two main sections: shrubs and herbaceous plants. It is very far reaching, illuminating people's lives and work in sometimes intimate detail. For example, the author relates the story of a dysfunctional family that grew apart through resentment over prizes and honors for sweet peas in the early years of the 20th century. In 2008, one set of cousins had no idea of the existence of a second set not too far away from them, because two sisters ceased talking to each other a hundred years before. Sweet peas were very popular in 1900 but, as with so many other things, fashion was fickle and excitement over sweet peas faded away after the first world war. David Burpee believed that marigolds should take their place and devoted thirty years of his life and work to making them preeminent once again, as only he could. Burpee was a genius at promotion.

This book covers eighteen genera in all, including roses, orchids, marigolds, begonia, magnolia, camellia and rhododendron. There is glamour and even some romance in the stories behind all this. For instance, the Duke of Devonshire was a very bored bachelor in 1840 until he was invited to open an orchid show, the sort of thing a duke did. At the show his soul was caught by a golden oncidium that changed his life forever. William Cavendish, Duke of Devonshire, transformed his estate at Chatsworth and employed Joseph Paxton who went on to build the Crystal Palace. The duke led the fashion for growing and displaying orchids. It could be said of him as of J.P. Morgan that if you had to ask how much something cost you could not afford it.

One of the English Lord Rothschilds devoted himself to breeding rhododendron and azalea after a very rackety youth. Every week, he gave his army of 13 gardeners their breeding orders of which plants to hybridize; the Exbury azaleas won prizes time after time.

A great deal was going on in the Continental European countries as well as in China, Japan and the Southern Hemisphere. Incredible roses were bred in Germany, both East and West, Czechoslovakia, Ireland and New Zealand, as well as in the United States and the United Kingdom.
In my knowledge there is no other book on this topic, honoring generations of pioneers who left us a legacy of beauty.

Reviewed by Margrethe Serek, Professor of Floriculture, Leibniz University of Hannover, Germany

NEW TITLES

Bent, Edward. 2014. Silicon Solutions. Sestante Edizioni, Bergamo, Italy. 184p. ISBN 978-88-6642-151-1. € 39 (printed book) / € 29 (digital flip-book). www.sestanteedizioni.com

Taylor, Judith M. 2014. Visions of Loveliness. Great Flower Breeders of the Past. Ohio University Press/Swallow Press, Athens, OH, USA. 424p. ISBN 978-0-8040-4062-4 (electronic), 978-0-8040-1156-3 (hardcover), 978-0-8040-1157-0 (paperback). $52 (hardcover), $23.96 (paperback). www.ohioswallow.com

Midmore, D. 2015. Principles of Tropical Horticulture. CABI Publishing, Wallingford, Oxfordshire, UK. 450p. ISBN 9781780645414 (hardback) / 9781845935153 (paperback). £ 85.00 / € 110.00 / $160.00 (hardback) / £ 39.95 / € 55.00 / $75.00 (paperback).
20% discount with discounted code "CCPTH20" when ordering through http://www.cabi.org/bookshop/book/9781845935153 or direct.orders@cabi.org

Courses and Meetings

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

International Congress on Controlled Environment Agriculture 2015 (ICCEA 2015), 20-22 May 2015, Panama City, Panama. Info: Dr. David Proenza, President of ICCEA 2015, Email: info@icceapanama.org, Web: www.icceapanama.org

International Conference on Viroids and Viroid-Like RNAs - Viroid Diseases and Molecular Mechanisms of Viroid Pathogenesis, 25-28 June 2015, Ceske Budejovice, Czech Republic. Info: Dr. Jaroslav Matousek, IPMB, ASCR, Czech Republic, or Prof. Gerhard Steger, Institute of Physical Biology, Heinrich-Heine University Düsseldorf, Germany, Email: viroid2015@biophys.uni-duesseldorf.de, Web: http://www.biophys.uni-duesseldorf.de/Viroid2015/

XI Master in Olive Growing and Oil Technology, September 2015, Cordoba, Spain. Info: Mediterranean Agronomic Institute of Zaragoza (IAMZ) – CIHEAM, Avenida Montanana 1005, 50059 Zaragoza, Spain, Phone: +34 976 716000, Fax: +34 976 716001, Email: iamz@iamz.ciheam.org, Web: www.iamz.ciheam.org

The third international "Fascination of Plants Day" 2015 will take place under the umbrella of the European Plant Science Organisation (EPSO). The goal of this activity is to get as many people as possible around the world fascinated by plants and enthused about the importance of plant science for agriculture, in sustainably producing food, as well as for horticulture, forestry, and all of the non-food products such as paper, timber, chemicals, energy, and pharmaceuticals. The role of plants in environmental conservation will also be a key message.
Everybody is welcome to join this initiative! We invite you to organize for the 18th of May 2015 a fascinating activity related to plants attracting and interacting with the public. Our goal is to break the record of 1000 events you organized in 2013. May 18th 2015 will be the Fascination of Plants Day itself and most events will be organised for this day. In addition, where this is not suitable, events will be organised throughout the weeks of 3-31 May 2015. Just contact your national coordinator (find at www.plantday.org – countries – your country – your NC contact details on right top) or the EPSO Coordinators Przemysław Wojtaszek (fopdpw@amu.edu.pl, for European countries) and Trine Hvoslef-Eide (trine.hvoslef-eide@umb.no, for countries beyond Europe) to discuss and get guidelines for using the Fascination of Plants Day. The Fascination of Plants Day corporate design can be downloaded for free at the "PR-toolbox" on this webpage to be used to prepare, hold and report on this day, see "Main Menu".
We invite many others to join in, ranging from schools to horticulture and anyone who feels they have a contribution suited to this initiative. Many plant science institutions, universities, schools, botanical gardens, and museums, together with farmers and companies, have opened their doors on the Fascination of Plants Day 2012 and 2013 with a variety of plant-based events for all the family – just look at the "Success Story" links in the given countries by clicking "Countries". Again, the media are invited to join in, and scientists, farmers, politicians and industrialists will discuss with them and present the latest state-of-the-art research and breakthroughs in the plant science world and explore all the new potential applications plant science can offer.
The Fascination of Plants Day will be backed up by a range of events in public spaces, theatres, cafes, central city squares and parks designed to get everyone thinking about plants.

Contact

Przemysław Wojtaszek, FoPD Coordinator European countries, fopdpw@amu.edu.pl; Trine Hvoslef-Eide, FoPD Coordinator beyond Europe, trine.hvoslef-eide@umb.no; or Karin Metzlaff, EPSO Executive Director, epso@epsomail.org, www.plantday.org

Section Vegetables, Roots, Tubers, Edible Bulbs, Brassica, Asparagus

Int'l Symposium on Carrot and other *Apiaceae*

The symposium was placed under the auspices of ISHS. Photo by J. Chaillou.

For the first time under the aegis of the ISHS, the International Symposium on Carrot and other *Apiaceae* was held from 17-19 September 2014 in Angers (France). The symposium was organised by Agrocampus Ouest-IRHS (higher education and research organisation), Ctifl (interprofessional institute for applied research on fresh fruit and vegetables), and Carottes de France (French Carrot growers' association), with the support of numerous sponsors in the private and public sectors.

The 540 participants, from 41 countries, came to share their expertise and know-how on a wide range of topics, including economics, growing techniques, genetics and breeding, biology and crop protection, seed technology, and product quality of carrot and other *Apiaceae* species.

More than 40 talks and 24 posters were presented. The partners and sponsors of the event displayed their products and services in 15 stands. This animated the hallways and allowed direct and fruitful discussions between participants.

There were two days of plenary, technical and scientific sessions. The themes of the plenary sessions were practices and stakes in the *Apiaceae* sectors, as well as product quality and value enhancement.

Among the many papers, some of the more notable were:

- evolution of production in Europe and Japan;
- applying Life Cycle Analysis to carrot production;
- the diversity of consumers' expectations, and their perception of carrot and carrot varieties (organoleptic characteristics);
- the diversity of the composition of the various *Apiaceae* (parsley, Arracacha roots);
- latest trends in breeding.

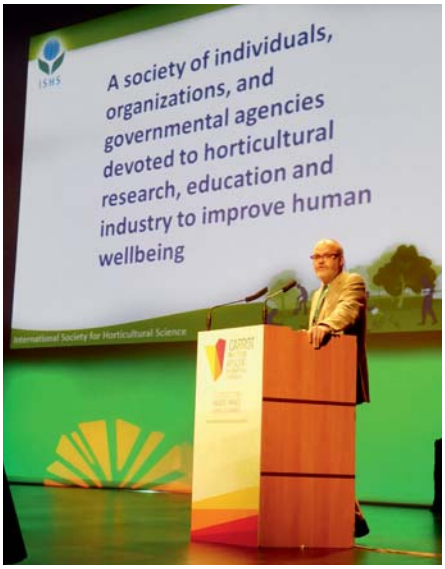
The genetic aspect represented an important part of the symposium. Breeding advancements made in Poland, the USA, Russia, Germany, Portugal, Tunisia, the UK and France were highlighted. The presentations called attention to the progress made in this field and especially:

- advances in the genome sequencing of carrot and new genotyping tools;
- studies on the control of anthocyanin and carotenoid pigment accumulation showing the genetic determinism and the regulating mechanisms of those compounds of interest;
- selection tools validated for carrot, such as the creation of lines using haploidy or markers to detect cultivated/wild cross-pollination;
- the special attention given to wild relatives of the species (better knowledge of kinships and new sources for resistance);
- the importance and stakes of prebreeding.

Several presentations addressed the appearance or resurgence of pests and diseases such as umbel browning and stem necrosis, which are detrimental to crops grown for seed, or the internal necrosis of carrot observed in the United Kingdom. More traditional pests and diseases also held a prominent place, for instance *Alternaria* on carrot and parsley. Innovative practices were noted to improve control of

pests and diseases, while limiting chemical crop protection.
Regarding pests, attention focussed on the carrot fly *Psila rosae* – the main pest affecting this crop – with research results showing the influence of landscape structures on fly populations.
As for growing techniques, fertilization was at the centre of several presentations on supervised phosphate supply and nitrates.
On the third day, theme visits were organised in the morning (seed companies and production farms, laboratories specialising in research on plant health and product quality, experimentation in aromatic plant crops, etc.). In the afternoon, participants visited trials at the GEVES (Groupe d'Étude et de contrôle des Variétés Et des Semences) site in Brion. Several trials concerned plant material: diversity of the cultivated *Apiaceae* types, importance of the genetic diversity of wild and cultivated carrot; platform of commercial varieties of various carrot types. One trial showed how observations on resistance or susceptibility to *Alternaria dauci* are carried out in the framework of the official registration of carrot varieties. Other exhibits and demonstrations presented ways to optimise growing practices: supervised management of nitrogen supply using the PILazo® method, use of alternating break crops to reduce soil diseases and nematode populations, tillage, and harvesting machines.

Fruitful exchanges between participants. Photo by J. Chaillou. ISHS activities. Photo by E. Geoffriau.



Speech of Yves Desjardins (ISHS) on ISHS activities. Photo by E. Geoffriau.

Scientific Committee: M. Briard (Agrocampus Ouest, Angers, France), P.W. Simon (USDA-ARS, Madison, USA), T. Nothnagel (Julius Kuhn-Institute, Quedlinburg, Germany), D. Grzebelus (University of Krakow, Poland), V. Faloya (INRA Rennes, France), P. d'Antuono (University of Bologna, Italy), E. Geoffriau (Agrocampus Ouest, Angers, France), F. Villeneuve (Ctifl, France), R. Collier (University of Warwick, UK – absent from the picture). Photo by J. Chaillou.

Two particularly appreciated workshops allowed participants to test sensory analysis techniques or to better identify various symptoms of pests and diseases.
In one of the plenary sessions, Yves Desjardins, Board member of the ISHS, was given the opportunity to present the activities of the ISHS, in particular its policy of optimising the exploitation of knowledge. On behalf of the ISHS and the participants, he congratulated the organisers and presented them with the ISHS medal; the recipients were: Mathilde Briard (Agrocampus Ouest), Henri Pluvinage (Ctifl) and Vincent Schieber (Carottes de France).
Furthermore, the meeting officialised the creation of the Working Group Carrot and Other *Apiaceae* within the Section Vegetables, Roots, Tubers, Edible Bulbs, Brassica, Asparagus.
The Symposium was an occasion for intense discussions between researchers, experimenters and growers. The next edition of this key event for the Carrot and other *Apiaceae* community will take place in 2018. For more information: http://www.symposium-carrot-apiaceae2014.fr

Mathilde Briard, Marc Delporte, Céline Genty and Emmanuel Geoffriau

Contact

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Eighth Int'l Symposium on Kiwifruit

The 8th International Symposium on Kiwifruit was successfully held on 18-22 September, 2014 at Dujiangyan, Sichuan, China. This was the second time that the symposium was held in China, following the 5th symposium in Wuhan (2000). Professor Hongwen Huang, Chair of the ISHS Working Group on Kiwifruit and its Culture, convened the event that attracted more than 300 academics and industrials including 138 registered representatives from 17 countries and some local growers and government agents.

The opening ceremony on 19 September featured welcoming remarks from Mr. Jianhui Chen (Chengdu Municipal Party Committee) and Dr. Ziyuan Duan (Bureau of Science & Technology for Development, Chinese Academy of Sciences). Professor Guglielmo Costa, on behalf of the ISHS, gave a comprehensive summary of ISHS developments. Professor Hongwen Huang described how kiwifruit production and research were undergoing major and profound changes. As the original homeland of kiwifruit, China could contribute significantly to the sustainable development of the world kiwifruit industry.

The scientific programme comprised 10 plenary talks, 64 oral presentations and 66 posters. The plenary talks included an overview of kiwifruit research and industry worldwide, recent advances in genetics and breeding, genomic studies for fruit characters and innovative devices in management.

Under the theme 'Quality and Sustainability', the symposium addressed a wide spectrum of disciplines. In the session 'Production, Management and Marketing', the challenge of commercial production and equipment development for efficient management were the main issues. The discussion focused on wild resources collection, evaluation and diversity analysis in the session 'Taxonomy and Germplasm'. The study of innovative use of germplasm, including polyploidy, genetic breeding and interspecific hybridization, was considered in the session 'Genetics and Breeding'. Starch accumulation, sugar metabolism and changes of physiological components were discussed in the session 'Nutrition and Physiology'. Bacterial canker of kiwifruit, a disease caused by *Pseudomonas syringae* pv. *actinidiae* (Psa) is having a major effect on the kiwifruit industry. Its occurrence, characterization and control strategies were considered in the session 'Pest and Disease (PSA)'. In the session 'Postharvest', harvest time and storage ability of fruit received particular attention. *A. arguta* is arousing considerable interest among kiwifruit colleagues, and participants discussed its growth, breeding, cold acclimation, shelf life and commercial

A

B

The Lifetime Achievement Award was presented to A. Dr. Mark McNeilage (second from left) with three previous winners of the award, Dr. Ross Ferguson (first on left), Professor Guglielmo Costa (second from right) and Professor Hongwen Huang (first on right); B. Professor Raffaele Testolin (center).

Professor Guglielmo Costa (left) presenting the ISHS medal to the Convener Professor Hongwen Huang (right).

operations in the session 'Workshop on *A. arguta*'. *A. arguta*, native to China and Japan, is a minor species of kiwifruit and a number of cultivars have been released into commercial production. The species is small fruited, hairless with green or purple colored skin.

During field tours, participants visited a kiwifruit orchard in the town of Xujia, Dujiangyan. At this site, modern planting technology such as rain-prevention cultivation, monitoring technique network and ecological cycle were displayed. The Mountainous Region Kiwifruit Cultivation Park and International Kiwifruit Exhibition Hall also impressed the symposium participants. There were two alternative tours on the afternoon of 21 September. One group toured the ancient Dujiangyan Irrigation Project, a UNESCO World Heritage site, which is the oldest and only surviving no-dam irrigation system in the world. The other group visited the Longmen Mountain Kiwifruit Gene Pool in Pengzhou County.

At the business meeting during the symposium, discussion primarily concerned future activities and leadership of the Working Group. It was enthusiastically agreed that the 9th International Symposium on Kiwifruit be held in Portugal and Spain in 2017 and that the following meeting be in Yalova, Turkey three years later. It was further agreed that Dr. Maria Dulce Antunes will assume future leadership as the next Chair of the Working Group on Kiwifruit and its Culture.

At the concluding banquet the Convener expressed appreciation to all delegates for participating in the symposium and to all members of the Organizing Committee for their efforts and contributions. In recognition of their outstanding contributions to kiwifruit research and to the industry, 'Lifetime Achievement Awards' were bestowed on Dr. Mark McNeilage (New Zealand) and Prof. Raffaele Testolin (Italy). It was a pleasure to stimulate debate and facilitate new collaborative initiatives at the symposium. The symposium was generally recognized as a scientific and social success.

Hongwen Huang

Contact

Prof. Dr. Hongwen Huang, Symposium Convener, Director South China Institute of Botany, Chinese Academy of Sciences, Xingke Road #723, Tianhe District, Guangzhou 510650, China, email: huanghw@scbg.ac.cn

Participants tasting a red-centered cultivar at Longmen Mountain Kiwifruit Gene Pool.

Participants crowd the main conference hall.

First Int'l Symposium on Grapevine Roots

The Research Centre for Viticulture of Conegliano (CRA-VIT), in partnership with Vivai Cooperativi Rauscedo (VCR), hosted the 1st International Symposium on Grapevine Roots, held in Rauscedo (Pn), Italy on October 16-17, 2014.

The symposium was organized under the auspices of the International Society for Horticultural Science (ISHS) and the International Organisation of Vine and Wine (OIV), with the financial support of the Italian Ministry of Agriculture, the Friuli Region, as well as growers' associations and local institutions.

The symposium was a unique opportunity to gather for the first time international scientists involved in grapevine root research, to share and document information on different aspects related to this important topic. A complete, multidisciplinary and well-balanced program was offered to the attendees, with a blend of the latest research, innovations and practical applications related to the symposium subject. Six distinct sessions were presented, each with a unique topic of interest. **Grapevine rootstocks: origins and future**, chaired by Nathalie Ollat from INRA, France, provided a global perspective on current rootstock use and on rootstock needs for the future, in the light of climate change. **Grapevine roots: interaction with natural factors and agronomic practices**, chaired by Kobus Hunter from the University of Stellenbosch, South Africa, discussed the effects of soil characteristics,

soil management, water supply and agronomic practices on root functions and grape quality. **Root molecular biology**, chaired by Luigi Cattivelli from CRA-GPG, Italy, provided information on the latest innovations and applications of molecular biology for new rootstock development and selection. **Root and vine mineral nutrition**, chaired by Roberto Pinton from the University of Udine, Italy, stressed the importance of better investigation of the mechanisms of root nutrient uptake and the interactions between roots and soil microflora for more efficient vine nutrition management. David M. Eissenstat, from Pennsylvania State University, USA, chaired the **Modern methods for vine root research** session, highlighting the importance of a multidisciplinary approach in root system studies. The last session, **Vine root system diseases and compatibility problems**, chaired by Josep Armengol from the Polytechnic University of Valencia, Spain, provided an overview of old and emerging vine root diseases and stressed the need for new methods of early detection and control of root pathogens.

The symposium offered a place for open dialogue during the oral and poster sessions as well as during the breaks. More than 60 high quality works from 21 countries were presented, either orally or as posters. The exceptional number of participants (more than 300 attendees including researchers, students, viticulturists and professionals in the vine industry) highlighted the great interest in the topic addressed by the symposium. The exchange of perspectives and experiences between different scientific areas provided a complete analysis of the vine root system, giving inputs for future research and practical information for vine management and the nursery industry. The need for new rootstocks resistant to drought and abiotic stresses and the requirement of new molecular methods for faster and better rootstock breeding, stand out as hot topics for current and future research.

Two technical visits enriched the symposium program. The visit to Vivai Cooperativi Rauscedo put the scientific community in contact with one of the biggest nurseries in the world, with a production of over 90 million cuttings/year and export to over 30 nations. The second-day visit took the delegates through the vineyards of the Colli Orientali del Friuli area, to learn about viticulture traditions and wines of this region. A post-symposium tour to the Prosecco DOCG was organized on Saturday, October 18 to view the landscape and

Welcome from the Convener Diego Tomasi (the one speaking) and from the authorities.

The symposium venue (VCR – Vivai Cooperativi Rauscedo) in Rauscedo, Italy.

Post-symposium tour to the Prosecco DOCG area, visiting the wineries (A) and the vineyards (B) in the area.

taste the wines of this prestigious area. The discussion at the end of the meeting highlighted the interest in further grapevine root meetings, to be held probably in 2017 in South Africa or Chile.
The book of abstracts is available at the symposium website vit.entecra.it/grapevineroots2014, which in the last three months has had more than 1,000 downloads. The proceedings of the symposium are in preparation for publication in *Acta Horticulturae* after editorial review.

Diego Tomasi, Federica Gaiotti and Fabrizio Battista

Contact

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From the Secretariat

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Argentina: Dr. Blanca Canteros; **Australia**: Dr. Inigo Auzmendi, Ms. Andrea Caldecourt, Ms. Sophie Dwyer, Mr. Max Edgley, Prof. Tim Entwisle, Mr. Robert Furniss, Petra Henniger, Prof. Stephen Hopper, Ms. Margarita Kumnick, Mr. Todd Layt, Mr. John Adrian Lepold, Mr. Nick Macleod, Mr. Christopher O'Connor, Mr. Peter Olde, Mr. Peter Salleras, Dr. Anthony Scalzo, Mr. Craig Scott, Mr. Phillip Sinclair, Mr. Warren Waddell, Robert Wakelam, Dr. Chris Williams; **Belgium**: Ms. Miet Boonen, Mr. Oliver Grunert, Carmen Van Mechelen; **Brazil**: Prof. Dr. Nina Silva, Fabiola Stockmans De Nardi; **Cambodia**: Dr. Borarin Buntong; **Cameroon**: Dr. Klaus Fleissner; **Canada**: Dr. John Armstrong, Dr. Daniel Cormier, Dr. Michael Dossett, Mr. Terry Gogarty, Mr. Simon Jalbert, Dr. Alexandre Leca, Ms. Valerie Mallamo, Ms. Josée Owen, Karina Sakalauskas, Ms. Gurleen Sidhu, Dr. Michel Tetreault; **Chile**: Ms. Camila Becerra, Prof. Dr. Gonzalo Díaz, Mr. German Poch, Ms. Isabel Sprenger; **China**: Assist. Prof. Shenglian Lu, Assist. Prof. Yanjun Peng, Mr. Yong Wang, Mr. Weiwei Yang, Dr. Guomin Zhou; **Colombia**: Ms. Patricia Samper; **Czech Republic**: Mr. Martin Dubsky, Dr. Ales Hanc, Mr. Martin Mészáros; **Finland**: Dr. Kari Jokinen, Ms. Niina Kangas, Prof. Dr. Saila Karhu, Dr. Liisa Särkkä, Mr. Esa Siitari, Dr. Eeva-Maria Tuhkanen; **France**: Jean-Marc Audergon, Ms. Emna Bairam, Dr. Valentina Baldazzi, Mr. Frédéric Bernard, Dr. Jessica Bertheloot, Dr. Frederic Boudon, Dr. Ibrahim Cheddadi, Dr. Zhanwu Dai, Dr. Isabelle Grechi, Ms. Virginie Montagne, Dr. Benoit Pallas, Mr. Raphaël Perez, Dr. Marie Turner, Dr. Bénédicte Wenden; **Germany**: Mr. Francesco Castellani, Dr. Thais Regina de Souza Chiachia, Ms. Felicitas Dittrich, Dr. Markus Gandorfer, Mr. Michael Helmut Hagemann, Dr. Agnes Klein, Prof. Dr. Winfried Kurth, Mr. Holger Linck, Dr. Andrea Linkmeyer, Ms. Christiane Schettler, Peter Schueller; **Honduras**: William McDonnell; **Hong Kong**: Mr. King Lai; **Hungary**: Ms. Anett Almassy, Ms. Ildikó Berczi, Dr. Attila Hegedüs, Mr. Gábor Kollányi, Mr. Hunor Kónya; **India**: Mr. Paresh Mungalpara, Dr. Chelviramessh Rajavadivu; **Indonesia**: Mr. Andi Dirpan, Dr. Tomy Perdana, Mr. Panca Jarot Santoso, Dr. Muhammad Imam Surya; **Iran**: Majid Basirat, Prof. Jamal Javanmardi, Ms. Bahareh Rahmani; **Israel**: Mr. Gilad Freund; **Italy**: Mr. Edward Bent, Dr. Rossella Briano, Prof. Antonino Felice Catara, Mr. Costantino Cattivello, Dr. Eugenio Cozzolino, Dr. Nicola Dallabetta, Dr. Ettore Fontana, Dr. Marzia Ingrassia, Barbara Pancino, Dr. Alberto Pansecchi, Mr. Francesco Reyes, Rabab Sanoubar, Dr. Giuseppe Sortino, Dr. Paolo Vezzali; **Japan**: Takaya Endo, Dr. Hidetoshi Ikegami, Mr. Alim Setiawan Slamet, Assist. Prof. Tatsuya Takeda, yasuyuki togano; **Jordan**: Dr. Sonia Damer; **Kenya**: Dr. Rose Onamu, Ms. Anja Weber; **Korea (Republic of)**: Prof. Dr. Yeonghwan Bae, Dr. Soh-Young Oh, Dr. Hyuntaek Seo; **Kosovo**: Mr. Kujtim Lepaja; **Latvia**: Egons Spalans; **Mexico**: Dr. Jose Lopez-Medina, Mr. Robert Lowe; **Namibia**: Mr. Johannes van der walt; **Netherlands**: Mr. Adugna Bote, Mr. Geu Koning, Mr. Leo Nugteren, Mr. Geerten van der Lugt, Dr. Adrie Veeken; **New Zealand**: Dr. Jason Smith, Mr. Trever Williamson, Prof. Linton Winder; **Norway**: Ms. Liv Hatleli, Mr. Tomasz Woznicki; **Oman**: Mr. Eric Hopkins; **Pakistan**: Dr. Iftikhar Ahmad, Mr. Zahid Khan; **Poland**: Dr. Pawel Krawiec, Dr. Agnieszka Orzel; **Portugal**: Filipa Pias; **Romania**: Ms. Ana Cornelia Butcaru, Dr. Adrian Serdinescu; **Senegal**: Mr. Abdoulaye Tamba; **Serbia**: Prof. Dr. Mirjana Ruml; **Singapore**: Mr. Edmund Lo; **Slovak Republic**: Assist. Prof. Ruslan Mariychuk, Janka Poracova; **Slovenia**: Prof. Dr. Martina Bavec; **South Africa**: Ms. Eugenie-Lien Louw, Dr. Mduduzi Ngcobo, Ms. Caroline O'Brien, Ms. Joan Sadie, Dr. Nicolette Taylor, Ms. Melissa Timothy, Mr. Teunis Vahrmeijer; **Spain**: Francisco Artes, Dr. Celia Cantin, Ms. Rosane Días, Dr. Rafael Fernández-Muñoz, Mr. Omar G, Mr. Pietro Gramazio, Mr. Álvaro López-Bernal, Dr. Enrique Moriones; **Sweden**: Dr. Assem Abu hatab, Dr. Tatiana Kuznetsova, Dr. Klara Löfkvist, Dr. Inger Olausson; **Switzerland**: Mr. Vincent Gigon; **Thailand**: Ms. Thanh Huong Ho, Dr. Nongnapat Kunagorn, Assist. Prof. Aussannee Pichakum, Dr. Sompop Prathanturarug, Assist. Prof. Sasivimon Swangpol, Mr. Aswin Varathon; **Tunisia**: Dr. Mouna Ayachi; **Turkey**: Dr. Ersin Atay, Prof. Dr. Nilgün Göktürk Baydar, Prof. Dr. Mukaddes Kayim, Dr. Nur Koyuncu, Dr. Mustafa Sakaldas; **Ukraine**: Mr. Oleg Bosyy, Mr. Sergii Zmiichuk; **United Arab Emirates**: Emil Moukarzel; **United Kingdom**: Dr. Gracie Barrett, Dr. Anne Claire Burns, Maria Del Carmen Alamar Gavidia, Ms. Nikki Jennings, Mr. Douglas Mackay, Mr. Ikenna Ohanenye, Mr. Simon Percival, Dr. Ankush Prashar, Keith Spurgin, Ms. Holly Vincent; **United States of America**: Karin Albornoz, Ms. Cara Allan, Mr. Basil Bactawar, Jonathan Baugher, Christine Bradish, Dr. David Bryla, Dr. Hannah Burrack, Steve Bushnell, Ms. Rose Caldwell, Walter Chism, Ms. Mikel Conway, Mr. Edward Crippen, Dr. Francisco de la Mota, Abigail Debner, Linda Della Rosa, Ryan Dickson, Dr. Lauren Diepenbrock, Emily Dixon, Mr. Dave Eagle, Prof. Dr. Ulrika Egertsdotter, Michael Fahner, Bill Folk, Mr. Allan Fulton, Lindsay Gasik, Dr. Kristin Getter, Michael Greenlief, Phyllis Hannan, Mr. Edwin Herman, Mengjun Hu, Sarah Hulick, Britney Hunter, Dr. Soo-Hyung Kim, Patricia R. Knight, Peter Kruger, Mr. Michael Larman, John Larse, Tiffany McAuslan, Mr. Steven McKay, David Mettler, Dr. Ivan Miller, Dr. Timothy Motis, Angela Myracle, Mr. Bryan Nemire, Mr. Tushar Patel, Dr. Katherine Pope, Shibu Poulose, Dr. Vijay Rapaka, Mr. Carlos Rodriguez, Assist. Prof. Melba Salazar, Dr. Blair Sampson, Sara Serra, Dr. Barbara Smith, Katharine Swoboda Bhattarai, Dr. Renee Threlfall, Amanda Vance, Nicole Waterland, Prof. Dr. Courtney Weber, Amanda Wright, Yuan Xue.

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 website navigation 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 2015

- April 8-11, 2015, Kaohsiung County (Chinese Taipei): NEW **International Symposium on GA3 Tropical Fruit (Guava, Wax Apple, Pineapple and Sugar Apple).** Info: Dr. Chung-Ruey Yen, Nat'l Pingtung University, Science and Technology, Dept. of Plant Industry, Neipu, Ping Tung 91207, Chinese Taipei. Phone: (886)87740265, Fax: (886)87740392, E-mail: yencr@mail.npust.edu.tw Web: http://www.2015ga3.org/
- April 19-24, 2015, San Remo (Italy): **VI International Symposium on Production and Establishment of Micropropagated Plants.** Info: Dr. Margherita Beruto, Regional Institute for Floriculture, IRF, Via Carducci 12, 18038 San Remo (Imperia), Italy. Phone: (39)0184535149, Fax: (39)0184542111, E-mail: beruto@regflor.it Web: http://www.regflor.it/ISHS2015/
- April 20-24, 2015, Murcia (Spain): **III International Symposium on Organic Matter Management and Compost Use in Horticulture.** Info: Dr. Miguel A. Sánchez-Monedero, CEBAS-CSIC, Campus Universitario de Espinardo, 25, 30100 Murcia, Spain. Phone: (34) 968396364, Fax: (34)968396213, E-mail: monedero@cebas.csic.es or Dr. Mariluz Cayuela, CEBAS-CSIC, Campus Universitario de Espinardo, 25, 30100 Murcia, Spain. E-mail: mlcayuela@cebas.csic.es Web: http://www.compost-for-horticulture.org
- April 21-24, 2015, Izmir (Turkey): NEW **II International Workshop on Bacterial Diseases of Stone Fruits and Nuts.** Info: Prof. Dr. Hatice Özaktan, University of Ege, Faculty of Agric., Dept. Plant Protection, 35100 Bornova-Izmir, Turkey. Phone: (90)232 3884000, Fax: (90)232 3744848, E-mail: hatice.ozaktan@ege.edu.tr Web: http://www.stonefruitsandnuts2015.org
- May 1-4, 2015, Kermanshah (Iran): **III International Conference on Quality Management in Supply Chains of Ornamentals (QMSCO 2015).** Info: Prof. Dr. Mohammad Mahdi Jowkar, Dept. of Agronomy and Plant Breeding, College of Agriculture, Islamic Azad University, Kermanshah, Iran. E-mail: mjowk@yahoo.co.uk Web: http://www.qmsco2015.com/
- May 18-22, 2015, Beijing (China): **V International Symposium on Ecologically Sound Fertilization Strategies for Field Vegetable Production.** Info: Prof. Dr. Silvana Nicola, University of Turin, Dept. of Agric., Forest and Food Sciences, Leonardo Da Vinci 44 (L.Paolo Braccini, 2), 10095 Grugliasco (TO), Italy. Phone: (39)0116708773, Fax: (39)0112368773, E-mail: silvana.nicola@unito.it or Prof. Dr. Guoyuan Zou, Institute of Plant Nutrition and Resources, Beijing Academy of Agric. & Forestry Sci., No. 9, Middle Shuguanghuayuan Rd., Beijing, Haidian District, China. Phone: (86)1051503998, Fax: (86)1051503996, E-mail: zouguoyuan@baafs.net.cn E-mail symposium: ishs2015@163.com Web: http://ishs2015beijing.csp.escience.cn
- May 21-25, 2015, Nigde (Turkey): **VII International Symposium on Edible Alliaceae.** Info: Ali Fuat Gokce, Nigde University, Faculty of Agric. Sci. and Technologies, Department of Agri. Genetic Engineering, 51240 Nigde, Turkey. Phone: (90)05365434241, E-mail: gokce01@yahoo.com E-mail symposium: isea2015turkey@yahoo.com Web: http://sempozyum.nigde.edu.tr/isea2015/
- May 31 - June 3, 2015, Alnarp (Sweden): **XVIII International Symposium on Horticultural Economics and Management.** Info: Dr. Lena Ekelund Axelson, Dept. of Work Science, Business Econ., Environmental Psychology, Box 88, S-230 53 Alnarp, Sweden. Phone: (46)40-415000, Fax: (46)40-415076, E-mail: lena.ekelund@slu.se Web: http://www.slu.se/ishseconomicman2015
- June 2-5, 2015, Montpellier (France): **X International Symposium on Modelling in Fruit Research and Orchard Management.** Info: Dr. Evelyne Costes, INRA UMR AGAP, 2, place Viala, 34060 Montpellier Cedex 1, France. Phone: (33)499612787, Fax: (33)499612616, E-mail: costes@supagro.inra.fr Web: https://colloque.inra.fr/modellingfruit2015
- June 2-4, 2015, Chantaburi (Thailand): **International Symposium on Durian and Other Humid Tropical Fruits.** Info: Mr. Anan Suwannarat, Director General, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. E-mail: dhtf2015@gmail.com E-mail symposium: dhtf2015@gmail.com Web: http://www.hsstth2.com/pdf/first%20announcement-DHTF2015.pdf
- June 7-11, 2015, Bari (Italy): **III International Symposium on Postharvest Pathology: Using Science to Increase Food Availability.** Info: Antonio Ippolito, Dept soil plant and food science, University of Bari, Via Amendola 165/A, 70126 Bari, Italy. Phone: (39)0805443053, Fax: (39)0805442911, E-mail: antonio.ippolito@uniba.it E-mail symposium: postharvest.bari2015@uniba.it Web: http://www.postharvestbari2015.it
- June 8-12, 2015, Avignon (France): **International Symposium on Innovation in Integrated and Organic Horticulture (INNOHORT).** Info: Stephane Bellon, INRA, Ecodevelopment Unit, SAD, Site Agroparc, Avignon Cedex 9, 84914, France. Phone: (33)432722583, E-mail: bellon@avignon.inra.fr or Dr. Nadia Bertin, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722324, E-mail: nadia.bertin@avignon.inra.fr or Dr. Sylvaine Simon, INRA PACA AVIGNON, Domaine Saint Paul, Site Agroparc, 84914 Avignon Cedex 9, France. Phone: (33)432722560, Fax: (33)432722562, E-mail: sylvaine.simon@avignon.inra.fr or Prof. Dr. Laurent Urban, Campus Agroparc, 301 rue Baruch de Spinoza, BP 21 239, 84916 Avignon, France. Phone: (33)490842214, E-mail: laurent.urban@univ-avignon.fr E-mail symposium: innohort2015@paca.inra.fr Web: http://colloque.inra.fr/innohort2015
- June 8-11, 2015, Lleida (Spain): **VIII International Symposium on Irrigation of Horticultural Crops.** Info: Dr. Jordi Marsal, IRTA, Centre udl-IRTA, Av. Rovira Roure 177, Lleida 25198, Spain. Phone: (34)973702639, Fax: (34)973238301, E-mail: jordi.marsal@irta.es Web: http://www.ipcongressos.com/en/symposium/irrigation-horticultural-crops
- June 10-13, 2015, Bologna (Italy): NEW **II International Symposium on Bacterial Canker of Kiwifruit (Psa).** Info: Prof. Dr. Francesco Spinelli, Alma Mater Studiorum, Viale Fanin 46, 40127 Bologna, Italy. Phone: (39)0512096447, Fax: (39)05120964401, E-mail: francesco.spinelli3@unibo.it or 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 E-mail symposium: psa2015.bologna@gmail.com Web: http://events.unibo.it/psa2015

- June 14-18, 2015, Bologna (Italy): **XIV Eucarpia Symposium on Fruit Breeding and Genetics.** Info: Dr. Stefano Tartarini, Dipartimento Scienze Agrarie, University of Bologna, Viale Fanin 46, 40127 Bologna, Italy. Phone: (39)0512096420, Fax: (39)0512096401, E-mail: stefano.tartarini@unibo.it E-mail symposium: convener@eucarpiafruit2015.org Web: http://www.eucarpiafruit2015.org
- June 21-24, 2015, Asheville, NC (United States of America): **XI International Rubus and Ribes Symposium.** Info: Dr. Gina Elizabeth Fernandez, North Carolina State University, 210 Kilgore Hall BOX 7609, Raleigh, NC 27695-7609, United States of America. Phone: (1)9195151188, Fax: (1)9195152505, E-mail: gina_fernandez@ncsu.edu E-mail symposium: rubusribes2015@newbeginningsmanagement.com Web: http://www.rubusribes2015.com
- June 22-26, 2015, Cartagena, Murcia (SPAIN): **V International Symposium on Cucurbits.** Info: Dr. Francisco Pérez-Alfocea, Dept. of Plant Nutrition, CEBAS-CSIC, PO Box 164, 30100 Murcia, Spain. Phone: (34)968396342, Fax: (34)968396213, E-mail: alfocea@cebas.csic.es or Dr. M.L. Gómez-Guillamón, Plant Breeding Dept., IHSM-La Mayora, CSIC-UMA, 29750 Algarrobo-Costa, Málaga, Spain. Phone: (34)952548990, Fax: (34)952552677, E-mail: guillamon@eelm.csic.es E-mail symposium: csoriano@cebas.csic.es Web: http://www.cucurbits2015.org
- June 28 - July 2, 2015, Melle (Belgium): **XXV Eucarpia Symposium on Ornamentals.** Info: Dr. Johan Van Huylenbroeck, ILVIO- Plant Unit, Applied genetics & breeding, Caritasstraat 21, 9090 Melle, Belgium. Phone: (32) 9-2722862, Fax: (32) 9-2722901, E-mail: johan.vanhuylenbroeck@ilvo.vlaanderen.be E-mail symposium: eucarpia-ornamentals@ilvo.vlaanderen.be Web: http://www.eucarpiaornamentals2015.be/
- June 29 - July 3, 2015, Shenyang City, Liaoning Province (China): **XVI International Symposium on Apricot Breeding and Culture.** Info: Dr. Weisheng Liu, Liaoning Inst. of Pomology, Xiongyue Town, Yingkou City Liaoning 115009, China. Phone: (86)417-7032822, Fax: (86)417-7842942, E-mail: weishengliu@aliyun.com Web: http://www.apricot2015.com
- July 5-8, 2015, Jupiter's Gold Coast, QLD (Australia): **ICESC2015: Hydroponics and Aquaponics at the Gold Coast.** Info: Mr. Graeme Smith, PO Box 789, Woodend Victoria 3442, Australia. Phone: (61)354272143, E-mail: graeme@graemesmithconsulting.com or Dr. Mike Nichols, 10 Newcastle St, Palmerston North 5510, New Zealand. Phone: (64)6-3576922, E-mail: m.nichols@inspire.net.nz E-mail symposium: secretariat@icesc2015goldcoast.org Web: http://www.icesc2015goldcoast.org/
- July 19-23, 2015, Evora (Portugal): **Greensys 2015 - International Symposium on New Technologies and Management for Greenhouses.** Info: Prof. Dr. Fátima Baptista, Universidade Evora, Dept.Eng.Rural - ICAAM, Nucleo da Mitra, Apartado 94, 7002-554 Évora, Portugal. Phone: (351)266760823, Fax: (351)266711189, E-mail: fb@uevora.pt or Prof. Dr. Jorge Ferro Meneses, Instituto Superior de Agronomia, Tapada da Ajuda, 1349-017 Lisboa, Portugal. Phone: (351)213602082, Fax: (351)213621575, E-mail: jmeneses@isa.ulisboa.pt or Prof. Dr. Luís Silva, University of Evora - ICAAM, Dept.Eng.Rural - ICAAM, Nucleo da Mitra, Apartado 94, 7002-554 Evora, Portugal. Phone: (351)266760933, Fax: (351)266760911, E-mail: llsilva@uevora.pt Web: http://www.greensys2015.uevora.pt
- July 26-29, 2015, Fredonia, NY (United States of America): **II International Workshop on Vineyard Mechanization and Grape and Wine Quality.** Info: Terence Bates, 6592 West Main Road, Portland, NY 14769, United States of America. E-mail: trb7@cornell.edu or Dr. Nick Dokoozlian, E & J Gallo, P. O. Box 1130, Modesto, CA 95353, United States of America. Phone: (1)5596466587, Fax: (1)5596466593, E-mail: nick.dokoozlian@ejgallo.com Web: http://events.cals.cornell.edu/ishs
- August 5-8, 2015, Yakima, WA (United States of America): NEW **IV International Humulus Symposium.** Info: Dr. Paul Matthews, S.S. Steiner Inc., 1 West Washington Avenue, Yakima, Washington, 98908, United States of America. E-mail: pmatthews@hopsteiner.com or Prof. Dr. Fred Stevens, 307 Linus Pauling Science Center, Corvallis OR 97331, United States of America. Phone: 541-737-9534, E-mail: fred.stevens@oregonstate.edu Web: http://ihs.hopsteiner.us/
- August 5-8, 2015, Madurai, Tamil Nadu (India): NEW **III International Symposium on Underutilized Plant Species.** Info: Dr. Ravindran Chandran, Assistant Professor (Horticulture), Department of Fruit Crops,, Horticultural College & Research Inst TNAU, Periyakulam-625604, India. Phone: (91)4546-231319, Fax: (91)452-231726, E-mail: ravi_hort@yahoo.com or Dr. Chelviramessh Rajavadivu, 67, TNAU Nagar First Street, Rajakambeeram, Y.Othakkadai, Madurai, Tamil Nadu, 625107, India. E-mail: selviramesh17@yahoo.co.in E-mail symposium: isups2015@gmail.com Web: http://isups2015.org
- August 6-9, 2015, Kyoto (Japan): NEW **II International Symposium on Pyrethrum.** Info: Prof. Kazuhiko Matsuda, Department of Applied Biological Chemistry, Faculty of Agriculture, Kinki University, 3327-204 Naka-machi, Nara 631-8505, Japan. Phone: (81)742-437153, Fax: (81)742-431445, E-mail: kmatsuda@nara.kindai.ac.jp E-mail symposium: pyrethrum2015@nara.kindai.ac.jp Web: http://www.pac.ne.jp/pyrethrum2015/
- August 13-15, 2015, Siem Reap (Cambodia): NEW **III Southeast Asia Symposium on Quality Management in Postharvest Systems.** Info: Dr. Borarin Buntong, Royal University of Agriculture, Chamkardaung, Dangkor District,, P.O Box 2696, Phnom Penh, Cambodia. Phone: (855) 12 822 910, E-mail: bborarin@rua.edu.kh Web: http://www.seasia2015-cambodia.com
- August 20-24, 2015, Perth (Australia): **VIII International Symposium on New Ornamental Crops and XII International Protea Research Symposium and XVII International Protea Association Conference.** Info: Dr. Robyn McConchie, The University of Sydney, Faculty of Agriculture Food and Natural Res, NSW 2006, Australia. Phone: (61) 2 8627 1045, E-mail: robyn.mcconchie@sydney.edu.au Web: http://protea-new-ornamentals2015.org/
- August 31 - September 3, 2015, Napoli (Italy): **V International Symposium on Fig.** Info: Prof. Dr. Tiziano Caruso, Department of Agricultural & Forest Science, University of Palermo, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39) 09123861207, E-mail: tiziano.caruso@unipa.it or Dr. Boris Basile, Department of Agricultural Sciences, Università di Napoli Federico II, Via Università, 100, 80055 Portici NA, Italy. Phone: (39)081-2539387, Fax: (39)081-2539389, E-mail: boris.basile@unina.it E-mail symposium: figsymposium2015@soishs.org Web: http://www.soishs.org/fig
- September 7-11, 2015, Vienna (Austria): **International Symposium on Growing Media, Composting and Substrate Analysis - SusGro2015.** Info: Dr. Andreas Baumgarten, Austrian Agency for Health and Food Safety, Institute for Soil Health and Plant Nutr., Spargelfeldstrasse 191, 1226 Wien, Austria. Phone: (43)50555 34100, Fax: (43)50555 34101, E-mail: andreas.baumgarten@ages.at E-mail symposium: susgro2015@ages.at Web: http://www.susgro2015.at

- September 8-12, 2015, Abuja (Nigeria): **II International Symposium on Mycotoxins in Nuts and Dried Fruits.** Info: Dr. Anthony Negedu, Raw Materials R&D Council, Food and Beverages Division, 17 Aguiyi Ironsi Street, Maitama, Abuja, Nigeria. Phone: (234)8055240599, E-mail: tonyneg2000@yahoo.com E-mail symposium: mycotoxinsymposium2015@rmrdc.gov.ng Web: http://www.rmrdc.gov.ng/event/view.jsf?ex=34
- September 13-16, 2015, Davis, CA (United States of America): **III International Conference on Fresh-Cut Produce: Maintaining Quality and Safety.** Info: Dr. Marita I. Cantwell, University of California Davis, Department of Plant Sciences, Mann Laboratory, Davis, CA 95616-8746, United States of America. Phone: (1)5307527305, Fax: (1)5307524554, E-mail: micantwell@ucdavis.edu Web: http://fresh-cut2015.ucdavis.edu
- September 13-16, 2015, Washington (United States of America): **II International Symposium on Mechanical Harvesting and Handling Systems of Fruits and Nuts.** 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 Prof. Dr. Qin Zhang, Center for Precision & Automated Agri. Sys., Washington State University, Prosser WA 99350, United States of America. Phone: (1)509-786-9360, E-mail: qinzhang@wsu.edu Web: http://ishs.wsu.edu/
- September 16-18, 2015, Belgrade (Serbia): **III Balkan Symposium on Fruit Growing.** Info: Prof. Dr. Dragan Milatovic, Faculty of Agriculture, Nemanjina 6, 11080 Beograd - Zemun, Serbia. Phone: (381)112615315, Fax: (381)112193659, E-mail: mdragan@agrif.bg.ac.rs E-mail symposium: 3bfsg@agrif.bg.ac.rs Web: http://3bsfg.agrif.bg.ac.rs
- September 28 - October 2, 2015, Darwin, Northern Territory (Australia): **XI International Mango Symposium.** Info: Mr. Bob Williams, 3 Hayward Place, Durack, Darwin 0830, Australia. Phone: (61)8 89314013, E-mail: rcekwilliams3@bigpond.com or Dr. Lucy Tran-Nguyen, NTDPIF, GPO Box 3000, Darwin Northern Territory 0801, Australia. Phone: (61)8 8999 2235, Fax: (61)8 8999 2312, E-mail: lucy.tran-nguyen@nt.gov.au or Dr. Ian Bally, Agri-Science Queensland, Dept. of Agriculture Fisheries and Forestry, PO Box 1054, Mareeba QLD 4880, Australia. Phone: (61)740484644, Fax: (61)74093593, E-mail: ian.bally@daff.qld.gov.au E-mail symposium: mango2015symposium@conlog.com.au Web: http://mango2015.com.au
- September 29 - October 2, 2015, La Plata (Argentina): **IX International Symposium on Artichoke, Cardoon and their Wild Relatives.** Info: Stella Maris García, Campo Experimental J.F. Villarino, C.C. 14, Zavalla S 2125 ZAA, Argentina. Phone: (54)341-4970080, Fax: (54)341-4970080, E-mail: sgarcia@unr.edu.ar or Vanina Pamela Cravero, Campo Experimental J.F. Villarino, C.C. 14, Zavalla S 2125 ZAA, Argentina. Phone: (54)341-4970080/85, Fax: (54)341-4970080/85, E-mail: vcravero@unr.edu.ar E-mail symposium: contacto@alcachofa2015.com Web: http://www.alcachofa2015.com/
- October 11-14, 2015, Wageningen (Netherlands): **V International Symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain - Model-IT 2015.** Info: Rob Schouten, Horticultural Production Chains, Wageningen University, Droevendaalsesteeg 1, 6708 Pd Wageningen, Netherlands. E-mail: rob.schouten@wur.nl or Prof. Dr. Leo F. M. Marcelis, Wageningen University, Horticulture & Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands. Phone: (31)317485675, E-mail: leo.marcelis@wur.nl Web: http://www.model-it.info/
- November 15-18, 2015, Manila (Philippines): **I International Symposium on Moringa.** Info: Dr. Manuel C. Palada, Central Philippine University, College of Agriculture, Res & Env Sciences, Lopez Jaena St, Jaro, Iloilo City, Philippines. Phone: (63)333331795, Fax: (63)333203685, E-mail: mpalada@gmail.com or Dr. Andreas Ebert, AVRDC - The World Vegetable Center, 60 Yi-Min Liao, Shanhua, 74151 Tainan, Chinese Taipei. Phone: (886)65837801, Fax: (886)65830009, E-mail: ebert.andreas6@gmail.com Web: http://ism2015.moringaling.net/
- November 16-19, 2015, Florence (Italy): **II World Congress on the Use of Biostimulants in Agriculture.** Info: New Ag International SARL, Jean-Pierre Leymonie, Managing Director, 12 rue du Hagueneck, 68000 Colmar, France. E-mail: newag@new-aginternational.com E-mail symposium: biostimulants@newaginternational.com Web: http://www.biostimulants2015.com/
- December 7-9, 2015, Ubon Ratchathani (Thailand): **I International Symposium on Quality Management of Organic Horticultural Produce.** Info: Dr. Wiraya Krongyut, 2, Faculty of Agriculture, Ubon Ratchathani Rajabhat University, Nai Muang 34000, Thailand. Phone: (66) 45-352-000, Fax: (66)45-352-088, E-mail: wirayakrongyut@gmail.com or Mr. Rachen Duangsi, 2, Faculty of Agriculture, Ubon Ratchathani Rajabhat University, Nai Muang 34000, Thailand. Phone: (66)45-352000, Fax: (66)45-352088, E-mail: rachen.d@ubru.ac.th

YEAR 2016

- January 11-17, 2016, Giza (Egypt): **IX International Symposium on In Vitro Culture and Horticultural Breeding.** Info: Adel A. Abul-Soad, Horticulture Research Institute, 9 Cairo University St.,, 12619 Giza, Egypt. E-mail: adelaboelsoaud@gmail.com E-mail symposium: 9ivchb-egypt16@gmail.com
- March 6-9, 2016, Santiago (Chile): **XIV International Symposium on Processing Tomato - XII World Processing Tomato Congress.** Info: Dr. Cosme A. Argerich, Instit. Nac. de Tecnol. Agro., C.C. Nro. 8, La Consulta, 5567 Mendoza, Argentina. Phone: (54)2622470304, Fax: (54)2622470753, E-mail: argerich.cosme@inta.gob.ar 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 or Dr. M.Teresa Pino, Rosario Norte 400 D53, Las Condes, Santiago, Chile. Phone: (56)-2-7575148, E-mail: mtpino@inia.cl E-mail symposium: wptc2016@tomate.org Web: http://www.worldtomatocongress.cl/index.php?page=home-en
- March 7-9, 2016, Krabi Province (Thailand): **I International Symposium on Tropical and Subtropical Ornamentals.** Info: Dr. Kanchit Thammasiri, Department of Plant Science, Faculty of Science, Mahidol University,, Rama VI Road, Phyathai,, Bangkok 10400, Thailand. Phone: (66)89-132-7015, Fax: (66)2-354-7172, E-mail: kanchitthammasiri@gmail.com E-mail symposium: tso2016thailand@gmail.com Web: http://www.sc.mahidol.ac.th/scpl/tso2016
- April 10-14, 2016, Orlando, FL (United States of America): **XI International Vaccinium Symposium.** Info: James Olmstead, University of Florida, 2211 Fifield Hall, Gainesville, FL 32611, United States of America. E-mail: jwolmstead@ufl.edu
- April 11-14, 2016, Izmir (Turkey): **III International Symposium on Organic Greenhouse Horticulture.** Info: Prof. Dr. Yüksel Tüzel, Ege University, Agriculture Faculty, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323111398, Fax: (90)2323881865, E-mail: yuksel.tuzel@ege.edu.tr or Assist. Prof. Golgen Bahar Oztekin, Ege University, Faculty of Agriculture, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)232-3112628/12, Fax: (90)232-3881865, E-mail: golgen.oztekin@ege.edu.tr Web: http://www.oghsymposium2016.org/

- April 27 - May 1, 2016, Antalya (Turkey): **III International Symposium on Biotechnology of Fruit Species.** 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
- May 6-10, 2016, Antalya (Turkey): **III International Symposium on Plum Pox Virus.** Info: Prof. Dr. Kadriye Caglayan, Mustafa Kemal University, Agriculture Faculty, Plant Protection Department, 31034 Antakya-Hatay, Turkey. Phone: (90)326 2455836 Ext.1347, Fax: (90)326 2455832, E-mail: kcaglayano@yahoo.com or Dr. Birol Akbas, Tarimsal Arastirmalar ve, Teknoloji Gelistirme Kampüsü, Istanbul Yolu Üzeri No 38, P.K. 51, 06171 Yenimahalle Ankara, Turkey. Phone: (90) 312 3271793, Fax: (90) 312 32708024, E-mail: bakbas@tagem.gov.tr E-mail symposium: k_degirmenci@hotmail.com
- May 9-12, 2016, Antalya (Turkey): **International Symposium on Carob: a Neglected Species with Genetic Resources for Multifunctional Uses.** Info: Prof. Dr. Hamide Gubbuk, Akdeniz University, Faculty of Agriculture, Department of Horticulture, 07058 Antalya, Turkey. Phone: (90)2423102422), Fax: (90)2422274564, E-mail: gubbuk@akdeniz.edu.tr
- May 16-20, 2016, Shiraz (Iran): **International Symposium on Role of Plant Genetic Resources on Reclaiming Lands and Environment Deteriorated by Human and Natural Actions.** Info: Dr. Ali Gharaghani, Department of Horticultural Science, College of Agricuture, Shiraz University, 12th Kilometers of Shiraz to Isfahan Road, 71441-65186, Shiraz, Iran. Phone: (98)7136138145, E-mail: agharghani@shirazu.ac.ir or Prof. Morteza Khosh-Khui, Department of Horticultural Science, College of Agriculture, Shiraz University, Shiraz, Iran. Phone: (98)7116243978, Fax: (98)7116246165, E-mail: mkhoshkhui@yahoo.com
- May 22-26, 2016, East Lansing, MI (United States of America): **VIII International Symposium on Light in Horticulture.** Info: Prof. Erik Runkle, 1066 Bogue Street, Room A288, Michigan State University, East Lansing, MI 48824, United States of America. Phone: (1)517.355.5191 x350, Fax: (1)517.353.0890, E-mail: runkleer@msu.edu or Prof. Roberto G. Lopez, Purdue University, 625 Agriculture Mall Drive, West Lafayette, Indiana, USA 47907, United States of America. Phone: (1) 765 4963425, Fax: (1) 765 4940391, E-mail: rglopez@purdue.edu Web: http://www.lightsym16.com
- May 22-26, 2016, Port-au-Prince (Haiti): **International Symposium on Valorisation, Preservation and Processing of Tropical Fruits and Vegetables.** Info: Dr. Marie Thérèse Charles, 430 Boulevard Gouin, Saint-Jean-sur-Richelieu QC J3B 3E6, Canada. Phone: (1)450-346-4494, Fax: (1)450-346-7740, E-mail: marietherese.charles@agr.gc.ca or Prof. Harold Corantin, Damien, route Nationale #1, Port-au-Prince, BP: 1441, Haiti. Phone: (509)48927198, E-mail: hcorantin@yahoo.fr Web: http://fruitsvegetableshaiti2015.com
- May 23-26, 2016, Murcia (Spain): **II International Workshop on Floral Biology and S-Incompatibility in Fruit Species.** Info: Dr. Encarnación Ortega Pastor, Dpto. de Mejora Genética, CEBAS-CSIC, Campus Universitario de Espinardo, Apdo 164, 30100 Espinardo, Murcia, Spain. E-mail: eortega@cebas.csic.es
- June 12-17, 2016, Verona (Italy): **X International Symposium on Grapevine Physiology and Biotechnology.** Info: Mario Pezzotti, Univeristy of Verona, Strada Le Grazie 15, 37134 Verona, Italy. E-mail: mario.pezzotti@univr.it
- June 13-16, 2016, Málaga (Spain): **V International Symposium on Tomato Diseases: Perspectives and Future Directions in Tomato Protection.** Info: Dr. Enrique Moriones, IHSM-UMA-CSIC, Algarrobo-Costa, Málaga, Spain. E-mail: moriones@eelm.csic.es or Dr. Rafael Fernández-Muñoz, IHSM La Mayora UMA-CSIC, Camino de La Mayora sn, E-29750 Málaga Algarrobo-Costa, Spain. Phone: (34)952-548990, E-mail: rfern@eelm.csic.es E-mail symposium: tomatodiseases2016@ihsm.uma-csic.es Web: http://www.tomatodiseases2016.es
- June 20-23, 2016, Cartagena, Murcia (Spain): **VIII International Postharvest Symposium: Enhancing Supply Chain and Consumer Benefits - Ethical and Technological Issues.** Info: Francisco Artes, ETSIA Paseo Alfonso XIII, 48., 30203 Murcia Cartagena, Spain. Phone: (34) 68-325510, Fax: (34) 68-325433, E-mail: fr.artes@upct.es E-mail symposium: postharvest@upct.es Web: http://www.postharvest2016.org
- June 20-25, 2016, Athens (Greece): **VI International Conference on Landscape and Urban Horticulture.** Info: Prof. Dr. Maria Papafotiou, Dept. Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294555, Fax: (30)2105294553, E-mail: mpapaf@aua.gr or Dr. Panayiotis Nektarios, Dept Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294554, Fax: (30)2105294553, E-mail: pan@aua.gr or Dr. Angeliki Paraskevopoulou, Dept. Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294554, Fax: (30)2105294553, E-mail: aparas@aua.gr
- June 28 - July 1, 2016, Kunming (China): **XII International Symposium on Flower Bulbs and Herbaceous Perennials.** Info: Prof. Ding Mu, No.12 Zhongguancunnandajie, Haidian District, Beijing city, 100081, China. Phone: (86)10-82105944, Fax: (86)10-62174123, E-mail: muding2011@126.com Web: http://www.flowerbulbs2016.org
- August 2-5, 2016, Minneapolis, MN (United States of America): **III International Symposium on Woody Ornamentals of the Temperate Zone.** Info: Dr. Stan C. Hokanson, Univ. of Minnesota, Dept. Of Horticulture, Breeding&Genetics, Woody Lndscape Plnts., 258 Alderman Hall, 1970 Folwell Ave., St. Paul, MN 55108, United States of America. Phone: (1)6126241203, Fax: (1)6126244941, E-mail: hokan017@umn.edu
- August 7-12, 2016, Ibadan (Nigeria): **III All Africa Horticultural Congress.** Info: Prof. Dr. Isaac Ore Aiyelaagbe, Department of Horticulture, University of Agriculture, PMB 2240 Abeokuta, Ogun State, Nigeria. Phone: (234)8033815606, Fax: (234)39243045, E-mail: ola_olu57@yahoo.com E-mail symposium: aahc2016@yahoo.com
- August 8-12, 2016, Atlanta, GA (United States of America): **II International Symposium on Ornamental Germplasm.** Info: Prof. Dr. Donglin Zhang, University of Georgia, Dept. Of Horticulture, 1111 Plant Science Building, Athens, GA 30602-7273, United States of America. Phone: (1)7065420776, Fax: (1)7065420624, E-mail: donglin@uga.edu
- August 14-17, 2016, Québec City (Canada): **VIII International Strawberry Symposium.** Info: Prof. Dr. Yves Desjardins, Horticulture Research Center/INAF, Faculty of Agriculture and Food, 2440, Blvd. Hochelaga, # 2736, Laval University, Québec, QC G1V 0A6, Canada. Phone: (1)418-656-2131x2359, Fax: (1)418-656-3515, E-mail: yves.desjardins@fsaa.ulaval.ca E-mail symposium: iss2016@conferium.com Web: http://www.iss2016-quebec.org
- September 19-22, 2016, Avignon (France): **HortiModel2016: Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation.** Info: Dr. Nadia Bertin, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722324, E-mail: nadia.bertin@avignon.inra.fr or Dr. Valentina Baldazzi, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722447, E-mail: valentina.baldazzi@avignon.inra.fr
- September 26-28, 2016, Kafr El-Sheikh (Egypt): **VI International Symposium on Tropical and Subtropical Fruits.** Info: Dr. Ali R. El-Shereif, Horticulture Department, Faculty of Agriculture, Kafrelsheikh University, 33516 Kafr El-Sheikh, Egypt. Phone: (20)473254315, Fax: (20)479102930, E-mail: aelshereif@agr.kfs.edu.eg

- October 3-7, 2016, Antalya (Turkey): **VI International Chestnut Symposium.** Info: Prof. Dr. Umit Serdar, Ondokuz Mayis University, Faculty of Agriculture, Horticultural Department, 55139 Samsun, Turkey. Phone: (90)3623121919, Fax: (90)3624576034, E-mail: userdar@omu.edu.tr

NEW

- October 5-7, 2016, Potsdam (Germany): **International Symposium on Sensing Plant Water Status - Methods and Applications in Horticultural Science.** Info: Dr. Werner B. Herppich, Leibniz-Inst. Agricult. Eng. Potsdam-Bornim, Max-Eyth-Allee 100, 14469 Potsdam, Germany. E-mail: wherppich@atb-potsdam.de or Prof. Dr. Manuela Zude, Leibniz Institute for Agricultural Engineering, Max-Eyth-Allee 100, 14469 Potsdam-Bornim, Germany. Phone: (49)331-5699-612, Fax: (49)3315699849, E-mail: zude@atb-potsdam.de E-mail symposium: spws2016@atb-potsdam.de

NEW

- October 10-14, 2016, Split (Croatia): **VIII International Olive Symposium.** Info: Dr. Slavko Perica, Director, Institute for Adriatic Crops, Put Duilova 11, 21000 Split, Croatia. Phone: (385) 21 434434, Fax: (385) 21 316584, E-mail: slavko@krs.hr E-mail symposium: ios2016-info@krs.hr Web: http://ios2016.krs.hr/

NEW

- October 16-21, 2016, Valencia (Spain): **VI International Symposium on Persimmon.** Info: Dr. Maria Luisa Badenes, Secretary General EUCARPIA, IVIA, 4 Apartado Oficial, 46113 Moncada (Valencia), Spain. Phone: (34)9634 24049, Fax: (34)9634 24106, E-mail: badenes_mlu@gva.es

NEW

- October 17-21, 2016, Chania, Crete (Greece): **III International Symposium on Horticulture in Europe - SHE2016.** Info: Dr. Panagiotis Kalaitzis, Mediterranean Agronomic Inst. Of Chania, 85, Macedonia Str. P.O. Box 85, 73100 Chania, Greece. E-mail: panagiot@maich.gr or Prof. George Assist. Manganaris, Anexartisias 33, P.O. Box 50329, 3603 Lemesos, Cyprus. Phone: (357)25002307, Fax: (357)25002804, E-mail: george.manganaris@cut.ac.cy
- October 24-29, 2016, Antalya (Turkey): **VIII International Symposium on Mineral Nutrition of Fruit Crops.** Info: Prof. Dr. Bekir Erol Ak, University of Harran, Faculty of Agriculture, 63200 Sanliurfa, Turkey. Phone: (90)4143183698, Fax: (90)4143183682, E-mail: beak@harran.edu.tr

NEW

- November 9-12, 2016, Agadir (Morocco): **V International Symposium on Saffron Biology and Technology: Advances in Biology, Technologies, Uses and Market.** Info: Prof. Mohammed Badraoui, Institut National de Recherche Agronomique, Avenue Ennasr, BP 415 Rabat, Morocco. Phone: (212)537772654, Fax: (212)537770049, E-mail: mohamedbadraoui@gmail.com Web: http://www.inra.org.ma/def.asp?codelangue=23&info=1124&rub1=1124&rub=1099

NEW

- November 20-25, 2016, Cairns (Australia): **International Symposium on Tropical and Temperate Horticulture.** 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 E-mail symposium: hort2016cairns@gmail.com

YEAR 2017

- March 7-10, 2017, Napier (New Zealand): **IV International Symposium on Molecular Markers in Horticulture.** Info: Dr. Vincent Gerardus Maria Bus, Plant and Food Research, Private Bag 1401, Havelock North 4157, New Zealand. Phone: (64)69758946, Fax: (64)69758881, E-mail: vincent.bus@plantandfood.co.nz E-mail symposium: Yvonne.McDiarmid@plantandfood.co.nz

NEW

- June 5-9, 2017, Yamagata (Japan): **VIII International Cherry Symposium.** Info: Prof. Dr. Satoshi Taira, Lab. of Pomology, Fac. of Agr., Yamagata University, Tsuruoka, Yamagata 997-8555, Japan. Phone: (81)235-282829, Fax: (81)235-282832, E-mail: staira@tds1.tr.yamagata-u.ac.jp 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 or Hideki Murayama, Faculty of Agriculture, Yamagata University, 1-23 Wakabamachi Tsuruoka, Yamagata 997-8555, Japan. Phone: (81)235282887, Fax: (81)235282812, E-mail: mhideki@tds1.tr.yamagata-u.ac.jp Web: http://cherry2017.jshs.jp
- June 18-22, 2017, Warsaw (Poland): **XII International Controlled and Modified Atmosphere Research Conference - CaMa2017.** Info: Prof. Dr. Franciszek Adamicki, Research Institute of Horticulture, Konstytucji 3 Maja 13 Str., 96-100 Skierniewice, Poland. Phone: (48)46 833 34 34, Fax: (48)46 833 31 86, E-mail: franciszek.adamicki@inhort.pl
- July 2-7, 2017, Angers (France): **VII International Symposium on Rose Research and Cultivation.** Info: Dr. Fabrice Foucher, UMR IRHS, Centre INRA, BP 60057, 49071 Beaucouze, France. E-mail: fabrice.foucher@angers.inra.fr E-mail symposium: secretariat.irhs@angers.inra.fr
- July 2-6, 2017, Bucharest (Romania): **IX International Peach Symposium.** Info: Prof. Dr. Florin Stanica, University of Agronomic Sciences, Faculty of Horticulture, B-dul Marasti, 59, Sector 1, 011464, Bucuresti, Romania. Phone: (40)722641795, Fax: (40)213182888, E-mail: flstanica@yahoo.co.uk
- August 15-19, 2017, Atakum, Samsun (Turkey): **IX International Congress on Hazelnut.** Info: Prof. Dr. Celal Tuncer, Ondokuz Mayis University, Faculty of Agriculture, Department of Plant Protection, 55139 Atakum, Samsun, Turkey. Phone: (90)3623121919, Fax: (90)3624576034, E-mail: celalt@omu.edu.tr
- August 20-24, 2017, Beijing (China): **Greensys 2017 - International Symposium on High Technology for Environment Engineering, Energy-Saving and Crop Management in Greenhouse Systems.** Info: Prof. Dr. Qichang Yang, IDEA, CAAS, 12#, Zhongguancun Southern Street, Haidian District, Beijing City, 100081, China. Phone: (86)010-82105983, Fax: (86)010-82106021, E-mail: yangqichang@caas.cn
- August 27-30, 2017, Chiba (Japan): **XIII International Symposium on Plant Bioregulators in Fruit Production.** Info: Prof. Dr. Satoru Kondo, Gratuate School of Horticulture, Chiba University, Matsudo, Chiba, 271-8510, Japan. Phone: (81)-47-308-8800, Fax: (81)-47-308-8800, E-mail: s-kondo@faculty.chiba-u.jp Web: http://www.pgr-fruit2017.org/
- September 18-20, 2017, Muscat (Oman): **X International Symposium on Temperate Fruits in the Tropics and Subtropics.** Info: Dr. Rashid Al-Yahyai, Dept.of Crop Sciences, CAMS, Sultan Qaboos University, P.O. Box 34, Al-Khoud 123, Oman. Phone: (968) 24413215), Fax: (968) 24413418), E-mail: alyahyai@squ.edu.om

NEW

YEAR 2018

- August 12-16, 2018, Istanbul (Turkey): **XXX International Horticultural Congress: IHC2018.** Info: Prof. Dr. Yüksel Tüzel, Ege University, Agriculture Faculty, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323111398, Fax: (90)2323881865, E-mail: yuksel.tuzel@ege.edu.tr Web: http://www.ihc2018.org
- October 15-17, 2018, Plovdiv (Bulgaria): **III International Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops.** Info: Assist. Prof. Stefan Gandev, Fruit Growing Institute, Ostromila 12, 4004 Plovdiv, Bulgaria. Phone: (359)32 69 23 49, E-mail: s.gandev@abv.bg

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Chronica Horticulturae
Author Information

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

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

News & Views from the Board. This section is usually confined to editorials from Board Members as well as general announcements of the Society.

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

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

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

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

The World of Horticulture. Articles in this section highlight horticultural industries and research institutions of particular countries or geographic regions throughout the world. Illustration with figures and tables is extremely helpful and highly advised. This section also includes book reviews that are requested by the Editor. Members who wish to recommend a book review should arrange for a copy of the book to reach the Secretariat.

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

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

Authors who wish to submit articles for publication in *Chronica* should contact ISHS headquarters and their request will be transmitted to the Editor. Authors should be aware that most articles should have a broad international focus. Thus, articles of strictly local interest are generally unsuited to *Chronica*. Illustrated articles are usually 1500 to 5000 words long. There are no page charges for *Chronica Horticulturae*. Photographs submitted should be of high resolution. Send articles or ideas for articles to:

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