A publication of the International Society for Horticultural Science

Chronica Horticulturae

Horticultural highlights

Horticultural science in crisis: where are the graduates required to assure its future? ● Ethics and horticulture ● Globe artichoke cultivation in Argentina ● Protected cultivation in Turkey

Symposia and workshops

GA3 tropical fruit (guava, wax apple, pineapple and sugar apple) ● Postharvest research, education and extension ● Citrus biotechnology ● Organic matter management and compost use in horticulture ● Bacterial diseases of stone fruits and nuts

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Cover photograph: Artichoke flower being pollinated by a bee. See article p. 15.

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

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Jens-Norbert Wünsche, ISHS Board Member
Responsible for Innovation, Outreach and Strategy

› Jens-Norbert Wünsche

The aim of the ISHS is "...to promote and encourage research and education in all branches of horticultural science and to facilitate cooperation and knowledge transfer on a global scale through its symposia and congresses, publications and scientific structure." Most if not all of us can relate well to the Society's fundamental purpose to recognize, promote, and support excellence in horticultural science throughout the world for the benefit of humanity and sustainability.

Status quo and quo vadis?

Horticulture is an excitingly complex, innovative, diverse, multidisciplinary and multifunctional profession, producing high value, highly nutritious, health benefiting food crops and beautiful environments. Horticulture is thereby of paramount importance for sustaining lives, livelihoods and landscapes and has great potential for contributing to meet Millennium Development Goals or now the Sustainable Development Goals.

Despite the many fascinating positive perspectives and critical importance of horticulture, it is regrettably not well recognized as a viable professional career by educators, policy-makers, administrators, politicians, funding agencies and media. There is strong need for joint efforts to change the image of horticultural science in the general public to gain increased visibility and greater recognition by those groups and to ensure that the worldwide deficiency of horticultural graduates is better aligned with the economic relevance of horticulture!

Horticulture is indeed a "withering field" in many developed and developing countries, facing an imminent crisis characterized by a shortage of competent, qualified horticultural staff at institutional, corporate and commercial levels. This is also reflected by a declining membership in some national and most international horticultural societies. How can a professional society help counteract this alarming erosion of horticultural attractiveness and in particular how can we as Board members in close cooperation with all Society members guide ISHS to lift its profile globally and that of our profession? There are numerous unexplored opportunities for leadership in our Society – a comprehensive and challenging role that encompasses science activities, communication, education, advocacy, networking, development work and industry and commercial imperatives.

Communication

A clear perception change of horticulture is unarguably needed in the public arena as horticulture is more than gardening! The ISHS needs to assume the leadership role for facilitating an internationally coordinated voice aimed at increasing public awareness of the importance of our profession and generating interest in horticulture as a career, specifically targeting young people. Unfortunately, scientists are often not good at, or adequately trained for, writing popular articles in layman's terms for the general public. We therefore have to align with journalists or communication managers to write the good news stories, to celebrate our scientific successes and to stand up proudly for horticulture and our Society. It is further important to use appropriately other forms of social media (such as Website, Twitter, YouTube, Facebook, LinkedIn) to promote the benefits of horticulture. The words need to be enriching, incisive, the graphical material eye-catching and inspirational, to be well accepted, absorbed and thought-through by the young minds. We need to make implicitly sure that we communicate with them in their language to attract them, to capture their motivation and curiosity and to make it fun and exciting.

Of course, we continue to value, support and communicate through our core activities of organising symposia, publishing proceedings in *Acta Horticulturae*, publishing the quarterly *Chronica Horticulturae* and releasing scientific refereed journals, such as the *European Journal of Horticultural Science*, in which our members and non-members are able to publish their research findings.

Advocacy

We must advocate locally and internationally for horticulture and assist and encourage the development of relevant education and training programs specifically targeted for youth. Because of the commercial/economic importance of horticulture, the ISHS has to forge relationships along the entire food value chain, e.g. between grower organizations and/or supermarkets to employ professional communicators to work alongside scientists and extension personnel to create such programs. Highlighting the value and richness of horticulture to young minds should at best commence at primary level in school gardens since the decision about future careers is often made at pre-university by 12-16 year olds. However, our primary target group are undergraduate students as they are required to make a decision on which professional specialization they are about to pursue.

As a mean of reaching to the potential young clientele, Board members envisage organizing an *idea contest* on each continent to understand the motivations, expectations and barriers to pursuing horticultural careers and becoming members of the ISHS. Harnessing the opinions of potential new horticulturists is essential to ensure that their voice is considered when shaping the path of our profession into the future. A professionally qualified and broadly based jury will assess the concept papers and future presentation, designed to demonstrate the excitement, enjoyment, variety as well as the nutritional and economic importance of this diverse profession.

In this context, the ISHS Board members are proud to support the first *European Conference of Post Graduate Horticultural Scientists*, which will take place on 12-13 May 2016 in Palermo, Italy (http://www.ishs.org/symposium/576). The two-day conference aims to bring together postgraduate students in horticulture to present and discuss their work in an intellectually stimulating and informal setting. Moreover, during this event we propose that a *Youth Task Force* or *Post Graduate Alumni Club* be created for students interested in becoming ambassadors of the ISHS.

The ISHS video "Harvesting the Sun: A Profile of World Horticulture" has been a great success at highlighting the diversity of horticulture and has had over 4000 hits on YouTube in just over a year. It focused mainly on the farm-to-table journey in industrialized countries, without having space to cover the exciting and positive "stories" that developing countries have to tell. We are keen to feature the beauty of horticulture on each continent in a *new video* (*or videos*) to demonstrate the breadth, opportunities and benefits of horticulture to young minds.

Finally, we need to identify passionate and committed champions and encourage them to lobby politicians, universities and the communities. In this regard, it is equally important to value and feature broadly our Fellows and Honorary Members as these are the figureheads of our Society.

Networking

It is our great pleasure to announce that a first Corporate Membership agreement has been signed with Bayer CropScience (BCS). The signing ceremony with the President of the ISHS, Professor Rod Drew, took place on Friday the 8th of May in Monheim at the BCS headquarter. The agreement offers a range of great benefits and opportunities to both parties, including cooperation on selected topics of international concern and importance. The agreement stands for four years and may be renewed thereafter. We anticipate further Corporate Membership agreements in due course, either by individually approaching key companies or by promoting ISHS through participation at Fruit Logistica or other trade fairs.

The ISHS continues a strong and strategically aligned partnership with Global Horticulture Initiative (GHI) to work on sustainable development goals such as food security issues and poverty mitigation in developing countries. Primary focus is on identifying and facilitating participatory research opportunities in small-scale horticulture systems, capacity building by providing effective and relevant horticultural training and education programs as well as connecting and informing the diverse and dispersed community of horticultural professionals by interactive hubs for gathering and organizing information.

The ISHS also needs to engage with other societies at a national/international level and perhaps organize cross-discipline events. Let us all ensure that the ISHS has a bright and exciting future and will never cease to exist: “Never doubt that a small group of thoughtful, committed people can change the world. Indeed, it is the only thing that ever has” (Margaret Mead, American cultural anthropologist).

› Misgivings about a current trend in horticultural science

Letter to the editor

I write as someone who has spent over forty years of my life in the field of crop physiology and would champion this field at any opportunity. I am concerned, however, by a recent trend in some reported “experiments” of not only the lack of true replication and randomisation, but the misuse of the analysis of variance (ANOVA).

Typically this would be seen in a comparison of fruit quality under a hail net compared to fruit quality in an un-netted area. Often the grower or the commercial organisation would like to know whether the hail netting has altered the fruit quality and if so, to what degree; a very reasonable request. To measure fruit quality from randomised samples taken from within both the netted and un-netted areas and then to perform ANOVA on the data is not an acceptable practice and is an example of pseudo-replication. The best that can be done in this case is to present the means and standard errors of the fruit quality obtained in the different areas. If data were available from the two areas before the netting was put on, this would help to confirm, or otherwise, whether there was an inherent difference in fruit quality between the two areas. Frequently, however, this is not done. I realise the logistical difficulties in arranging large scale replicated, randomised trials with hail netting but that is no excuse for inappropriate statistics. Each experimental design has its limitations and the statistical analysis should be appropriate to the design.

In the long term someone needs to do a meta-analysis of all the published information using each site as a replicate. At least this would be true to the scientific method, although even here it assumes that all studies have been published, irrespective of the results obtained.

At the risk of suggesting scientific sloppiness, I think there has been a genuine misunderstanding of the need for replication and randomisation. If there is a requirement to see the effect of different hail netting materials on fruit quality for example, then a properly randomised, replicated trial with individual trees covered with different materials, would furnish genuine replication. The microenvironment under the tree would be somewhat different from that under a large hail netted area but at least you can draw valid statistical conclusions on possible differences between the different materials. The magnitude of these effects could then be compared to that observed with the inside/outside of large covered areas. If they are comparable, then it gives you greater confidence in your results. If this approach is coupled with a meta-analysis of all the trials published, then this could be even more enlightening.

John W. Palmer

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Horticultural science in crisis: where are the graduates required to assure its future?

Errol W. Hewett

Horticulture is in a crisis

Horticulture is facing a crisis in many countries. There are simply not enough well-trained people being produced in local institutions to service the broad range of careers that comprise the horticulture sector. Sectors within the horticultural industry are becoming very concerned at the reduction in the number of young people undertaking post-high school education in horticulture and/or horticultural science. Headlines such as those indicated below have become increasingly common in many countries over the past few years.

"Horticulture is under siege in the USA".
"Is horticulture a withering field in the USA?"
"Careers in agriculture fail to win hearts and minds of the young".
"Concerns over shortage of agriculture graduates in Australia".
"Uganda's flower sector faces an imminent shortage of qualified managers and supervisors in flower firms".
"Horticulture is facing a crisis in the United Kingdom".
"Kenya has a shortage of competent horticultural staff at institutional and commercial levels".
"New Zealand horticulture requires a net increase of 7,800 qualified people by 2025 with an additional 26,300 people needed to cover natural attrition".

A recent Royal Horticultural Society (RHS, 2014) publication highlighted the fact that 70% of horticultural businesses surveyed in the United Kingdom struggled to fill skilled vacancies, with 90% of respondents saying horticulture lacked career appeal. In Australia in 2010, there were just 743 graduates in agricultural science but over 4,500 agricultural science jobs were advertised. It is estimated that the horticulture sector will require about 2,000 new jobs each year for the next decade in order to retain its current position (J.E. Pratley, Charles Sturt University, pers. commun.) let alone achieve the growth targets being set by the sector. The decline in horticultural graduates in Australia during the last 11 years, from about 150 to about 40 per year, has been dramatic and is inadequate to meet sector needs. A serious and inevitable consequence of this decline in enrolments has been the disappearance of horticultural degrees from technical and university programmes in all Australian universities apart from Charles Sturt University and the University of Melbourne. This trend of disappearing Departments of Horticulture is mirrored in many European, American and Oceanic countries. The USA is not producing the number of scientists required to sustain its high value specialty crop (horticultural) sector.

There is no doubt that science underpins successful horticultural development throughout the world, whether it is on large corporate farms in developed countries or small subsistence units in developing countries. In a recent study the Coalition for Sustainable Agriculture in the USA indicated that too few scientists are being trained in agriculture (including horticulture) areas of science (Enoch, 2014).

World population and horticulture

World population increased by nearly 1 billion people between 2000 and 2012, a 16% increase (Table 1). The largest percentage increases were in Africa (35%), Oceania (17%) and Asia (15%).

World production of vegetables and fruit increased by about 32% over the 12 years 2000 to 2012, with the largest increases occurring in Africa and Asia, regions where population growth has been greatest (Table 1). There was a 62% increase of vegetable production in Africa and 73% increase in fruit production in Asia. This major increase in production of vegetables and fruit would not have occurred without the concerted efforts of horticultural scientists and producers worldwide. There is no doubt that these increases in vegetable and fruit production contributed to the Millennium Development Goals (MDGs) of reducing extreme poverty, improving nutrition and reducing child mortality rates in developing countries. In contrast, fruit and vegetable production in Europe decreased by 13% for vegetables and 36% for fruit. Europe's population growth was lowest of all continents with a change of only 1.6% between 2000 and 2012.

What is Horticulture?

Horticulture is difficult to define precisely and is often subsumed and regarded as a sub-section of agriculture. Too often, the public perception of horticulture is that it is a poor-paying job, requiring few if any skills, working long hours in menial laboring tasks in all weathers and seasons, and requiring no tertiary education. This is far from the truth. Horticulture is a knowledge-intensive, high-tech industry, which is vitally important internationally and deserving of its own place in the sun.

Farr (2014) stated that *"Horticulture is a synthesis of science, technology, art and society; implementing it requires technical appreciation of engineering, plant sciences, ecology, – including marketing, strategic management, human resources and financial planning"*.

The Eden Project in the United Kingdom believes that *"Horticulturists help ensure the survival of the human race by combining the energy of the sun with soil, seeds, water and ingenuity"* (Anon., 2014a).

In Wikipedia **horticulture** is defined as the *"branch of agriculture that deals with the art, science, technology, and business of plant cultivation. It includes the cultivation of fruits, vegetables, nuts, seeds, herbs, sprouts, mushrooms, algae, flowers, seaweeds and non-food crops such as grass and ornamental trees and plants. It also includes plant conservation, landscape restoration, landscape and garden design, construction, and maintenance, and arboriculture"* (Anon., 2014b).

Because of its unique attributes, horticulture must be considered an integrative discipline in its own right and should develop its own specific 'brand' standing apart from agriculture. According to Kahane and Pilot (2012),

in many countries horticulture is rapidly decreasing in recognition as an academic science in its own right. Rather, it is being included in less distinctive entities such as Natural Resources or Plant and Environmental Sciences that have little, if any, direct impact or relationship with the richness and diversity that is horticulture. Specific disciplines that are essential contributors to, and often associated with, horticulture include: Agronomy, Agriculture, Botany, Crop Science, Plant Pathology, Plant Science Management, Soil Science, Entomology, Plant Ecology, Environmental Science, Natural Science and Agribusiness Management. Horticultural careers exist in plant breeding; fruit, vegetable and cut flower production; protected cultivation in green and plastic houses; landscape, nursery, public botanic gardens; sports turf and community businesses; private and public extension (outreach) services; postharvest quality and supply chain management; consultancies in plant production; plant science; plant genetic technology; pests and diseases; food safety and security; as well the physiological and psychological benefits of plants. Successful horticultural industries depend on the integration of some or all of these disciplines into coherent and synergistic systems for optimal outputs.

Horticulture is an intensive productive sector and is of growing importance in contributing to poverty alleviation, nutritional enhancement, environmental sustainability and beautification and economic growth. Fruit, vegetables and cut flowers are generally more profitable to small farmers than staple or arable crops as they are high-value with value-added income generation potential (Weinberger and Lumpkin, 2005). Most staple agronomic crops, including cassava, maize, sorghum and rice, do not fall within the normal definition of horticultural crops. However, these staple crops are grown by smallholder farmers in developing countries and will continue to be important sources of carbohydrates and income at the household level. For this reason, their production should be integrated with horticultural crops and also require the attention of the scientific community.

Other positive attributes of horticulture include increased employment opportunities, increased commercial (servicing) opportunities in the rural sector and the potential for urban and periurban plant production for personal consumption (food security, health and nutrition) and local sales (income generation).

Vegetables and fruit are essential components of a well-balanced, healthy and nutritious diet. This is well recognised worldwide. The World Health Organisation (WHO) and the Food and Agricultural Organisation (FAO) advocate a minimum daily intake of 400 g of fruit and vegetables. Programmes such as "5 + a Day" are proving very useful in educating consumers about the nutritional and health benefits provided by horticultural products. Many dieticians and health professionals advocate a greater range and daily intake of vegetables and fruit (Slavin and Lloyd, 2012).

Horticultural foods provide a range of nutrients and different bioactive compounds including phytochemicals (phenolics, flavonoids and carotenoids), vitamins, (vitamin C, folate and pro-vitamin A), minerals (potassium, calcium and magnesium) and fibre (Liu, 2013). New technological knowledge is needed to produce enhanced yields of quality products. This will be generated by scientists and implemented by growers and others in the value chain. The products will be harvested, processed, packaged, stored and transported using modern postharvest and processing technologies. Production of such knowledge requires well-educated and trained horticultural professionals, whether they are specialised plant breeders, plant physiologists, plant pathologists, entomologists, soil scientists, horticultural engineers, agribusiness managers, consultants or combinations of the above. There is an international paucity of such horticultural professionals. The problem is exacerbated by the aging of existing professionals and compounded by the lack of young people choosing to study horticulture at tertiary level in many countries.

Horticulture is not only about production of food. It contributes to quality of life and lifestyles, to the beauty and sustainability of the human environment through local and national parks, reserves and gardens, and to enhancement of community economic value. Amenity or community horticulture creates places that contribute to improved mental and community health as well as contributing to the local and national economy. Aldous and Johnston (2012) stated that the global urban horticulture market was worth US$287.5 billion. A report of the economic value of protected open spaces in S.E. Pennsylvania (Anon., 2011) showed that the following benefits could be attributed to the open spaces: $16.3 billion added to the value of housing stock, $240 million gain in annual property and transfer tax revenue for the local government, $133 million reduction in costs avoided as a result of the natural provision of environment services, $577 million in annual benefit to residents who recreate in open spaces, $795 million annually in avoided medical costs, plus the creation of 6,900 jobs.

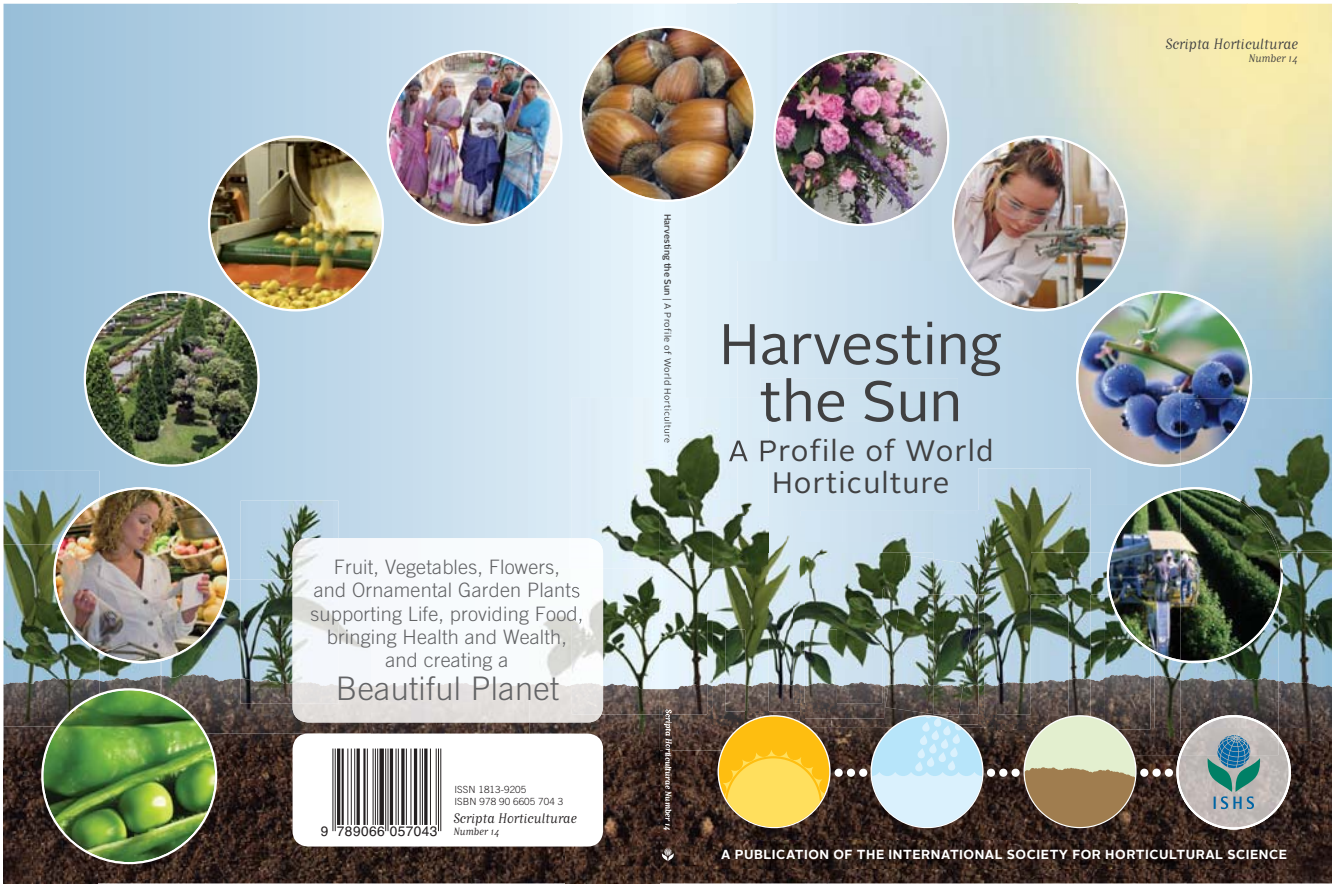
Table 1. World vegetable and fruit production and population change between 2000 and 2012. Source: FAOSTATS: Accessed October 2014.

		Tonnes (million)			Population
		2000	2012	% change	% change
World	Vegetables	1,390	1,792	28.9	16.2
	Fruit	625	839	34.2	
Africa	Vegetables	175	283	61.8	34.6
	Fruit	77	113	47.2	
Asia	Vegetables	804	1,120	39.3	14.6
	Fruit	279	481	72.5	
Americas	Vegetables	153	161	5.2	12.0
	Fruit	142	158	11.1	
Europe	Vegetables	242	210	-13.3	1.6
	Fruit	125	76	-36.2	
Oceania	Vegetables	7	8	16.4	17.2
	Fruit	5	7	25.9	

Why does horticulture lack appeal to young people?

Regrettably, the general perception of horticulture by the general public, including prospective students and their parents, is negative and ill informed. For horticulture and horticultural science to prosper in the future, this negative perception must be changed through an active advocacy and marketing programme.

There is a perception that horticulture is low-tech and boring. This is not so. Horticultural producers are among the initiators and first users of any new technology. They are avid users and rapid adopters of new ideas, new varieties and new high-tech inno-



› Harvesting the Sun is freely available for ISHS members to view, use and share.

vations, especially those that enable more sustainable and productive systems.

There is a perception that horticulture is low paid with poor career prospects. That need not be so. New horticultural graduates in New Zealand and Australia can receive more than $70,000 p.a. on initial recruitment into selective, highly responsible roles with great opportunities for rapid advancement and income increases.

A very wide and varied range of careers exists for horticultural graduates. Well-trained and educated people are required to ensure that nutritious fruit and vegetables are on tables 365 days a year, parks and gardens are available to people in urban and rural environments and sustainable production, postharvest and amenity horticultural systems are universally practiced through the entire supply chain from farm to consumer. In many cases, employment in horticulture enables working outside in pleasant surroundings, provides opportunities for international travel and chances to provide updated advice and assistance in developing countries.

And yet there is a huge actual and projected deficit in well-trained horticultural graduates in many countries – insufficient numbers to meet future needs. Kenya has a shortage of competent horticultural staff at institutional and commercial levels. New Zealand horticulture will require a net increase of 7,800 qualified people by 2025 with an additional 26,300 people to cover natural attrition. In Australia there are 60,000 unfilled jobs in the agriculture/horticulture sector but only 500 graduates every year to fill them. Seventy percent of horticultural businesses surveyed in the United Kingdom struggled to fill skilled vacancies, with 90% saying horticulture lacked career appeal.

The International Society for Horticultural Science (ISHS) has commenced a campaign of advocacy about horticulture. A book (ISHS, 2012) and a video (on You Tube – https://www.youtube.com/watch?v=MvlFcEyAezA) titled: "Harvesting the Sun" has been produced in an attempt to demonstrate the breadth, range and diversity of horticulture, its nutritional, health, economic, community and social importance. It is written in a simple text with many colourful pictures that show a wide spectrum of horticultural aspects including potential careers. This book has been translated into several languages to date. Hopefully, appropriate volunteers can be found to translate the book into other languages.

The Royal Society for Horticultural Science (RHS, 2014) in the United Kingdom has produced "Horticulture Matters", a report on the state of horticulture in the UK. Its main objectives include: promoting horticulture across government, improving the perception of horticulture in society and to government, embedding horticulture in education, promoting and supporting training, and safeguarding the health of UK horticulture. A varied number of initiatives have been launched across the sector, with a focused attention on youth, and initial results appear promising.

In the White Paper "Promoting Horticulture in the United States" (Anon., 2014c), the authors encapsulated the issue concisely: *"Today our world is highly dependent on horticultural expertise to provide the technology and people necessary to meet the rapidly increasing global demand for fruits, vegetables, nuts, herbs and ornamentals in the face of the changing global environment and limited natural and financial resources. Horticultural Science is critical in improving the nutritional content of food, enhancing the safety of our produce supply, and increasing the supply of healthy, local and sustainably produced foods. Expertise in environmental horticulture is necessary to address the global issues of climate change; water quality, availability, storm water runoff, and retention; and energy production through biofuels. Additionally, the role that horticulture plays in promoting positive mental well-being, on a large scale from public botanic gardens, parks, and sports fields, to small scale individual home gardens is critical to our life today."* The issue in the USA is exactly the same as in many other countries.

The USA programme focuses on young people. It intends to raise funds for integrating horticulture firmly into core curricula at schools, to develop marketing programmes for universities and colleges to reach parents and potential students, and to promote knowledge about the importance of horticulture to the general public (Anon., 2014c).

Can the declining trend be reversed?

It is critically important that more young people are encouraged to undertake advanced education and training as the horticulture sector requires an adequate and skilled workforce to fulfill its undoubted potential. There have been a number of suggestions made by a range of people and organisations to reverse the decline in available personnel needed by the horticulture sector.

Marketing and advocacy

(i) Make horticulture an appealing and relevant subject at school. Give it a WOW factor and stress its national and international importance. It is widely accepted that a comprehensive marketing or advocacy programme will be required to change the image of horticulture in the broader community. Most people are ignorant about the nature and essential importance of the sector to their health, nutrition and wellbeing. The key to such messages would include:
- modern horticulture is a high-tech, diverse and interesting topic of study;
- horticulture will be essential to help solve the big problems facing humanity, such as food security and global warming;
- horticulture has a wide range of well-paid, interesting jobs that should be demonstrated through case studies;
- horticulture is international and employment opportunities are available throughout the world for horticultural graduates in private, public and international businesses and institutions.

(ii) Should the sector consider changing its name from horticulture to something that most people will recognise immediately? Horticulture encompasses food, nutrition, health and wellbeing and uses sciences from all disciplines to generate economic, social and community outputs for people. In the USA, government (through the US Department of Agriculture) no longer funds horticultural research. Instead increased funding for R&D is being allocated to the Specialty Crops programme that is defined as "fruit, vegetables, tree nuts, dried fruit, horticulture, and nursery crops (including floriculture)."

(iii) Obtain data that can be used to demonstrate to policy makers the implications of the decline in horticulture graduates. Hopefully this would persuade them to invest more in horticultural education and R&D. To some extent this has occurred in Africa where heads of government, through the Comprehensive Africa Agriculture Development Programme (CAADP), have agreed to allocate 10% of budget allocations to achieve a 6% growth rate target in agriculture. Such success will undoubtedly lead to increased funding in agricultural education that also includes horticulture. Creation of six regional hubs of excellence, strategically located throughout the continent, would facilitate research on local and regional problems and could develop into a network of scientific and educational centres for advanced horticultural education and training (Kahane and Pilot, 2012).

(iv) Individual horticultural sectors must become involved in helping solve the shortage of well-educated, well-trained and committed young people by integrated inclusion in any marketing endeavours. Funding and enthusiastic advocacy is expected from the industry itself in cooperation with other committed agencies.

(v) A sharpening of the marketing focus to educate children about the source of products and the journey they follow from the farm to the mouth, would be valuable. The 2014 Produce Marketing Association (PMA) meeting was particularly interesting because of the marked increase in advertising of products with a focus on children. Significant efforts were made by many companies to use dramatic colours, cartoon characters and catchy tunes and phrases to attract children to purchase their products (Anon., 2014d).

Educate and encourage youth

(i) Start advocacy early. All three major advocacy programmes above have a very strong commitment towards young children and youth. Generating knowledge, understanding and interest about horticulture in youngsters during early school years will have major outcomes relating to education and career choices later.

(ii) Adjust curricula. Appropriate and relevant adjustments should be made to national curricula at both primary and secondary levels to ensure that students are made aware of the economic, social, environmental, nutritional, health and wellbeing benefits that are contributed by horticulture to humankind. At the very least, primary school students should gain an understanding of plants, their growth and care, and their importance to them and their families. At the tertiary level, a balanced combination of lectures, laboratory and practical fieldwork under enthusiastic mentors who would bring an international perspective is important.

(iii) Enthusiastic teachers. It is critically important that teachers of biological and horticultural sciences are knowledgeable and genuinely enthusiastic about their subject. Too often, teachers at both primary and secondary level have no background in or experience of horticulture so their knowledge is also inadequate. An increase in horticultural science graduates would provide a larger pool of teachers with both scientific and horticultural expertise.

(iv) Encourage educational and career pathways. Ensure that the path from school to tertiary education to employment is clear, direct and unimpeded. At the same time it should retain flexibility to enable individuals to enter, leave and re-enter to fit personal circumstances. Students, parents and career advisory officers need accurate and constantly updated information about employment and remuneration options for horticultural graduates. Horticultural science is for the best and brightest of our youth.

(v) New pedagogical models. Wals et al. (2013) suggested that traditional tertiary agricultural and horticultural education programmes were inadequate for meeting the global challenges of the next 50 years. Most existing agricultural/horticultural curricula do not include major global issues that are of real interest to the current generation of young people. Climate change, loss of biodiversity, global economic trends, over-exploitation of natural resources of land, water and energy (Anon., 2012), food losses and waste (Gustavsson et al., 2011), the social importance of transforming individual poverty to community wealth, the power of social media to spread knowledge and ideas at lightning speed, and the globalisation of trade, are rarely incorporated into horticulture and agriculture curricula. Many young people are idealists who relish the opportunity to use their knowledge and skills to help others less fortunate than themselves in environments away from the comforts of home. Horticulture enables graduates to do this!

(vi) Meeting society demands. The societal benefits should be highlighted and promoted through multiple media sources with wide circulation.

There are signs emerging that more students are enrolling for tertiary education in horticulture in some countries. The impact of the

global economic crisis has resulted in huge loss of traditional jobs and unemployment; one outcome in some countries is an increase in young people enrolling in horticultural courses with the intention of producing food at home, in developing countries or improving the environment.

Conclusion

Production of fruit and vegetables has increased faster than the increase in the rate of world population from 2000 to 2012. This is especially evident in Africa and Asia. Considerable progress has been made in meeting MDG goals: poverty has been reduced by 50%; hunger continues to decline; chronic child undernutrition and child mortality have almost halved. However, much more has to be done. It is certain that horticulture has contributed significantly to some of these successes through increases in high value, highly nutritious horticultural foods, as well as the generation of additional incomes by adding value through postharvest storage and processing.

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However, this contribution was underpinned by enhanced horticultural extension, research and development programmes in many countries. To ensure that production and availability of fruit and vegetables continue to increase faster than population through to 2050, it is imperative that a highly qualified, well-skilled and educated horticultural workforce, from producer through the supply chain to the market, is maintained or increased immediately. A major shortfall in horticultural graduates has the potential to threaten their industries over the next two decades. A few national and international agencies have embarked on advocacy programmes to change the perspective of families, students and communities to the important realities of horticulture and the myriad of career opportunities in the sector. A worldwide cooperative, collaborative and coordination effort involving international agencies, industry groups and tertiary institutions must become part of this movement. National and international agencies must work together to increase the number of scientists, extension specialists and consultants who will be crucial for the future success and prosperity of horticulture as it contributes to feeding, nourishing and beautifying our world.

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› Ethics and horticulture

Jules Janick and Ian Warrington

Ethics refers to moral considerations on a human level. It includes standards of what is considered inherently "right or wrong" in terms of rights, obligations, and benefits to individuals and to society. Furthermore, ethical considerations involve the precepts of specific virtues such as honesty and fairness, and impose obligations on conduct, including the obligation to avoid harm to others and to abstain from misrepresentation or selectively using known information. The relevance of ethics in the context of horticulture (the growth, management, and use of plants such as fruits, vegetables, ornamentals, culinary spices, and medicinal plants) is explored across a number of subjects including employment, supply chain management, plant breeding and the release of improved cultivars, genetically modified organisms, invasive species, pesticide use, product claims, and the responsibilities of scientists. Two overriding guidelines are offered: "do no harm" and "do good" for producers, workers, consumers, and the environment.

Introduction

Ethics refers to moral considerations on a human level. It includes standards of what is considered inherently "right or wrong" in terms of rights, obligations, and benefits to individuals and to society. Furthermore, ethical considerations involve the precepts of specific virtues such as honesty and fairness, and impose obligations on conduct, including the obligation to avoid harm to others and to abstain from misrepresentation or selectively using known information. Most professional organizations, in medicine for example, have developed standards of ethics for their practitioners. What may not be widely known is that similar standards are imposed within the plant sciences as well. The object of this essay is to consider ethical standards for the activity we know as horticulture, i.e., the growth, management, and use of plants such as fruits, vegetables, ornamentals, culinary spices, and medicinal plants (Aitken et al., 2012). We offer two overriding guidelines: "do no harm" and "do good" for producers, workers, consumers, and the environment. We realize that many people are directly or indirectly involved with horticultural activities along the entire supply chain and we acknowledge that a balance must be maintained between conflicting and competing issues and beliefs.

Many different elements comprise horticulture. They can be considered to be the components of a supply chain and it is these that we examine individually below. However, given the integration that occurs in the pathway from producer to consumer, the responsibilities at one level will *ipso facto* transfer to those at all other levels within that chain.

Producers

Since many horticultural activities involve growers of plants who are selling either a product or service as a means of livelihood, a fair return or profit is necessary for the efforts and investments that they expend. Ethical producers – whether single individuals or corporations – do not exploit workers and must respect and reward their contributions in a fair and equitable manner. Producers must certainly not exploit children and must avoid all forms of discrimination in the workforce. Too often, the margins of return available to producers, even in the developed world, are so small that workers employed in the production and processing sectors are usually paid only at, or even below, the minimum wage specified by society. Any exploitive employment practices that deviate from the norms expected by society should be regarded as being unethical, if not illegal (Wasley, 2011). Unfortunately, employment in many horticultural industries is now highly unattractive. Therefore, producers increasingly shift to labor-reducing methods such as mechanization and rely on migrant labor. In California, for example, all tomatoes for processing are machine harvested (Rasmussen, 1968; Huffman, 2010) and most fruits and vegetables that are hand harvested use migrant labor. Labor cost is a contentious and sensitive issue and whole industries have disappeared as a result of producers seeking to reduce expenses. One such example is the pineapple processing industry of Hawaii, once the major world producer. The industry moved to Southeast Asia where wage structures were lower (Bartholomew et al., 2012). In this case, Hawaii's loss was The Philippines' gain. Thus there is a paradox in these examples. Some have argued that the use of mechanization, or the relocation of industries, are in their very actions unethical, as these changes have deprived those who were previously employed of an income and created major disruptions to local economies (Schmitz and Seckler, 1970). However, most societies expect technologies, such as mechanical harvesting, to be developed and progressed as a normal activity. Equally, the globalization of food production has resulted in monumental shifts in sources of supply as consumers expect year-round supply of affordable fruits, vegetables and ornamental plants. Consequently, movements of horticultural industries cannot be regarded as being unethical *per se,* unless it can be demonstrated that the shift in locations involves exploitative practices. Unfortunately this is often the case. We realize that this is a conundrum and the problem is certainly not unique to horticulture, but is a common issue when industries get globalized and become increasingly controlled by multinational corporations. Many such corporations have developed codes of behavior in order to demonstrate to consumers that they are behaving responsibly (see http://corporate.marksandspencer.com/documents/policy-documents/2_code-of-ethics.pdf; accessed 25 March 2015).

The product, often but not always a food, must be assured to "produce no harm." The product must be safe. This involves efforts to eliminate any contamination from poor sanitation, freedom from known and excessive harmful residues, both natural and chemical, and avoidance of misrepresentation of any kind. To ensure product safety, the producer and consumer need to be linked. Thus methods to preserve the chain of identity of products, including the marketplace, are to be applauded. Increasingly, producers around the world must conform to the use of good agricultural practices (GAP) where many of these issues of concern are addressed in a systematic way and can be subjected to close scrutiny through independent audits (FAO, 2003).

Modern horticultural producers are themselves consumers of inputs required for the production of various fruits, vegetables and ornamentals. Access to germplasm (improved seeds and clones) is one such input that can lead to various ethical considerations. For example, newly bred elite cultivars of fruit trees in modern production systems can be legally protected for a limited period, usually about 20 years. For example, clonal plants in

the United States can be protected under Plant Patent Law. Seed-propagated plants are protected by Plant Variety Protection. In the European Union and other countries, Plant Breeder's Rights allow the breeder to recover a royalty through their unique intellectual contribution in developing that particular cultivar. During this period of protection, it is unethical to propagate plants or plant parts without paying royalties based either on tree number or, if the license requires, on the amount of product produced. To propagate such material without a license (i.e. without permission), or where production is subject to royalties, to grow the product without declaring the amount produced, is both an unethical and often illegal practice. In emerging economies where farmers are often poor, there is much controversy regarding plant variety rights but it should be noted that there is usually an exemption for farmer-saved seed. Nonetheless, commercial seed companies often protect their cultivars of many vegetables such as eggplant and onion by producing F_1 hybrids. In addition to providing hybrid vigor and uniformity, the off-spring do not grow true-to-type and thus the grower must continually purchase seed. Producers must make the decision to assess the return on the extra cost of the seed through the enhanced performance and uniformity of product. We do not consider the production of F_1 hybrids unethical since the producer can make a decision on whether or not to purchase such seed.

In some instances, the risks with a product are not always readily apparent. For example, producers in the nursery sector need to consider the production of potentially harmful products such as ornamental capsicum peppers. These pose a risk to children because of eye injury from the highly potent oils that are produced by the attractive fruits. Clearly, such products should not be sold if such risks can be identified and are serious, but balance is also needed. Roses, many cacti, and a number of other plants have thorns that can cause injury and others, such as cassava or peanut, contain toxin or allergins. In Europe, 5% of the population is allergic to apples! Most societies have regarded these as acceptable risks, and consequently, the production and sale of such plant material has not been regarded as unethical. In such examples, it is reasonable to expect that consumers will take the necessary measures to avoid any injury or harm.

Marketers

Those who market and handle horticultural products must strive to avoid misrepresentation including cultivar identity, source and origin of product, treatments imposed on the product, and sanitary handling. Unfortunately, except for apples, pears, and some ornamentals such as roses, most horticultural products on the market do not have cultivar labeling and this vital piece of identification is lost. Some marketers such as Driscoll Strawberry Associates, marketers of berry fruits, use a brand name to ensure and represent quality where the specific clone or cultivar that changes with the season, is not mentioned. We suggest that, in many cases, inclusion of cultivar names would be valuable both to consumers and to breeders as a means of discerning quality and avoiding unethical misrepresentation.

Modern breeding is highly sophisticated and expensive and the cultivars that emerge from such programs can be superior in terms of size, flavor, or appearance, as well as having improved traits such as disease resistance. Accordingly, they usually command a premium. Nonetheless, to a consumer, there is often little visual difference between an improved cultivar and a "standard" one, leading some producers and marketers to unethically misrepresent or obscure cultivar designation.

Farmers' markets in temperate urban areas, which often purport to be the champions of "grow local" campaigns, are frequently observed to unethically offer produce that is not locally grown and sometimes even include imported tropical fruits such as bananas and pineapples amongst their range of products. Consumers who purchase food at such local markets should know where the food that they are purchasing is produced. Many urban farmers' markets now have local rules that forbid the practice of selling food not produced by the seller. In many countries, imported food must be so labeled.

The issue of fresh product labeling is contentious but extremely important. For example, because of health concerns it is essential that all horticultural products need to be traceable back to the original producer. Failure to do this imposes a threat to all producers of that product. Disease outbreaks due to contamination from *Escherichia coli* or *Salmonella* soon become national news and quickly impose a tremendous threat to all producers of that specific crop (see http://en.wikipedia.org/wiki/2011_Germany_E._coli_O104:H4_outbreak; accessed 25 March 2015). Rapid isolation of the source of the problem becomes vital. To knowingly avoid the compulsion of such labeling requirements can be regarded as being unethical and, in many instances, illegal.

The treatment of fresh fruit and vegetables with ionizing radiation, such as gamma-rays (see http://www.epa.gov/radiation/sources/food_irrad.html; accessed 25 March 2015), is a controversial issue that has ethical implications. There is consumer resistance to such practices because of concerns of the chemical changes that might occur with such treatments. The fear that the foods could become radioactive is completely unwarranted. The practice is widely used in imported dried spices yet labeling is usually not required. The irradiation of fruits may be necessary because of import restrictions in certain countries that prohibit the presence of specific invasive insects such as spotted winged fruit fly (*Drosophia suzukii*), marmorated stink bug (*Halyomorpha halys*), and the Asian citrus psyllid (*Diaphorina citri*) that is responsible for spreading citrus yellows (Huanglongbing) caused by the bacterium (*Candidatus* Liberibacter asiaticus). Whether irradiation should be declared on the product is part of a wider issue of what is necessary or appropriate on food labeling and who decides on the detail that should be declared. There are many who would consider avoidance of labeling irradiated food as unethical, but the case can be made that if this practice is proven to be a safe and necessary practice, then labeling imposes an undue imposition on marketers.

Many consumers believe that organic products are completely pesticide free. However, production of many organic products can involve sprays with copper hydroxide, copper sulphate, and a number of other pesticides (usually "natural" products), yet there is no insistence that these products be so labeled. The labeling of genetically modified foods is equally contentious. This problem would be solved with the requirement that clonal genetically modified cultivars be identified (discussed further below).

The market chain has become a strong force in horticulture and, in many industries, the marketers have had a dominant voice in pricing and control over producers. As an example, one corporate marketer has arranged contracts where the producer of bedding plants is not paid until the item is sold in-store, thus eliminating the marketer's risk when the lack of sales may have been due to poor handling by the retail outlet. Such practice should be regarded as unethical since in-store management and not the producer has corrupted the product.

Processors

Many horticultural products are preserved or processed in various ways (canned, frozen,

dried) and many are only components of other processed products, such as composite fruit juices or sauces. Many processed horticulture products are extensively altered and "refined" such as in a number of tomato-based products. Processors have an ethical obligation to truthfully represent the treatments that have been imposed, and to precisely state the amount of each component that is in a processed product. This requirement falls within the jurisdiction of product labeling, which is fraught with controversy. Many consumer advocate organizations are demanding more complete information on the product label. Such requirements are strictly regulated in developed countries and are the responsibility of government supported food authorities (such as Food Standards Australia New Zealand, www.foodstandards.govt.nz/; accessed 25 March 2015 and the Food and Drug Administration (FDA) of the United States).

Labeling of processed food is a tremendously challenging issue that involves serious ethical considerations. In the United States, the FDA regulates food labeling and their guidelines are often followed worldwide (especially where producers and processors wish to export to the USA). What should be on labels of food products must balance two issues: the consumer's right to know vs. the issue of where to draw the line on what information is essential. For example, although the FDA has taken the position that there is no evidence that genetically modified food is unsafe, labeling defining such modification is required. Consequently, the food processing industry and the biotechnology companies involved in producing these products are vehemently opposed to this requirement of labeling. Furthermore, many ordinary foods are involved indirectly through other steps in processing that might involve the use of genetically modified products. For example, practically all cheeses use a genetically engineered substitute for rennet. Labeling of processed products that contain genetically modified organisms has become an issue because many consumers have an unwarranted fear of such products. Almost all processed products in the United States contain small amounts of soybean or maize products, which in the United States are practically all genetically modified. This creates a special problem for the processing industry, which fears consumer boycott of their products if this fact is emphasized. However, despite the complexity of the problem and our agreement with the vast body of scientific research that has found no evidence of danger from transgenic food, we acknowledge that a great number of people feel that they have the right to know if a genetically modified component is included in the product. Interestingly, it is neither illegal nor unethical to exclude such a provision in many instances given the inability to trace such components in the end-product or due to the very small amounts that may be present. This issue is solved in a number of countries by the production and marketing of a class of processed products using the designation as "GMO free" to satisfy those customers who demand this assurance. This is similar to products identified for vegans who require assurance that the processed product contains no meat products, or observant Jews, Moslems, or Hindus who want assurance that the processed product contains no ritually-unacceptable ingredients.

Processors should avoid health claims or insinuations that are misleading. This is an increasingly contentious area and the food industry is often perceived as misleading the public in their advertising campaigns. This issue extends to some sectors in the fresh fruit and vegetable industries that claim specific health benefits that are often unproven. Such health claims are prohibited under current food regulations, for example, in the European Union (see http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32006R1924; accessed 25 March 2015). Companies like Zespri Ltd, the main kiwifruit marketing company in New Zealand, have invested heavily in defining many of the beneficial health characteristics of kiwifruit but are required to represent such information circumspectly (see http://www.zespri.com/nutritious; accessed 25 March 2015).

Many processors have been at best "creative" in extolling the benefits of some of their products and at worst misleading. For example, promoting some "health" drinks as a way for children to get their vegetables (without the "vegetably" taste!!) by promising two servings of vegetables based on the presence of small amounts of tomato and potato juice, is an example of a "creative" practice. Bakery products with pictures of blueberries that do not contain the actual fruit are simply fraudulent. Similarly, processed fruit and vegetable products with high additions of salt and refined sugars are considered to be unhealthy and their promotion as healthy foods on that basis is clearly unethical.

The environment and sustainability

In order for horticulture to be sustainable in the long term, there must be respect for the environment. In the early 20th century, the unrestricted use of arsenic damaged many soils, given the persistent nature of that element in the environment (Smith et al., 1998). Currently, any excessive and persistent use of copper sprays in organic production is also dangerous to the environment (see http://www.epa.gov/oppsrrd1/REDs/factsheets/copper_red_fs.pdf; accessed 25 March 2015) and, consequently, their use must be very carefully managed. Application of pesticides or herbicides whose residues damage the soil or the air must be considered as being unethical practice. The use of products such as plastics or pesticides must also take into consideration their disposal as well as these long-term effects.

Exploitation of natural germplasm must be handled in a responsible manner. Wild species that have horticultural value, orchids for example, must not be extracted in a manner that causes extinction in the natural habitat. The ownership of such natural vegetation is a very controversial issue. Some would maintain that it is a right of national ownership similar to that for oil or minerals, while others suggest that the earth's biological bounty is a heritage for all of humankind. The reality is that most of our present horticultural plants originate from other locations around the world. They are currently grown very widely, and often have been for millennia, without consideration being given to their place of origin. We suggest that access to genetic resources is a general right for humanity, and we agree with recent conventions that this germplasm should be a part of equitable international exchange and conservation (see Gepts (2004) for an overview of this topic; and http://www.cbd.int/convention/text/ (accessed 25 March 2015) for the actual convention).

Intellectual property

Much of horticultural activity includes intellectual activity. Products and outcomes can now be protected by patents and royalties on fair use where these are demanded, but only for a limited time (Staub et al., 1996; Ryder, 2005). This concept is based on the premise that innovation must be encouraged. In exchange for the discovery or invention, the inventors or developers can profit from their discoveries by being granted a monopoly over a stated interval of time, usually 20 years, for the protection of a cultivar. The concept is that this will encourage future innovation. We concur that this concept has validity. This concept should work for utility patents, plant patents, and copyrights. In many cases, copyrights have been extended for excessive periods of time, while 20 years may be too brief for some plant patents because, as in tree fruits, it often takes 7 or 8 years for commercial development and for economic yields to be realized.

Plant breeding

The genetic improvement of plants would appear to be non-controversial since improved performance of plants has benefited humanity in terms of increased production of food, feed, fiber, and medicines for many decades. It can also lead, for example, to marked reductions in pesticide use through the selection of pest-resistant cultivars (Volk et al., 2013). However, plant breeders face serious ethical decisions in various areas including the acquisition and transfer of plant genetic resources, which are the raw materials for plant breeding, because the priorities and goals seem to favor international seed companies over producers. The use of biotechnology has been controversial, particularly in some parts of the world, and it is fair to say that this practice involves ethical considerations that have not been resolved to everyone's satisfaction (Fowler and Lower, 2005; Janick and Mureşan, 2010; Dias and Ortiz, 2012). Currently, transgenic plants such as in soybean, maize, cotton, and canola are now planted in 28 countries worldwide on over 170 million hectares involving 17 million farmers (James, 2012). The production of genetically modified horticultural crops is minor by comparison. The best example in horticulture is the incorporation of transgenic virus resistance in two cultivars of papaya (Manshardt, 2012). Societies in the Americas, China, and Australia, have approved and accepted the production of these crops but they cannot be imported into most of Europe. This reveals the differences in acceptance across these major regions of the world.

An interesting dilemma is deciding the best method to improve the nutritional value of foods. This can be accomplished by gene technology solutions (Dwivedi et al., 2012), or in the case of many vegetable crops, by improving quality, flavor, appearance, and yield by conventional approaches that would reduce the cost of healthy foods and thereby increase consumption. Clearly, these two approaches are not mutually exclusive.

Healthful and harmful plants

While we admire and love many plants, particularly ornamentals and delicious fruits, we must not lose sight that many plants can have harmful effects on humans. The production, sales, and distribution of many injurious plant products have important ethical considerations. Thus, while a species of *Nicotiana* has been used as an ornamental, the harmful effects of smoking tobacco cannot be ignored. Similarly, the opium poppy, a species with valuable medicinal uses (morphine), is also a source of addictive opium and heroin (Finetto, 2008). It is reasonable that the production and supply of products of plants such as coca (*Erythroxyilum* spp.), opium poppy (*Papaver somniferum*), hemp (*Cannabis sativa*), and khat (*Catha edulis*) be regulated. Regulation of marijuana production has become an issue as the recreational use of this product has already become decriminalized in some states of the United States, while various medical effects have been claimed. At present, the production of cannabinoid-resistant hemp as a textile crop has been curtailed by this ban in the United States but not in Europe.

A number of plant introductions, especially landscape ornamentals, have turned out to be invasive and have become a serious danger to the environment in various locations. Thus, introduction of exotic plant species involves a serious ethical situation for the ornamentals industry (Niemiera and Phillips, 2006). Kudzu vine (*Pueraria lobata*), introduced from Japan to the United States in 1876 as a potential forage crop and for erosion control, is a well-known example of an invasive species that became a serious noxious weed in the southern United States. Other examples include *Rosa multiflora*, Japanese barberry (*Berberis thungergii*), and *Melaleuca* spp. in various regions of the United States, and cactus, which infested millions of hectares in Queensland and New South Wales, Australia, in the 1920s and still remains a problem.

Do plants have rights?

There are some who would suggest that plants as living creatures have rights that must be respected. At various times such practices as pruning, grafting, and micro-propagation have been felt by some to be unnatural and thus unethical. In our opinion, these claims are specious. Plants are non-sentient and granting them human feelings is anthropomorphic. However, we do consider that for the long term survival of humans, plant life must be protected in an environmental and conservation sense. The wanton destruction of plants, and particularly driving a species to extinction, is unethical.

Horticultural researchers and scientists

In many of the areas covered above, the matter of ethics within various sectors of the community involved with horticulture has been outlined and discussed. Almost without exception, each of the areas covered includes elements of scientific and technical research and the behavior and influence of individual scientists and communities of scholars. Horticultural scientists, working either individually or collectively, are subjected to formally promulgated ethical principles and regulations. In academia, there are important ethical guidelines (codes of ethics) for research, including the appropriate use of human and animal subjects, intellectual honesty, falsification of experiments and results, and especially plagiarism, the appropriation without attribution of another scholar's language, thoughts, and ideas in the preparation of publications. Plagiarism, however, can often be a complex and contentious area since all scientists appropriate and build on the ideas and language of others. Modern software packages are now frequently used in academia and by scientific journals to detect incidences of plagiarism in a range of outputs including students' assignments and scholarly contributions.

Scientific ethics typically originate within professional societies (see, for example, the statement by the Australian Society for Horticultural Science at http://www.aushs.org.au; accessed 25 March 2015), academic organizations, and government departments or ministries. Within universities and governmental organizations, staff members are often bound by formal ethical standards that recognize the expectations of society and the laws and regulations that exist within the country concerned. For example, Massey University in New Zealand, a country that currently does not allow the field release of genetically-modified organisms, does allow research on such organisms in containment; all such research is overseen by a Genetic Technology Committee that must approve all experiments before they are allowed to commence (see http://www.massey.ac.nz/massey/research/research-ethics/genetic-technology/code-ethicalconduct.cfm; accessed 25 March 2015). This committee is comprised of technical specialists, academics, and community representatives.

Conclusions

The many examples and controversies over ethical issues discussed above suggest that ethics is not an absolute concept but rather a balancing act of many points of view and issues. We concede that there are many different interpretations and many different sides of the many issues that divide the horticultural community and the solutions must be equitable to all as far as possible. It is not always clear as to what is "right" or what is "wrong" in areas that are highly complex, either because of the nature of the technology or because of the extent of a supply chain. The horticultural industry and the community of scholars together must strive to do what is right for the greater good,

with special attention to both ordinary workers and the consumers of products, to local, national, and international economies, and to both the local landscape and the world environment. Since we increasingly live in a global community, horticulture must strive to reach consensus and strive to develop more uniform definitions that make sense across national boundaries. However, our overriding concern still remains to "do good" and "do no harm."

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Globe artichoke cultivation in Argentina

Stella Maris García, Vanina P. Cravero, Fernando López Anido and Enrique L. Cointry

Horticulture in Argentina

Horticulture in Argentina is an intensive activity that covers a smaller area than other agricultural activities, but involves a greater return per hectare. Agriculture occupies around 30% of Argentina's total area of approximately 270 million hectares. Whilst only 2% of this area involves horticultural practices, it represents up to 11% of the value of Argentinian agricultural products.

The horticulture area has expanded to approximately 500,000 hectares, but varies from year to year since most crops are annuals. Garlic, sweet potato, onion, lettuce, potato, pepper, beans, tomato, carrot, and squash comprise 85% of the total horticultural production value (Table 1). Annually, around 10 million people are employed in horticulture, making it an activity of important social value.

The fresh market absorbs 90% of the country's production, in wholesale and retail markets. The remaining 10% goes to industry, and is mainly processed as canned, frozen or dehydrated products and, to a lesser extent, as pickled or ground products. In recent years, an increase in the consumption of vegetables has been evident globally because consumers have become more aware of the benefits to human health. However, the mean vegetable daily intake in Argentina is approximately 140 g/person, far short of the 400 g/person recommended by the World Health Organization (WHO, 2012).

Table 1. Cultivated area of horticultural crops in Argentina (mean of the last decade). Source: INTA, 2009.

Crop	Area (ha)
Common bean	220,000
Potato	120,000
Lettuce	30,000
Onion	27,000
Tomato	24,000
Pea	23,000
Lentil	20,000
Squash	20,000
Sweet potato	20,000
Sweet corn	14,000
Pepper	10,000
Water melon	10,000
Carrot	9,000
Melon	7,500
Chickpea	4,000
Globe artichoke	**3,700**
Asparagus	1,300
Strawberry	1,000

Globe artichoke in Argentina

The term "alcaucil" instead of "alcachofa" is used to refer to globe artichoke (*Cynara cardunculus* var. *scolymus*) in Argentina. *Alcaucil* is derived from the Arabic *harscioh* or *al-karshuf*, which mean earth spines or pricking plant.

Soon after World War I, a significant number of Italians emigrated to Argentina and along with their culinary customs they introduced the first globe artichoke varieties and cultivation techniques to Argentina.

During the decade from 2003 to 2013, the production of globe artichoke increased, both in total production and in productivity per hectare (Table 2). The average annual percentage increase in harvested area (ha), total production (t) and productivity (t/ha) over this 10-year period were -2.8, 1.43 and 3.9%, respectively (Figure 1).

The shift towards new cultivars and the implementation of improved agronomic practices have allowed harvest to begin as early as May, resulting in better prices than in spring, and increased total yield.

Table 2. Argentinian production (t) and yield (t/ha) during the period 2003 to 2013 (FAO).

Year	Production (t)	Yield (t/ha)
2003	88,000	18.72
2004	89,930	19.55
2005	94,094	20.02
2006	88,951	18.73
2007	90,000	19.14
2008	91,154	18.96
2009	76,948	20.20
2010	84,694	23.73
2011	100,891	26.22
2012	106,000	26.50
2013	106,325	24.93

Figure 1. Average annual percentage increase in harvested area (ha), total production (t) and yield (t/ha) from 2003 to 2013.

Figure 2. Main globe artichoke production regions in Argentina.

Productive zones

The La Plata's horticultural belt (Buenos Aires province) is the major production zone, and 64% of the country's globe artichoke fields are located there. Rosario (Santa Fe province) and Cuyo area (Mendoza and San Juan provinces) each have around 14% of the production fields (Figure 2). Generally artichokes

Figure 3. 'Romanesco'.

Figure 4. 'Ñato'.

Figure 5. 'Precoz Italiano'.

Figure 6. 'Blanco de San Juan'.

Figure 7. 'Oro Verde FCA'.

Figure 8. 'Gauchito FCA'.

are destined for the fresh market, with the exception of those from Cuyo, where the processing industry has absorbed up to 65% of the production for some years.

The rest of the globe artichoke fields are sparsely distributed amongst the horticultural belts of important cities like Mar del Plata, Córdoba and Tucuman.

The climatic and soil conditions vary in the different production areas. La Plata and Rosario have a temperate climate, frost-free between October and April, 1000 mm mean annual rainfall and a medium-heavy clay soil with up to 5% organic matter. Cuyo is characterized by its dry climate, sandy soils and very low annual rainfall, which is usually less than 100 mm.

Vegetatively-propagated cultivars

'Romanesco'

'Romanesco', also known as 'Francés', 'Francés precoz' or 'Ñato Francés', is a violet material derived from the Lazio region in Italy. In order to maintain the secret of its origin, Italian horticulturists claimed that it was a French cultivar, which explains the term 'Francés', which means French (Figure 3).

Figure 9. 'Gurí FCA'.

'Ñato'

'Ñato', also named 'Ñato criollo' or 'Violeta', was the cultivar most popular in the 1980s, but because of its late spring production it was progressively replaced by 'Romanesco', which fruits earlier (Figure 4).

Figure 10. Sucker of 'Blanco de San Juan'.

'Precoz Italiano'

'Precoz Italiano' is an old Italian cultivar, probably derived from 'Precoce di Jesi'. Due to its early fruiting and its origin, it was named 'Precoz Italiano', which means precocious Italian (Figure 5).

Figure 11. Plants grown using polyethylene mulching.

'Blanco' or 'Blanco de San Juan'

'Blanco' or 'Blanco de San Juan' is equivalent to the Spanish cultivar 'Blanco de Tudela', which was introduced by Spanish immigrants to the San Juan province (Figure 6).

'Oro Verde FCA'

'Oro Verde FCA' is a late spring, productive cultivar adapted to the fresh market. It was created by researchers at the Faculty of Agricultural Science, Rosario's National University (Figure 7).

'Gauchito FCA'

'Gauchito FCA' is a late spring, productive cultivar bred from French material, suitable for both the fresh market and processing. It was developed by researchers at the Faculty of Agricultural Science, Rosario's National University (Figure 8).

'Gurí FCA'

'Gurí FCA' is a late spring, productive cultivar that originated from a cross between a local and a French clone. It was selected for the fresh market. It was developed by researchers at the Faculty of Agricultural Science, Rosario's National University (Figure 9).

Seed-propagated material

Seed-propagated cultivars are from recent introductions to Argentina, including 'Madrigal', 'Opal' and 'Concerto'.

Propagation and cultivation techniques

In Argentina, globe artichoke multiplication is traditionally by vegetative means, using rooted offshoots in Rosario and La Plata (Region 1), and suckers or stumps in San Juan and Mendoza (Region 2) where the main cultivar is 'Blanco de San Juan' (Figure 10). More recently, hybrids and cultivars multiplied by seed have also been used.

The time when seeds and suckers are planted varies between cultivation regions. In Region 1, asexual propagation is performed in autumn, whereas propagation by seed takes place in spring. In contrast, planting of suckers takes place during summer (January-February) in Region 2.

Plants are maintained for three or four years in cultivation, therefore it is considered to be a perennial crop.

Growth regulators like gibberellic acid (GA) are used widely nowadays to obtain early production and are applied during March-April.

Plants are commonly grown on ridges and polyethylene mulching is sometimes used (Figure 11). Irrigation is often necessary and water is applied using the drip system.

Harvest

Artichokes are harvested by hand. Heads are cut with a knife leaving about 20 cm of stem and the two leaves closest to the inflorescence for primary heads and leaving only 10 cm of stem for secondary heads.

In the past, harvest was carried out using a cart with an elevated axle that passed directly over the plant and was pulled by horses (Figure 12).

Harvest time varies according to the production region and the crop cycle and there are early, intermediate and late cultivars. For 'Romanesco', harvest starts in August without GA application but can move forward to June if GA is applied. For later cultivars, such as 'Ñato', 'Oro Verde FCA', 'Gauchito FCA' and 'Gurí FCA', harvest starts in mid-September

Figure 12. Old way of harvesting, using a cart that has a high axle. Image by G. Villena.

and it is not possible to accelerate harvest using GA.

Harvest finishes in December when high temperatures reduce the development of high quality heads.

Marketing

Crop profitability varies depending on the time of harvest. Prices are higher at the beginning of harvest when supply is limited but they gradually decrease as production increases.

In general, higher prices are obtained during June and July, and then they stabilize. Finally, prices fall considerably in the period from October to December, when temperatures are higher and quality drops (Figures 13 and 14).

Breeding in Argentina

Globe artichoke is a cross-pollinated species, resulting in the need for vegetative multiplication to avoid heterozygosity and segregation in seed progenies, and plasticity in breeding programs. In this context, the phrase "if you plant artichokes, you will grow cardoons" (popular saying) was coined (cardoons are artichoke thistles, i.e. *Cynara cardunculus* var. *altilis* DC). During domestication of the globe artichoke, sexual reproduction was progressively abandoned. Asexual multiplication has long been used by horticulturists and breeders. However, nowadays, the search for seed varieties is important to avoid virus spread and to result in an annual crop.

The cultivar 'Francés', very popular in the Rosario's horticultural belt, has shown great variation in precocity and this has been shown to be associated with leaf type (Pecaut and Martin, 1993). This variability could be explained by a mixture of clones that were brought when the cultivar was introduced. Clonal selection could be conducted in order to result in uniform production.

In Argentina, systematic breeding programs were established in the 1990s with the introduction of European cultivars. This was the start of breeding using sib-crossing, self-crossing and open pollination. Along with these breeding methods, genetic parameters were estimated (López Anido et al., 1998; Asprelli et al., 2001; Cointry et al., 2005a; Crippa et al., 2011). The inheritance of colour and head compactness were studied, and the effect of selfing while obtaining inbred lines for hybrid production was assessed (Cravero et al., 2002, 2003, 2004). Heterosis in crosses between distant

Figure 13. Proportion of the globe artichoke crop supplied over the year in Argentina. Source: Mercado Central de Buenos Aires.

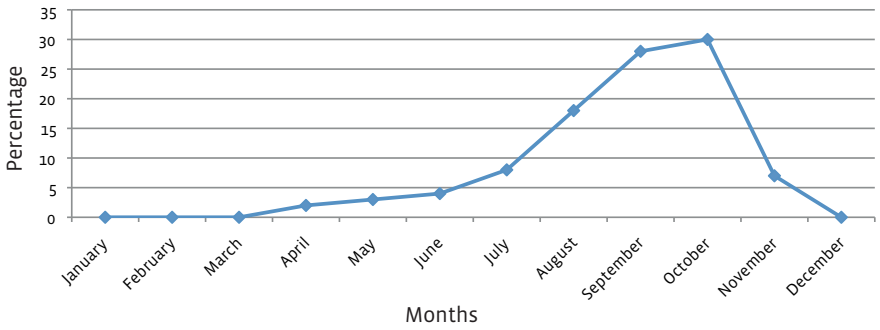

Figure 14. Price per dozen globe artichoke (US$) during the year in Argentina. Source: Mercado Central de Buenos Aires.

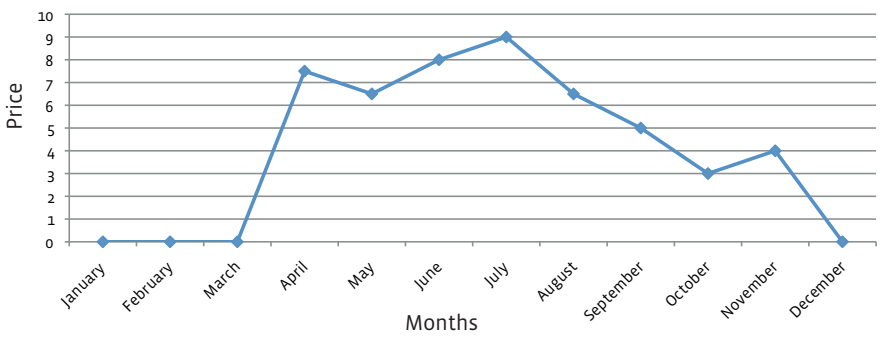

Figure 15. Typical dish: paella with artichoke, at the Artichoke Fest.

Figure 16. Stand of artichokes for sale at the Artichoke Fest.

parents was also evaluated and superior genotypes were selected within the progeny. Segregating populations were generated, out of which four new clones were selected ('Esmeralda FCA', 'Oro Verde FCA', 'Gauchito FCA' and 'Gurí FCA'), which broadened the spectrum of Argentinian cultivars (Cointry et al., 2005b). Also, from non-segregating material, a cultivar with a uniform violet head colour was derived and resulted in the first seed-propagated cultivar ('Estrella del Sur FCA') generated by the breeding program of the Faculty of Agrarian Science at Rosario's National University.

The genetic diversity in a collection of accessions of the species *Cynara cardunculus* was studied with the aid of *SRAP* (Sequence-Related Amplified Polymorphism) molecular markers, and these markers proved to be a useful tool (Cravero et al., 2007). Out of this collection, a core-collection was generated based on morphological and molecular attributes (Crippa, 2015). In the breeding program, the molecular approach, along with bulk segregant analysis, enabled the detection of amplicons associated with head colour and precocity (Martin et al., 2008), and the construction of a genetic linked map (Martin et al., 2013). Recently, the possibility of using this species as a biofuel in Argentina has been encouraged (Cravero et al., 2012).

Artichoke fest

Because it is the main production area in Argentina, La Plata was recognized as the "Artichoke capital" of the country. Ninety seven percent of the production area in this region is occupied by globe artichokes, so locals decided it should have its own festival. The first "Artichoke Fest" was celebrated in 2007. It has been conducted every year since. The next Fest will take place in late September this year, coincidentally at the same time as the IX International Symposium on Artichoke, Cardoon and their Wild Relatives (http://www.ishs.org/symposium/424).

Visitors can taste delicious dishes prepared by local farmers (Figure 15), enjoy folk concerts and participate in cooking workshops to learn how to cook artichokes. Moreover, they can learn about the culture surrounding artichokes by visiting the live show and going around several stands where they can find a wide range of gourmet foods.

The "Artichoke Fest" is how horticulturists choose to celebrate the harvest and share with the community their cultural traditions, their history and their ancestor's legacy. These are the ancestors who came from Italy in the 1950s and began the artichoke culture in the regional horticultural belt.

The "Artichoke Fest" is not only run so that people have a good time but also to provide information to increase artichoke consumption and to stimulate its production (Figure 16).

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Protected cultivation in Turkey

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Introduction

The Mediterranean Region is one of the most important areas in terms of protected cultivation because the mild winter makes production under simple structures possible. Protected cultivation includes horticultural production within greenhouses, either plastic or glass covered, and under high or low plastic tunnels.

Turkey (36-42°N, 26-45°E) is one of the countries located beside the Mediterranean Sea and has one of the larger protected cultivation industries in this region, close behind Italy and Spain (Table 1). According to recent statistics, the total area of protected cultivation reached 64,912 ha in 2014 (Turkish Statistical Institute (TUIK), 2015). The area under low plastic tunnels was 24.1% while that under plastic greenhouses, high plastic tunnels and glasshouses was 46, 17.4 and 12.5% of the total, respectively. In the last decade, the increase in total area was 35.9%, whereas polyethylene (PE) greenhouse and high tunnel areas increased by 76.4 and 70.2%, respectively. Glasshouse production, which is almost unique in the Mediterranean Region, increased in area by 12.9%. However, the area under low tunnels decreased by 8.1% over this period; in particular, there was a slow but steady reduction after 2011 due to fluctuations in crop prices over this period (Figure 1).

Protected cultivation is mainly located on the south coast, where the climatic conditions are favourable for protected cultivation without additional heating. In 2014, 79.9% of the total protected area was located in the Mediterranean region of Turkey. This included 79.3, 63.8, 63.8 and 85.8% of Turkish production area under glasshouses, PE greenhouses, high tunnels and low tunnels, respectively. In this region, Antalya is the most important protected cultivation centre, representing 32.3% of the overall production within the country (Figure 2). Figure 3 shows the favourable climatic conditions in Antalya that are similar to those in Almeria, Spain. However, in the last decade, greenhouse cultivation has extended to the western part of the country (11.6% of total), where geothermal energy is available.

Figure 1. Increase of total protected cultivation area over 10 years.

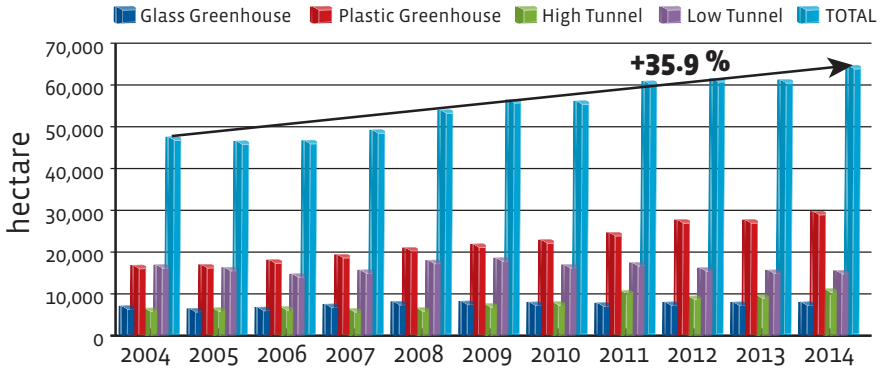

Figure 2. One of the protected cultivation areas (Kumluca, Antalya).

Table 1. Protected cultivation area (ha) in countries around the Mediterranean Sea.

Country	Low plastic tunnel	PE greenhouse (including high tunnels)	Glass greenhouse	Total	Year	Reference
Egypt	14,053	2,037	4,032	16,094	2013	Agric. Eco. Affairs Sector, Egyptian Min. of Agric.
Greece	5,181	5,398.9	175	5,574	2013	Greek Min. of Agriculture
Israel	-	8,650	< 1	8,650	2014	Israeli Min. of Agric. Extension Service
Italy	30,000	37,000	5,800	72,800	2004	Tuzel and Leonardi, 2009
Jordan	3,532	4,473.5	3	8,008	2013	Jordan Min. of Agriculture
Morocco		20,000	3,770	23,770	2006	Tuzel and Leonardi, 2009
Spain	13,055	53,843	4,800	71,698	2005	Tuzel and Leonardi, 2009
Turkey	15,672	41,142	8,097	64,911	2014	TUIK, 2015

Table 2. Vegetable production under protected cultivation in Turkey (tons) (TUIK, 2015).

Crops	2004	2009	2014
Tomatoes	1,960,185	2,657,461	3,285,570
Cucumber	940,455	973,871	1,095,626
Watermelon	540,411	755,863	653,343
Pepper	243,613	345,032	528,988
Eggplant	253,193	197,785	261,874
Melon	59,403	117,627	143,889
Squash	106,680	119,503	108,086
Lettuces	44,591	45,584	85,452
Beans	27,065	36,570	46,008
Onion (green)	1,516	2,105	4,797
Spinach	2,501	2,408	3,179
Purslane	647	1,551	3,108
Rocket	179	939	2,192
Parsley	161	334	521
Cress	18	132	507
Cabbages	333	192	477
Cowpea	-	2	265
Leek	399	115	183
Pepino	-	-	100
Dill	20	31	74
Radish (red)	-	2	40
Green peas	22	30	35
Mint	12	94	31
Garlic (green)	20	20	24
Artichokes	-	-	7
Broccoli	-	6	5
Okra	41	-	2
TOTAL	4,181,465	5,257,257	6,224,383

Figure 3. Temperatures in Antalya (Turkey) and Almeria (Spain) (von Zabeltitz, 2011).

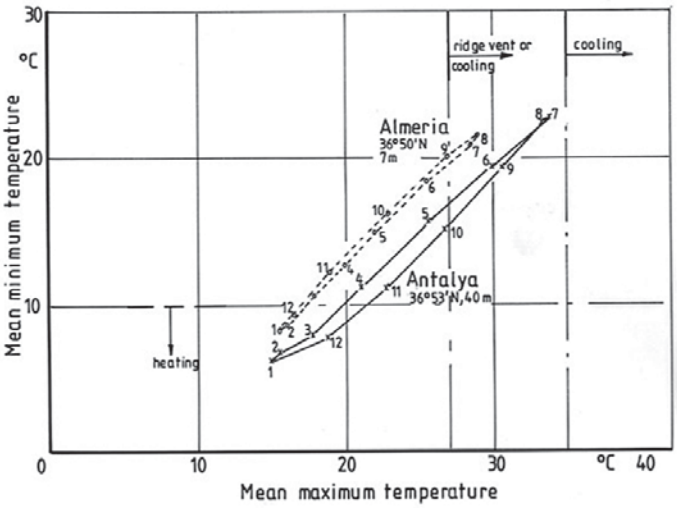

Table 3. Fruit production under protected cultivation in Turkey (tons).

Crops	2004	2009	2014
Strawberries	81,837	121,732	158,564
Banana	90,928	145,788	180,088
Grape	-	-	378
Apricots	-	-	646
Peaches (nectarines)	-	-	66
TOTAL	172,765	267,520	339,742

■ Table 4. Production of ornamental plants under protective cover (units).

Products	2011	2012	2013	2014
Cut flowers	961,567,892	1,001,846,812	925,641,260	942,260,244
Indoor ornamental plants[1]	-	-	34,022,698	39,572,516
Natural flower bulbs[1]	-	-	11,289,460	11,308,780
Outdoor ornamental plants[1]	-	-	169,859,008	187,757,370
TOTAL	961,567,892	1,001,846,812	1,140,812,426	1,180,898,910

[1] Data have been compiled since 2013.

A wide diversity of crops are grown under protected cultivation, including vegetables, ornamental crops and fruits. Vegetable production is by far the most important, representing 96% of the production. Vegetable production has increased 1.49 times during the last decade. Solanaceous crops represent 65% of vegetable yields from protected cultivation, followed by cucurbits at 32.1% (Table 2). Lettuce and other leafy vegetables are grown in the cool season as a second crop.

Fruit production is expanding at a steady pace, both in amount (i.e. 1.97 times more) and diversity (e.g. grape, apricot and nectarine) (Table 3). Although the share represents only 1% of the total production under protected covers, it has grown sharply in recent years. Fruit production was 339,742 tons in 2014 on 63.8 ha (Table 3). In the early 2000s only strawberries and bananas were grown under cover, but stone fruits (i.e. peaches, apricots, plums, nectarines) have now been introduced (Figure 4). Greenhouse stone fruits can be harvested earlier than in conventional field production, and this enables export opportunities to be extended. The harvest of these fruits starts in mid-April and they are exported to Russia, Ukraine and Iran.

Cut flowers are the predominant ornamental crop grown in greenhouses, with a 79.8% share of the overall ornamental production, followed by outdoor (15.9%) and indoor (3.4%) ornamental plants and natural flower bulbs (1.0%). Among the cut flowers, carnation, gerbera daisy, rose and chrysanthemum have a significant share of the overall production with 63.5, 13.7, 9.3 and 4.16% of production, respectively. Additionally, anemone, freesia, goldenrod, gypsophilla, lisianthus, gilly flower, iris, gladiolus, tulip, orchids, statice, hyacinth, and daffodil are also grown under cover. The records available for the years between 2011 and 2014 showed a 22.8% increase in ornamental production (Table 4). This production is mainly concentrated in the Mediterranean (south), Aegean (west) and Marmara (northwest) regions.

Greenhouse technology

Greenhouses can be categorized into two main groups: low-tech or high-tech, according to the structure, technology level, climate control and size (Figure 5). There has been uptake of technology from the high-tech to the low-tech structures, resulting in a third intermediate category, defined as medium-tech.

Most of the greenhouses in Turkey can be considered low-tech. They are characterized by very simple structures in terms of design and climate control and their size is usually quite small. For instance, more than three-quarters of greenhouses are less than 0.5 ha in size. They are covered with either plastic or glass and are supported by steel. They are devoid of climate control (almost no heating), but are often equipped with roof sprinkler irrigation systems or simple heaters to protect the plants against frost damage. Side ventilation is common, yet ventilation area is small. Crops are planted in soil in the majority of these small-scale greenhouses. Short growing cycles (autumn and spring) are preferred in order to avoid cold weather conditions. Most of the product is sold in wholesale markets and product price is determined by brokers, resulting in dissatisfaction among the farmers (Tuzel et al., 2010; Gale et al., 2014).

High-tech greenhouses are generally built as galvanised steel structures and are covered with glass or PE. They are normally taller (i.e. up to 4.5 m eaves and 6.5 m at the ridge) with much higher ventilation areas and capacity. The average size of these operations is between 3 and 4 ha. The investment cost is usually very high. More advanced growing technologies, including soilless culture, are often used in these greenhouses. Crops suitable for long-season production cycles (from August till July) are commonly grown in these greenhouses and production is export-oriented. Integrated plant protection (IPP) techniques are applied and products generally meet GlobalGAP certification protocol. These greenhouses also have state-of-the-art climate-control systems (i.e. central heating system, forced ventilation, shading, evaporative cooling) (Cevik and Tuzel, 2014).

■ Figure 4. Banana (A), plum (B) and nectarine (C) trees under cover in Mersin (source: M. İsfendiyaroglu).

Covering materials

Of the total protected cultivation area, 87.5% is covered with plastic films (PE) and the rest with glass. Coextruded plastic technology has improved in Turkey and many types of PE films

Figure 5. Low-tech (A, B) and high-tech (C, D) greenhouses.

(e.g. UV, IR, AV, AF, AM, AD, EVA) are available on the market. However, the area under glass is still high compared with other Mediterranean countries because of the low cost of glass and labour. Recently, polycarbonate has started to be used for high-tech greenhouses.

Climate control

Turkey has the advantage of availability of alternative energy resources, predominantly geothermal energy. As a result, there has been an increase in construction of high-tech greenhouses in areas where geothermal water resources are available (Figure 6).

Heating, ventilation, CO_2 enrichment, fogging and/or lighting have resulted in different effects on yield, input use and environment. Calculations done by Hemming et al. (2010) for the Western part of Turkey showed that heating and CO_2 application in a Venlo-type greenhouse with continuous roof ventilation resulted in high yields and a short financial payback period for long season tomato production (Table 5).

Production technology

Even though there are significant differences among the greenhouses in terms of design and climate control, important improvements have been achieved in new cropping technologies since the end of the 1990s. These include improved quality of seedlings, particularly through grafting, the use of soilless culture, and widespread implementation of good agricultural practices.

Seedling production

During the last two decades, seedlings have been produced in climate-controlled greenhouses by private nurseries for either protected cultivation or open field production (Figure 7). From 1999 to 2015, the number of nurseries increased by almost ten times (from 12 to more than 110), while transplant production grew by 700-fold (from 500,000 to 3.5 billion) during that time. Some of those nurseries (27.3%) have implemented grafting technology, which is foreseen as one of the alternatives to chemical soil disinfection. There has been a significant improvement in this regard and nowadays 30 nurseries are producing grafted seedlings of tomato, watermelon, eggplant, pepper and cucumber. It is estimated that approximately 143 million grafted seedlings are produced each year. Sixty-five million tomato, 60 million watermelon, 10 million eggplant, 7.5 million cucumber, and 0.5 million pepper were produced in 2014 (Sari, 2015). Turkey also exports watermelon and cucumber seedlings to Romania, Hungary and Georgia, but in smaller amounts (Oztekin and Tuzel, 2013).

Soilless culture

The majority of greenhouse crops are grown in soil, but there has been an increasing interest in the use of soilless culture techniques to overcome soil-specific problems. The soilless cultivation area increased from 10 ha in 1995 to 700 ha in 2012 (Table 6).

Soilless culture started in the 1990s with a few commercial companies located in Antalya. Since then, many enterprises have established soilless production greenhouses in the geothermal areas because of the need for strict climate control to increase yield and quality. Therefore, the Aegean Region in the western part of the country has attracted many modern greenhouses using the cheap and abundant geothermal sources. At the beginning, local substrates such as pumice or perlite were used, but nowadays, rockwool and cocopeat are mainly utilized. The main crop is tomato and blocky type pepper takes the second place with a limited area.

Implementation of good agricultural practices

IPP approaches were introduced in the 1990s at the request of exporters. Good agricultural practises (GAP), a certificated production system, began to be adopted by growers in approximately 2000 as a result of the demand

Table 5. Some of the calculated indicators for evaluation of different greenhouse systems for the Western part of Turkey (Hemming et al., 2010).

	Standard		With CO_2		With fogging		With CO_2 + fogging + closed water system	
	PE	Glass	PE	Glass	PE	Glass	PE	Glass
Water consumed (kg m^{-3})	30.5	28.3	53.0	41.8	25.1	27.1	53.0	49.4
Heat consumed (MJ kg^{-1})	21.9	14.7	14.4	9.9	21.4	14.5	14.2	9.7
Yield (kg m^{-2})	36.7	36.0	54.4	53.3	36.7	36.4	55.4	54.7

Table 6. Soilless cultivation area in Turkey (Gul, 2013).

Year	Production area (ha)	Years	Increase in production area (ha $year^{-1}$)
1995	10		-
2000	20	1995-2000	2
2004	75	2000-2004	13.8
2007	185	2004-2007	36.7
2010	400	2007-2010	71.7
2011	500	2010-2011	100
2012	700	2011-2012	200

Table 7. Data of GAP for Turkey (www.antalya.tarim.gov.tr).

Years	Number of farmers	Area (ha)
2007	651	5,360.7
2010	4,540	78,174.0
2013	8,170	98,509.9

Figure 6. High-tech greenhouses heated with geothermal energy (Dikili Region in İzmir).

coming from Europe. However, problems faced by Turkish fresh fruit and vegetable exporters to the European Union have forced both producers and exporters to adopt the newer EUREPGAP/GlobalGAP certification. The interest of government, local administrators and exporters in the GAP regulations has encouraged producers to shift their terms of references in order to sustain export markets (Akkaya et al., 2006).

The GAP certified area and number of farmers increased 18.4 and 12.5 times, respectively, between the years 2007 and 2013 (Table 7). Today, subsidies for good agricultural practices such as soil analysis and bumble bee use have resulted in an increase in certified production in low-tech greenhouses, however, production in high-tech greenhouses is all GlobalGAP-certified since the products are mainly exported to Europe.

Conclusion

Although good agricultural practices have been adopted in high-tech greenhouses, wider

Figure 7. Seedling production in greenhouses in Turkey (grafted seedling on the right).

adoption by small growers is needed. Some factors limit the expansion of GAP systems in Turkish greenhouses, such as poor environmental control that lowers yield and quality, high input costs, difficulties in record keeping by growers, marketing tools, and lack of well-organized farmers' unions. Despite this, Turkey possesses some advantages for producing high quality crops under protected cultivation, particularly the favourable climatic conditions, geothermal sources, water quantity and quality, and cheap labour. If these advantages can be incorporated together, along with GAP, Turkish products will certainly compete better in the global market.

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› Courses and meetings

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

2015-2017 Master Degree Program in Agronomy, September 2015 - July 2017, Baoding, Hebei, China. Info: Feng Ying or Kou Hongda, International Cooperation Office, Room 1213, the Comprehensive Building, Agricultural University of Hebei, 289 Lingyusi Street, Baoding 071001, Hebei, China, Phone: 0086-312-7521276 (Kou) or 0086-312-7521488 (Feng), E-mail: ndgjhzchu@163.com or Ndws2008@hebau.edu.cn

Postharvest Technology Course, 13-16 October 2015, Wageningen, The Netherlands. Info: Jeltje Daamen, Programme manager, Wageningen Academy, Phone: +31 317 48 24 52, E-mail: jeltje.daamen@wur.nl, Web: http://www.wageningenur.nl/en/Education-Programmes/wageningenacademy-1/show/Postharvest-Technology-Course-Wageningen.htm

9th International Symposium on Plant-Soil Interactions at Low pH (PSILPH), 18-23 October 2015, Dubrovnik, Croatia. Info: Prof. Zdenko Lončarić, E-mail: 9thpsilph@gmail.com, Web: http://www.agroekologija.eu/9thpsilph/

10th International Conference on the Plant Hormone Ethylene 2015, 15-20 November 2015, Chongqing, China. Info: Prof. Zhengguo Li, School of Life Sciences, Chongqing University, Chongqing, 40030, China, E-mail: ethylene2015@163.com, Web: http://www.ethylene2015.org

Symposia and Workshops

› International Symposium on GA3 Tropical Fruit (Guava, Wax Apple, Pineapple and Sugar Apple)

Section Tropical and Subtropical Fruits #ishs_sets

› Participants from different countries attended the International Symposium on GA3 Tropical Fruit in Garden Villa, Kaohsiung, Taiwan.

The International Symposium on GA3 Tropical Fruit (Guava, Wax Apple, Pineapple and Sugar Apple) was successfully held on April 8-11, 2015 in Kaohsiung County, Taiwan. It was organized by the Taiwan Society for Horticultural Science, the Taiwan Agricultural Research Institute, and the National Pingtung University of Science and Technology under the aegis of the International Society for Horticultural Science, and was sponsored by the Council of Agriculture and the Taiwan Agricultural Research Institute.

Objectives of the symposium

Tropical fruits are cultivated mostly in warm climates and are core players of tropical horticulture. They also are major cash crops in commodity markets with regional and global scopes, and therefore are economically important to a number of tropical and subtropical countries including Taiwan. In particular, guava, pineapple, wax apple and sugar apple, the so-called GA3, are four world-class commercial tropical fruits that also provide good sources of essential nutrients to our diet. The objective of this international symposium was not only to address the significance in sustainable development of GA3 tropical fruit industry but also to bring together scientists and relevant stakeholders to share the current successes and challenges.

Atmosphere of the symposium

The symposium kicked off with an interesting and rewarding two-day field trip. Participants were able to enjoy farm tours to local orchards and plantations, including plantings of the four target fruit crops of this symposium. The activities were followed by two days of a scientific program that allowed participants to link theory to practice. Each feasible link was given so that participants could actually 'see' and 'understand' the feasibility of implementing the theory and the efficacy of a developed technology. The well-arranged welcome banquet and farewell dinner party were also highlights of the symposium. They created an atmosphere for participants to enjoy and relax, to renew friendships and make new friends.

Topics discussed

The focal points and main topics for the symposium were: 1) Genetics, Breeding and Biotechnology; 2) Physiology and Cultural Practices; 3) Biotic and Abiotic Stresses and Protected Cultivation; and 4) Postharvest Handling and Processing. There were 28 papers presented in oral sessions and 27 papers presented in poster sessions, in addition to 5 invited papers and 3 keynote papers. ISHS President Prof. Dr. Roderick Drew spoke on the International Society for Horticultural Science, the Global Horticulture Initiative, world poverty and the importance of tropical fruits. Prof. Dr. Sisir Kumar Mitra, Chair of the ISHS Section Tropical and Subtropical Fruits, gave a presentation on crop regulation for year-round harvesting of guava. Prof. Dr. Robert E. Paull spoke on production and postharvest handling of low acid hybrid pineapple. During the sessions, new concepts, novel ideas and newly-developed technologies from various fields were shared and discussed that would further enhance the development of related scientific areas and fruit industries for these four major tropical fruit crops.

Interesting outcomes

1. Although GA3 tropical fruit may not be the most popular or common fruit crops in the global market, the symposium attracted 123 participants from 10 countries (Austria,

China, India, Indonesia, Japan, Philippines, Thailand, Taiwan, USA and Vietnam). The diversity and richness of research topics presented at the symposium were creditable and admirable.

2. The value of the symposium was positively recognized by the ISHS and participants from various countries. Some participants expressed their interest in establishing possible partnerships in research and networks for knowledge sharing. A company from India was very interested in using bagging technology for guava and wax apple.
3. This symposium was held at a time when the Council of Agriculture (Taiwan) is very keen to strengthen research on tropical fruit trees and development of related fruit industries. Such an initiative builds on recent advances in many new fruit cultivars and cultivation technologies, which create great potential to export Taiwan's high quality fruit products to various international markets. High quality fruits represent substantial financial benefits to local farmers and fruit industries, as well as contribute to nutrient intake and health of domestic consumers.

Chung-Ruey Yen

› GA3 Convener, Dr. Chung-Ruey Yen, informing tour participants about the tropical fruit germplasm in National Pingtung University of Science and Technology.

› The impressive Taiwanese performance at the opening ceremony was well received by the participants.

› Dr. Hsueh-Shih Lin, President of Taiwan Society of Horticultural Science (first on left), Dr. Dennis Wang, Director of Tainan District Agricultural Research and Extension Station (second from left), Prof. Roderick Drew, ISHS President (third from left), and Dr. Junne-Jih Chen, Director General of Taiwan Agricultural Research Institute (third from right) were present at the opening ceremony of the International Symposium on GA3 Tropical Fruit.

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› Third Asia-Pacific Symposium on Postharvest Research, Education and Extension

Commission Education, Research Training and Consultancy #ishs_cmet
Commission Quality and Postharvest Horticulture #ishs_cmph

The 3rd Asia-Pacific Symposium on Postharvest Research, Education and Extension was held on 8-11 December, 2014 in Hochiminh City, Vietnam. It was organized by the Vietnam Institute of Agricultural Engineering and Postharvest Technology (VIAEP) in cooperation with the Nong Lam University and with the approval of the Ministry of Agriculture and Rural Development of Vietnam, under the auspices of the International Society for Horticultural Science (ISHS).

A total of 180 participants attended with 147 participants from overseas including USA, France, Italy, Belgium and Hungary. Sixty-two oral papers and 98 posters were presented by participants from 20 countries. Keynote speakers from different universities,

› A. Participants of the symposium.
B. Award ceremony for outstanding contributors to postharvest and horticultural research and education.

institutes and international organizations were invited, such as ISHS, the International Food and Agriculture Organization of the United Nations (FAO), the World Vegetable Center (AVRDC), the French Agricultural Research Centre for International Development (CIRAD), and the International Center for Tropical Agriculture (CIAT). Some private companies actively participated by presenting papers and contributing to discussions during the symposium. A representative from the Ministry of Science and Technology of Vietnam delivered the opening speech and expressed the important role of postharvest research, education and extension in Vietnam and the rest of the world, with the hope that the 3rd Asia-Pacific Symposium on Postharvest Research, Education and Extension would help Vietnam and other countries in the region to reduce postharvest losses, maintain quality and increase the added value of horticultural products.

› Cultural field visit to Mekong River Delta.

The following topics were presented at the symposium: current situation and further development needed to reduce postharvest loss in Asia and the Pacific region; supply chain management and value chain system improvement for agricultural products; quality assurance and food safety management; packaging and storage of agricultural products; processing and preservation of agricultural products and food safety in international trade policy. Postharvest technology for small-holder farmers around the world, postharvest and market innovations for climate-smart agriculture, as well as mechanization and automation in fresh technologies were also interesting topics in the symposium. The new application methods for postharvest treatments such as vapor heat and irradiation treatments for the fresh fruit export market were of particular interest to participants as well. The modes and lessons of postharvest delivery and horticultural education and training were presented and discussed for further improvement. In order to introduce a better understanding of the strong relationship between research, education and extension activities and the market and consumers, some renowned speakers shared their insightful knowledge on these matters. For example, a New Zealand case was presented to show an innovative company model designed specifically for government research institutes to support agricultural industry. Another case was presented to explain how consumers perceived quality and price of high value specialty crops in supermarkets in the United States. Action learning in value chains for postharvest research, development and extension was also showcased at the symposium.

Awards were presented to participants who had made an outstanding contribution to postharvest, horticultural research and education at this symposium.

The symposium included a one-day field excursion to Tien Giang and Ben Tre provinces in the Mekong River Delta to view dragon fruit trees and a rice processing factory. The cultural music dinner attracted many participants and provided the opportunity for everybody from different cultural backgrounds to exchange ideas and enjoy an evening together.

New networks were established between research scientists, lecturers, managers, and enterprises, as well as with different international organizations for further cooperation and development programs.

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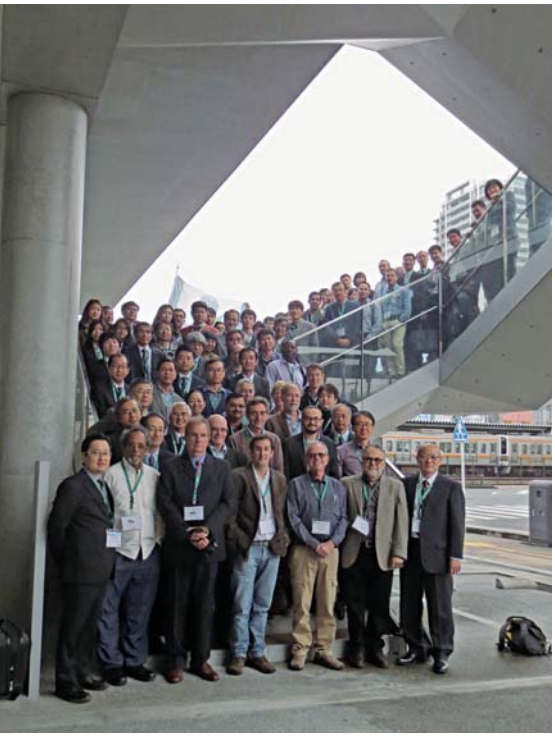
› Third International Symposium on Citrus Biotechnology

Commission Molecular Biology and In Vitro Culture #ishs_cmmv



› Symposium participants in front of the venue (Shimizu Marinart).

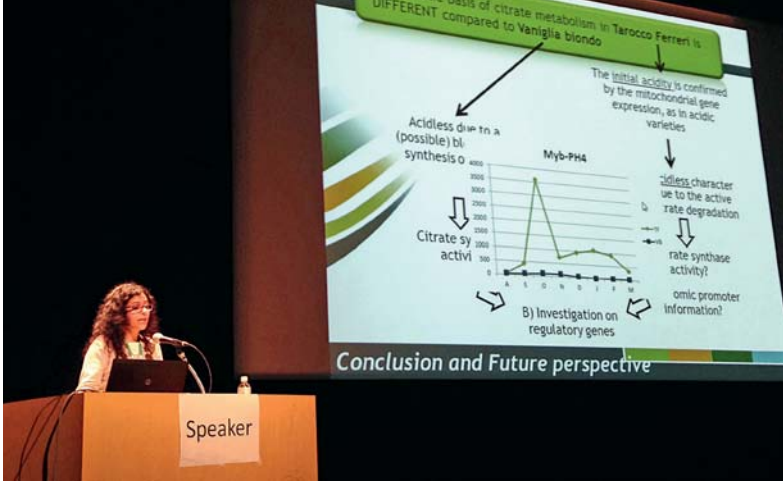
The 3rd International Symposium on Citrus Biotechnology was held from November 11-14, 2014 in Shizuoka City, Japan. It was organized by the International Society of Citriculture (ISC) Japan chapter and NARO Institute of Fruit Tree Science (NIFTS) under the auspices of the International Society for Horticultural Science (ISHS) with support from the Japanese Society for Horticultural Science (JSHS). The symposium was attended by a total of 107 participants from 12 countries (53 from Canada, China, France, Israel, Italy, Korea, Morocco, Spain, Turkey, USA, and Uruguay, and 54 from Japan).

At the opening ceremony, Prof. Shigeto Tominaga, Symposium Co-Convener, and Dr. Nagao Matsuta, Director of NIFTS, gave a welcome address on behalf of the host organizations. Dr. Yair Erner (Israel), Chair of the former Section Citrus of ISHS, welcomed the participants and presented a brief introduction to the ISHS. Prof. Motoaki Doi (Kyoto University), Vice President of JSHS, Emeritus Prof. Shuichi Iwahori (Tsukuba University), ISHS Fellow, and Prof. Ryutaro Tao, Board member of ISHS, also expressed their warm welcome to the symposium.

One of the purposes of this symposium was to catch up on cutting-edge citrus research and exchange ideas between broad research fields. Breeding by marker-assisted selection, mutation induction, introgression of cis- or trans-genesis are anticipated to quickly develop promising varieties. Furthermore, strong demand for improving fruit quality and commercial value, and for enhancing tolerance to environmental stress and disease and insect damage, is increasing. Two recently-published papers separately reported successes in genome sequencing of citrus. The advent of the genome era with the power of next-generation sequencing technology was another important topic discussed at the symposium.

At this symposium, three excellent invited speakers gave overviews on the following topics. Professor Fred G. Gmitter (USA) introduced his genomics and breeding approaches aimed at improving tolerance of Huanglongbing (HLB) disease. Dr. Minoru Sugiura (Japan) introduced his epidemiological studies to clarify the health benefits of β-Cryptoxyanthin, a novel functional carotenoid mostly found in Satsuma mandarin. Professor Masaya Kato

› Field tour in Okitsu Citrus research station.



› Oral presentation by Dr. Concetta Licciardello.

(Japan) introduced his recent studies to reveal the carotenoid biosynthesis pathway, and his current approaches to regulate content and composition of carotenoids in fruit.

The scientific program consisted of 19 oral and 32 poster presentations in four sessions: Breeding, Genomics and Genetics – Ongoing efforts to improve breeding efficiency using DNA marker developments, cytogenetic approaches, and marker assisted selections were reported.

Physiology and Production – The identification of novel genes or compounds that could regulate flowering, tolerance to pests or diseases, and also fruit quality were reported. Evaluation of photosynthesis on fruit suggested it plays a role in alternate bearing and sugar accumulation.

Omics, Applications and Emerging Technologies – Biochemical evaluations reported the regulatory manner of acid metabolism in citrus fruits. Several approaches proposed future directions on phenotyping, e.g. introducing a smart device or high-resolution image analysis using a multicoptor (drone).

Stress, Pests and Diseases – Efforts to understand and enhance tolerance to stress or HLB infection were reported. A signal induction pathway caused by infection or insect attack suggested possible key points to improve tolerance.

The poster presentation area was large, and many participants continued discussions after both oral and poster presentations.

On the last day of the symposium, participants visited a citrus grower's orchard in Shizuoka City. The owner has been an early adopter of the latest techniques for producing premium grade of the elite cultivar, 'Harumi'. Many participants asked about these techniques. Participants also visited a citrus packing house in Mikkabi town that manages all sorting and shipping processes automatically using RFID tag technology. In the packing house, all of the fruits are identified for their size, color, appearance, Brix content, and acidity by sensors and cameras, then sorted into several grades according to these scores. Most of the packing houses in Japan have already introduced such facilities for quality control, and the Co-Conveners hoped these visits demonstrated the current status of the Japanese citrus industry.

Two social activities during the symposium (the welcome party at a small restaurant that serves local foods, and the formal dinner) were held in a relaxed and comfortable atmosphere. Furthermore, some of the participants also visited Okitsu Citrus research station after the symposium finished, to explore the germplasm collection and the breeding program orchard.

The proceedings of the symposium will be published as a volume of *Acta Horticulturae*.

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› Third International Symposium on Organic Matter Management and Compost Use in Horticulture

Commission Organic Horticulture #ishs_cmor
Commission Plant Substrates and Soilless Culture #ishs_cmps

The Third International Symposium on Organic Matter Management and Compost Use in Horticulture was held from 20th to 24th April, 2015 in Murcia, a region in the South-East of Spain with a strong agricultural background. The event was organised by the Spanish National Research Council (CSIC-CEBAS) under the auspices of the ISHS.

The symposium received a positive response from research groups from the five continents with 304 authors and 80 delegates presenting their most recent research in the area. The third edition of this symposium was especially relevant this year, coinciding with the celebration of the 2015 International Year of Soils. The overall topic of the symposium, combining organic waste management and compost use in horticulture, covered aspects of different key agricultural practices in line with the main goals of this important FAO initiative.

The scientific program was designed to bring together the main scientific and practical challenges facing sustainable recycling of organic residues in horticulture. All these challenges were addressed in six scientific sessions and a round table discussion. The selection of research topics included nutritional issues (nitrogen (N) use efficiency and phosphorus (P) recycling) and the implication on global food security, different

environmental impacts associated with the use of organic amendments, and also a reflection on novel soil conditioners and future needs to ensure their safe use. The opening lecture by Prof. Ed Stentiford (UK), *"Past, present and future of compost research"*, provided the background for the event and highlighted the main research needs in the area. The ISHS representative, Prof. Michael Raviv (Israel), Chair of the ISHS Commission Plant Substrates and Soilless Culture, reviewed a key research topic in this discipline, *"Compost as a tool to suppress plant diseases: established and putative mechanisms"*.

The nutritional value of compost was the research topic that attracted the attention of many delegates. There was an increasing interest in the recycling of phosphorus from organic wastes through composting. Prof. Rodrigo Ortega, convener of the previous symposium in this series held in Santiago (Chile) in 2013, gave a keynote lecture on *"Phosphorus fractions in organic materials and their effects on soil P levels and crop nutrition"*. There were several interesting contributions demonstrating successful cases of practical recycling of P from different organic wastes and in different crops.

Another important topic that attracted the attention of delegates was the impact of the use of compost on human health and global warming, including the impact on soil sustainability. Several keynote speakers were invited specifically to address these topics. Prof. Martí Nadal (Spain) presented an overview on the impact on human health entitled *"Health risks associated to solid waste composting: from production to use in agriculture"*. Dr. Sally Brown (USA) presented *"Carbon accounting for compost – from feedstock to farm"*, which covered the main aspects related to global warming and food security. The presentation by Prof. Maria de Nobili (Italy) entitled *"The complexity of soil sustainability: linking organic C levels to soil biological properties and soil resilience"*, discussed the importance of the addition of composts on soil sustainability.

The last day of the scientific sessions was devoted to the use of novel organic amend-

› Participants of the symposium.

› Opening session. From left to right: Dr. Peter Kuikman (Alterra, The Netherlands) as coordinator of the FERTIPLUS EU Project, Prof. Michael Raviv (Chair ISHS Commission Plant Substrates and Soilless Culture), Prof. Juan José Alarcón (Director of CEBAS-CSIC, Spain), and Miguel A. Sánchez-Monedero (Convener).

› One of best poster awards presented to Miss Inés López-Cano from CEBAS-CSIC (Spain).

› Technical visit to COATO.

ments, especially biochar, either alone or in combination with compost. Biochar has attracted the attention of researchers in recent years and this symposium served as a platform to explore the interaction of biochar with organic matter during composting, in combination with compost as an organic amendment or as a component of growing media. All these topics were addressed during the symposium, and included the latest research outputs from a European Project working on this topic (FERTIPLUS - www.fertiplus.eu). Results were discussed at a round table, which gathered experts from academia and industry, and covered a wide range of expertise from soil science, horticulture and nutrient management, waste management and biochar. The main conclusions of this session highlighted the potential of biochar to enhance the composting process and the quality of the end-product, to be used as a component of soil growing media, and also to mitigate nitrous oxide emissions in agricultural soils. The main advantages and limitations for the agricultural use of biochar were discussed and, finally, a general agreement was reached on the potential of biochar to be integrated in local waste management practices.

The technical tour included a visit to COATO (http://www.coato.com/en/), a farmer's cooperative that is a European leader in organic agriculture with a production area of over 21,000 hectares of crops for fruits and vegetables, pepper for paprika, almond trees and olive trees.

An effort was made to encourage the participation of early stage researchers, with special fees for students and three Young Scientist Awards. We were very pleased that about one third of the oral contributions were presented by talented PhD students who demonstrated a high scientific level and will ensure the continuation of compost research. During the business meeting the ISHS participants voted to hold the next symposium in Canada in 2017 and Dr. Thomas Forge will be the next Convener.

All participants learnt from the many and varied presentations, engaged in thrilling scientific discussions, found useful contacts for their network and enjoyed meeting old and new colleagues.

Miguel A. Sánchez-Monedero, Mariluz Cayuela, Jose A. Alburquerque and Asunción Roig

› Contact

Miguel A. Sánchez-Monedero, Mariluz Cayuela, Jose A. Alburquerque and Asunción Roig, Organising Committee of the ISHS Symposium, CEBAS-CSIC, Campus Universitario de Espinardo, 30100 Murcia, Spain, E-mail: monedero@cebas.csic.es

› Second International Workshop on Bacterial Diseases of Stone Fruits and Nuts

Commission Plant Protection #ishs_cmpp
Section Nuts and Mediterranean Climate Fruits #ishs_senu
Section Pome and Stone Fruits #ishs_sefr

The Second International Workshop on Bacterial Diseases of Stone Fruits and Nuts was held in İzmir, Turkey during the period 21-24 April, 2015 under the aegis of the ISHS. Organization of this event was a joint initiative between Ege University, Department of Plant Protection and the Ministry of Food and Agriculture of Turkey.

The workshop was attended by 46 delegates from 13 different countries. Delegates came from Austria (1), Bulgaria (1), France (4), Hungary (2), Latvia (2), Norway (1), Poland (2), Serbia (2), Spain (3), Switzerland (3), The Netherlands (3), Turkey (21), and the United States (1). The workshop provided the opportunity for scientists and students to present their latest findings and discuss their current work related to basic and applied aspects of bacterial diseases of stone fruits and nuts.

The meeting covered all aspects of research on bacterial diseases of stone fruits and nuts, presenting the latest advances in relevant fields such as host and pathogen genetics/genomics, host-pathogen interactions and behaviour, disease epidemiology and ecology, pathogen identification, resistance breeding, chemical/biological control and disease management strategies.

The workshop scientific program comprised 1 plenary talk, 15 oral presentations and 15 posters. The keynote speaker of the workshop was Dr. Jaab Janse from The Netherlands. He gave a talk on the quarantine bacterium *Xylella fastidiosa*, its importance in light of its recent detection in the Mediterranean and some remarks on the approaching devastating citrus disease Huanglongbing ('*Candidatus* Liberibacter spp.').

This event was supported by COST Action FA1104 "Sustainable production of high-quality cherries for European market". The Chair of this COST Action, Jose Quero Garcia, gave

› Participants of the workshop.

› Semih Erkan, Head of Plant Protection Department of Ege University (left), and Birol Akbaş, Head of Plant Protection Department of General Directorate of Agricultural Research and Policy of Ministry of Food and Agriculture (right), during their welcome speeches.

› Jaab Janse, keynote speaker (left) and Jose Quera Garcia, Chair of COST Action FA1104 (right) during their speeches.

› Marcel Wenneker, ISHS representative, presenting the ISHS medal award to the Convener Hatice Özaktan (left), Organizing Committee members (center), and Luciana Parisi, nominated to organize the 3rd International Workshop on Bacterial Diseases of Stone Fruits and Nuts in Avignon, France (right).

an informative talk on progress and prospects for COST Action FA1104.

Research highlights included:

- Invasion biology & emerging bacterial disease threats of stone fruits and nuts
- Classical and molecular diagnosis of bacterial agents of stone fruits and nuts
- MALDI-TOF MS for microorganism identification: from pattern recognition towards marker based approaches
- Epidemiology and ecology of the diseases
- New approaches on disease management strategies

The social program of the workshop included a welcome dinner in Ege University Restaurant and a gala dinner in a typical Turkish restaurant with amazing Izmir bay views. The cultural program of the workshop was very interesting to participants. They became acquainted with sights and historical places of Izmir and could take part in an excursion tour to the historical ancient city Ephesus, Şirince village and an organic farm in Selçuk, Izmir.

For all participants, the workshop was an excellent opportunity to learn about new diagnostic techniques, emerging diseases and environmentally friendly control measures of important bacterial pathogens.

The third workshop will be held in Avignon, France in 2018 and the Convener will be Dr. Lusiana Parisi, INRA, PACA Research Center, Plant Pathology Research Unit.

At the conclusion, the Conveners expressed their thanks to all members of the Organizing Committee and to all delegates for coming to the workshop and participating in its demanding program.

Hatice Özaktan

›Contact

Dr. Hatice Özaktan, University of Ege, Faculty of Agriculture, Department of Plant Protection, 35100 Bornova, Izmir, Turkey, Phone: +902323111410, E-mail: hatice.ozaktan@ege.edu.tr

From the Secretariat

› New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Australia: Ms. Denyse Corner, Mr. Angus Crawford, Ms. Sandra Crockett, Dr. Ibrahim El Saliby, Ms. Jennifer Hashim-Maguire, Mr. Gary Hill, Mr. Ashley Lansley, Ms. Liz Mann, Mr. Kyle Manning, Mr. Ben McInnes, Mr. Nathan Morrison, Mr. Lodi Pameijer, Mr. Wayne Turner, Mr. Folke Van der Spek, Ms. Rosemary Viggers; **Austria:** Mr. Ralph George; **Belgium:** Dr. Rob Moerkens, Mr. Bruno Telemans; **Bosnia and Herzegovina:** Prof. Dr. Pakeza Drkenda; **Botswana:** Mr. Som Pal Baliyan; **Brazil:** Prof. Dr. Cassandro Amarante, Mr. Detony José Calenzani Petri, Jorge Luis Carvalho Silva, Prof. Adriana Corrent, Prof. Dr. J. Albersio Lima, Prof. Dr. Silmara Pantaleao, Prof. Dr. Claudoi Roberto Meira de Oliveira, Mr. Paulo Cesar dos Santos, Prof. Dr. Flávio Schmidt, Prof. Carlos Silva; **Bulgaria:** Ms. Stanislava Dimitrova, Assist. Prof. Lilyana Koleva; **Canada:** Ms. Vera Borsos-Matovina, Sarah Story, Dr. Ashraf Tubeileh; **Chile:** Prof. Dr. Rodrigo Infante, Mr. Jabes Medeiros, Assist. Prof. Alexis Kooichi Vidal Takasaki; **China:** Ying Baozhu, Jianhua Gong, Song Heli, Xie Hong, Jin Jiankun, Mingxiang Jin, Prof. Dr. Peng Jin, Rongda Jin, Deng Jing, Han Jingyi, He Ke, Mr. Li Kun, Dr. Tao Li, Prof. Dr. Hetong Lin, Bing Long, Ling Nan, Dai Shengcong, Zhiwei Song, Geng Wang, Tang Xia, You Yong, Hongyou Zhao, Yang Zhenwu, Jun Zhou, Zhang Zide; **Chinese Taipei:** Dr. Wuu-Yang Chen; **Colombia:** Prof. Rafael Flórez Faura; **Congo:** Ms. Justine Tshidibi Tshimbila; **Cote d'Ivoire:** Cheikhou Badio; **Czech Republic:** Miroslav Horák, Martin Jonás, Pavol Suran, Mr. Radek Vávra, Ms. Ivona Zdárská; **Denmark:** Dr. Habtamu Giday Gebraegziabher, Mr. Martin Himmelboe, Mr. Md. Nahidul Islam, Mr. Hans Henrik Kampmann; **Ecuador:** Bjarne Hjorth; **Egypt:** Dr. Diaa El-Ansary, Dr. Eslam Elfadly; **Finland:** Nadija Timonen; **France:** Dr. Aude Alaphilippe, Ms. Amélie Devillepoix, Dr. David Gomez Candon; **Germany:** Jan Maier, Dr. Elke Meinken, Mr. Sebastian Olschowski; **Greece:** Mr. Evangelos Gklavakis, Ms. Athanasia Karantzi, Marios-Ioannis Sotiras; **India:** Prof. Dr. P.V. Balachandran, Prof. Dr. Tarsem Singh Dhillon, Ms. Indravathi Gundrathi, Mr. Durga Rao Koppishetti, Dr. Ravishankar Manickam, Prof. Dr. Nagesh Naik, Prof. Dr. Rajendran Pangath, Prof. Dr. P Rajendran, Dr. Sat Pal Sharma, Dr. Ranjit Singh, Dr. Sujata Upadhyay, Dr. V.K. Vashisht; **Iraq:** Mr. Ali Hadi AL-Maamory, Mr. Ali Kadhim, Prof. Dr. Jamal Selman; **Israel:** Asaf Bar Hadas; **Italy:** Dr. Floriana Bedussi, Dr. Laura Crippa, Dr. Cecilia Di Primio, Dr. Enrico Maria Lodolini, Dr. Laura Pistelli, Dr. Patrizia Zaccheo; **Japan:** Mr. Taro Fukuyama, Prof. Dr. Takahiro Hayashi, Mr. Jun Ito, Assist. Prof. Yutaka Jitsuyama, Mr. Takayuki Kobayashi, Prof. Dr. Kaihei Koshio, Assist. Prof. Arisa Noguchi, Prof. Dr. Kazuhiko Shimasaki, Mr. Shinichi Shimizu, Ms. Diyah Yumeina; **Korea (Republic of):** Dr. Suwimol Chockchaisawasdee, Ms. Yu-Min Jeon, Prof. Dr. Jongyun Kim, Mr. Sung Tai Kim, Mr. Sungjin Kim, Assist. Prof. Jongseok Park, Ms. Songyi Park, Prof. Daeyoung Son; **Libya:** Mr. Abdel Karim Al Osta; **Lithuania:** Prof. Dr. Remigijus Daubaras; **Macedonia:** Prof. Dr. Tosho Arsov, Assist. Prof. Viktor Gjamovski, Prof. Dr. Marjan Kiprijanovski; **Malaysia:** Dr. Samsuzana Abd Aziz, Ms. Ming Siang Lem, Ms. Noor Camellia Noor Alam, Dr. Ajit Singh; **Mexico:** Fernando Hernandez Lohr; **Morocco:** Prof. Omar Chlyah; **Netherlands:** Mr. Janjo de Haan, Mr. Nikolaos Ntagkas, Dr. Theoharis Ouzounis, Mr. Maxence Paillart, Ms. Faline Plantenga, Mr. Ad Van Rooijen; **New Zealand:** Dr. Nagin Lallu, Mr. Iain Latter, Mr. Grant Ryan; **Nigeria:** Mr. Adewole Adeyanju, Mr. Babatunde Folarin, Dr. Umar Muhammad Sokoto; **Norway:** Dr. Mette Goul Thomsen; **Portugal:** Rui Pinto, Prof. Dr. Henrique Ribeiro; **Reunion:** Mathilde Capelli; **Russian Federation:** Dr. Valentina Gorina, Dr. Sergey Khokhlov, Dr. Larisa Komar-Tyomnaya, Dr. Vadim Korzin, Dr. Tatyana Latsko, Prof. Dr. Irina Mitrofanova, Dr. Elena Shishkina, Dr. Anatoliy Smykov, Dr. Sergey Tsuypka; **Saudi Arabia:** Mr. Fadi Itani; **Serbia:** Mr. Hassan Alrgei, Dr. Milica Fotiric Aksic, Dr. Ivan Glisic, Mr. Basem Guffa, Prof. Dr. Milan Ivanovic, Prof. Dr. Sanja Lazic, Milan Lukic, Sladjana Maric, Dr. Aleksandar Radovic, Durjina Ruic, Jelena Tomic, Mr. Milan Ugrinovic, Assist. Prof. Dragan Vujovic, Assist. Prof. Slavica Vukovic, Assist. Prof. Gordan Zec; **Slovak Republic:** Dr. Katarina Rovna; **South Africa:** Prof. John Annandale, Mr. Joseph Boshomane, Dr. Nicola Combrink, Ms. Annaline Smith; **Spain:** Assist. Prof. Alejandro Pérez-Pastor, Dr. Victor Rodriguez, Mr. Thomas Semark, Mr. Manuel Tienza; **Thailand:** Assist. Prof. Kiattisak Duangmal, Dr. Somkit Jaitrong, Dr. Thanachan Mahawanich, Dr. Sirima Puangpraphant, Dr. Ubonrat Siripatrawan, Dr. Sontisuk Teerachaichayut; **Tunisia:** Dr. Rim Zitouna Chebbi; **Turkey:** Mr. Hasan Akyar, Mr. Erol Aydin, Prof. Dr. Elif Candir, Mr. Gurcan Dilek, Assist. Prof. Hakan Engin, Mr. Mehmet Ali Gundogdu, Prof. Dr. Serra Hepaksoy, Dr. Idris Macit, Mr. Andac Kutay Saka, Yavuz Turhan, Dr. Kadir Uçgun, Mr. Mehmet Yavuz, Prof. Dr. Kadir Ugurtan Yilmaz; **Ukraine:** Mr. Andrii Fedyk, Mr. Alexander Pavlovsky; **United Kingdom:** Ms. Maria Bengtsson, Mr. Andrew Bourne, Dr. Graham Clarkson, Mr. Ivan Davie, Mr. Ben Olins, Dr. Simon Pearson, Ms. Alicja Rys-Parsons, Ms. Passaraporn Sawasdee, Ms. Melanie Webb; **United States of America:** Dr. James Altland, Dr. Doug Bailey, Dr. Marco Bello, Mr. Jon Bender, Andre Biscaro, Mr. Shaun Broderick, Courtney Bryller, S.T. Chou, Mr. Howard Davis, Dr. Jan Debaene, Thomas Flewell, Ms. Miranda Ganci, Mr. William Gerlach, Mr. Jim Gilbert, Sidney Grief, Dr. Kale Harbick, Ms. Odile Huchette, John Jifon, Gemma Jundi, Ian Justus, Nicole Kitchens, Dr. Raksha Kuenen, Jaume Lordan Sanahuja, Chris Marble, Qingwu Meng, Yujin Park, Mr. Bala Ramamoorthy, Mr. Manuel Rivera, Ms. Joan Rosen, Maria Sabbagh, Mr. Andrew Schaecher, Mr. Nahum Shpak, Dr. Jason Stout, Dr. Dominic Strohlein, Mr. Norb Warnes, Prof. Glenn Young; **Vietnam:** Ms. Huyen Nguyen Thu.

› In memoriam

› Wouter van Doorn

Wouter van Doorn (1951-2015)

With the unexpected death of Dr. Wouter van Doorn, May 16, 2015, floricultural science lost a leading intellect, and we mourn the passing of an outstanding colleague, productive scholar and generous friend. Wouter was born in The Netherlands, December 10, 1951. After graduating in 1976 from the University of Utrecht with an M.Sc. in biology, Wouter worked for several years in a research institute of The Netherlands' Department of Agriculture. In 1984 he joined the Sprenger Institute at Wageningen, now a Department of Wageningen University and Research Center, where he studied for his Ph.D. As a member of that world-renowned postharvest team of researchers Wouter conducted research on the postharvest biology and technology of cut flowers. With colleagues and students, he investigated the factors affecting the postharvest lives of a range of species, including such staples as roses, gypsophila, iris and carnation, but also exotic flowers including one of his very favorites, the flower of the lotus.

Articulate, thoughtful, and energetic, Wouter was fluent in several languages and travelled widely, working with colleagues in many countries. He recounted many adventures from his travels, most dramatically his almost miraculous escape from a flooded cabin in Phuket, Thailand, during the terrible 2004 Tsunami.

Together with his frequent collaborator Ernst Woltering, he conducted important surveys of many floral species, in particular a frequently-cited study of the role of ethylene in the senescence of flowers from an impressive range of botanical families. He and his colleagues carried out elegant anatomical and biochemical investigations of the processes of petal senescence. His exhaustive examination of gene expression during anthesis and senescence in iris flowers provided data that others have depended on in designing studies of gene function during the process.

A budget-dictated early retirement in 2007 did not slow Wouter's creativity. He satisfied his passions for floriculture research and travel by working with colleagues and students in laboratories throughout the world. Their research resulted in a continuing flow of peer-reviewed publications, many in high impact journals, and many in collaboration with colleagues in Japan, Thailand, and the U.S. At Davis we were delighted to provide an academic 'home' for Wouter, and greatly enjoyed his visits, which always inspired debate and fun in equal measure.

A true renaissance scholar, Wouter was more than a productive researcher – in mid-career, he studied philosophy at the Universities of Leiden and Rotterdam. This experience perhaps was part of the inspiration for the more theoretical articles that he published in recent years reviewing molecular events underpinning senescence and suggesting provocative models for coordination of the process. He was especially interested in the apoptotic senescence that has been well demonstrated in animal systems, and focused, in particular, on the possible role of autophagy.

Wouter was an insightful colleague and advisor to the many students with whom he worked. He also served for many years on the editorial board of Postharvest Biology & Technology, as that journal's book review editor, and as chair of the ISHS Working Group Quality of Ornamentals. A regular attendee at ISHS symposia, particularly those relating to postharvest, Wouter could always be counted on to generate interesting discussion, and to join in the important social aspects of those functions as well.

Wouter had recently returned from Thailand, where he spent several months every winter for the past few years working with faculty and students at Kasetsart University, and succumbed rapidly to complications from a long-standing lung infection. We will miss his smile, his enthusiasm and keen insights, and the generous spirit that made him a true colleague and friend. I can do no better, in concluding this brief obituary, than to marvel how he lived up to his own words:

'Part of the enjoyment of life is to know where we stand, to find out about the meaning of it all, and to fill our life with as much meaning as we can.'

Michael Reid,
University of California Davis, USA

› 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

- 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

- August 5-8, 2015, Madurai, Tamil Nadu (India): **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 E-mail symposium: isups2015@gmail.com Web: http://isups2015.org
- August 6-9, 2015, Kyoto (Japan): **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 6-8, 2015, Yakima, WA (United States of America): **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 E-mail symposium: ivhumulussymposium@gmail.com Web: http://ihs.hopsteiner.us/
- August 13-15, 2015, Siem Reap (Cambodia): **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 or Prof. Glenn Young, University of California, Davis, Davis California 95616, United States of America. Phone: (1) 530-220-0363, E-mail: gmyoung@ucdavis.edu Web: http://www.seasia2015-cambodia.com
- NEW August 20-21, 2015, Skopelos (Greece): **III EUFRIN Plum and Prune Working Group Meeting on Present Constraints of Plum Growing in Europe.** Info: Prof. Dr. Alexandros Papachatzis, ATEI of Thessaly, 41110 Larissa, Dptm of Agricultural Engineering, Horticultural Laboratory, Greece. Phone: (30)2410684283, Fax: (30)2410684283, E-mail: papachad@teilar.gr or Dr. Damiano Avanzato, International Horticulturist Consultant, Via Casaserena, 42, 00040 Pomezia (Roma), Italy. Phone: (39)3381109542, E-mail: damiano.avanzato@gmail.com E-mail symposium: skopelos@teilar.gr Web: http://skopelos.teilar.gr
- 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
- NEW 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.myctoxinssymp.com.ng/
- September 13-18, 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 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/
- NEW October 5-8, 2015, Bahía Blanca, Buenos Aires (Argentina): **XXXVIII Argentinian National Congress on Horticulture.** Info: Roberto Rodríguez, Dpto. Agronomía, Universidad Nacional del Sur, San Andrés 850, Altos Palihue, 8000 Bahía Blanca, Argentina. E-mail: asaho15secretaria@gmail.com Web: http://38congresohorticola.wix.com/congresohorticultura
- 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@newaginternational.com E-mail symposium: biostimulants@newaginternational.com Web: http://www.biostimulants2015.com/
- NEW 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 E-mail symposium: qmoh2015@ubru.ac.th Web: http://qmoh2015.ubru.ac.th

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- 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: 9ivchbegypt16@gmail.com
- NEW January 24-27, 2016, Ambalavayal, Wayanad, Kerala (India): **International Symposium on Succulents and Other Ornamentals.** Info: Prof. Dr. P.V. Balachandran, Director of Extension, Directorate of Extension, Mannuthy, Thrissur, Kerala, India, Thrissur, Kerala, 680651, India. Phone: (91)487-2370150 , E-mail: balachandran.pv@kau.in or Prof. Dr. Rajendran Pangath, Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Ambalavayal, Wayanad , 91, 673593, India. Phone: (91)4936 260421, Fax: (91)4936 260421, E-mail: adramb@kau.in
- 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
- NEW 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 Web: http://conference.ifas.ufl.edu/vaccinium/
- 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
- NEW 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 Web: http://isppv2016.org
- NEW 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 Web: http://www.carob2016.org
- NEW May 12-13, 2016, Palermo (Italy): **I European Conference of Post Graduate Horticultural Scientists (ECPHS).** Info: Prof. Dr. Paolo Inglese, Department Agriculture and Forest Sciences, Università degli Studi di Palermo, Viale delle Scienze, ED. 4, 90142 Palermo, Italy. Phone: (39)09123861234, Fax: (39)09123860820, E-mail: paolo.inglese@unipa.it E-mail symposium: ecphs2015@unipa.it Web: http://www.soihs.it/ecphs/default.aspx
- 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, Michigan State University, East Lansing, MI 48824, United States of America. Phone: (1)5173530350, Fax: (1)5173530890, 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

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