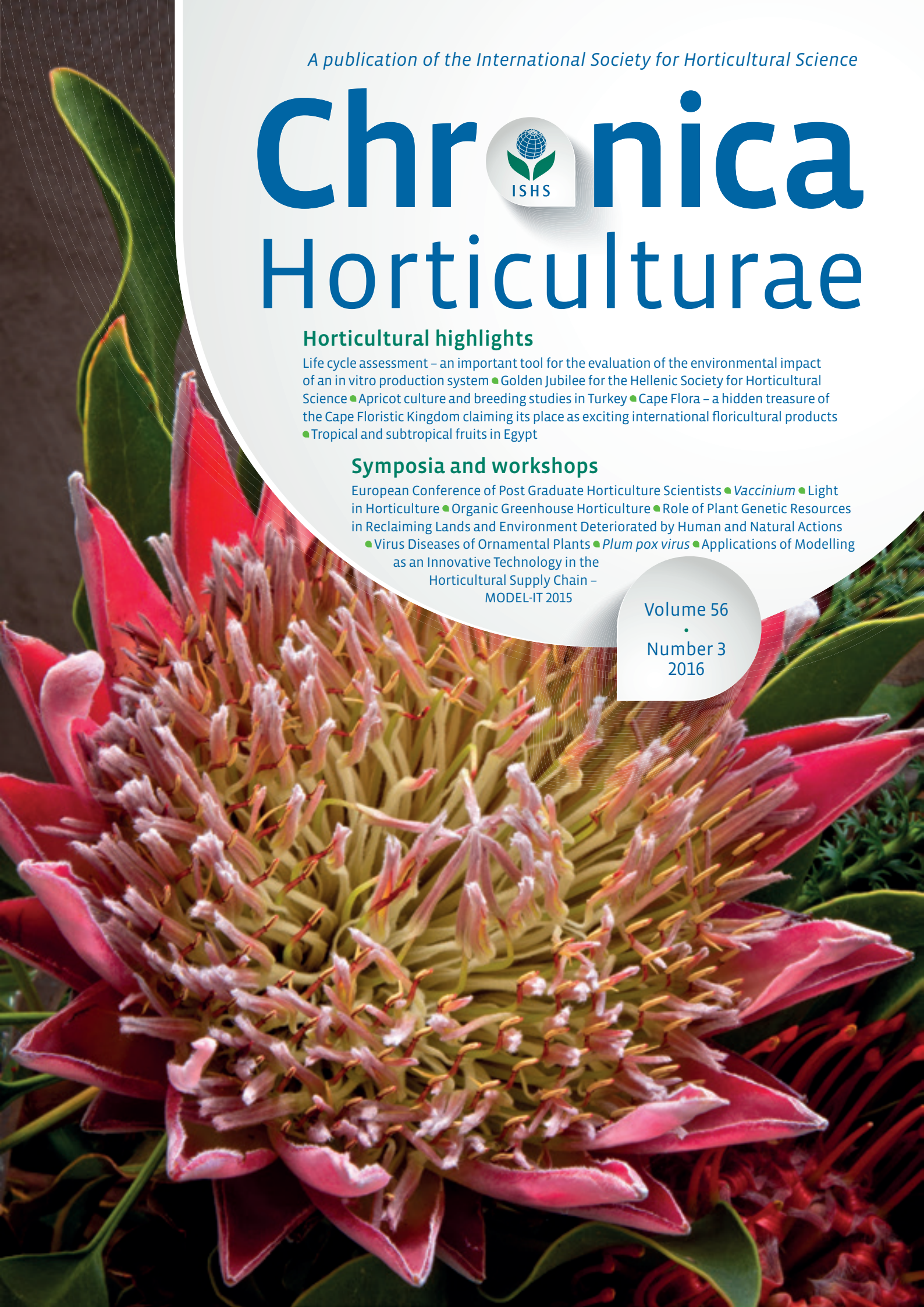
A publication of the International Society for Horticultural Science

Chronica Horticulturae



Horticultural highlights

Life cycle assessment – an important tool for the evaluation of the environmental impact of an in vitro production system • Golden Jubilee for the Hellenic Society for Horticultural Science • Apricot culture and breeding studies in Turkey • Cape Flora – a hidden treasure of the Cape Floristic Kingdom claiming its place as exciting international floricultural products • Tropical and subtropical fruits in Egypt

Symposia and workshops

European Conference of Post Graduate Horticulture Scientists • *Vaccinium* • Light in Horticulture • Organic Greenhouse Horticulture • Role of Plant Genetic Resources in Reclaiming Lands and Environment Deteriorated by Human and Natural Actions • Virus Diseases of Ornamental Plants • *Plum pox virus* • Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain – MODEL-IT 2015

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eJHS
The *European Journal of Horticultural Science* (eJHS) accepts original research articles and reviews on significant plant science discoveries and new or modified methodologies and technologies with a broad international and cross-disciplinary interest in the scope of global horticulture. The Journal focuses on applied and fundamental aspects of the entire food value chain, ranging from breeding, production, processing, trading to retailing of horticultural crops and commodities. ISHS members benefit from discounted submission fees. eJHS is available in print + online Open Access. Additional information can be viewed on **www.ishs.org/ejhs**.

Fruits
A leading scientific journal, recently acquired by the ISHS, and published from 1 January 2017 by the Society in collaboration with CIRAD. The journal includes original articles and reviews on tropical and subtropical horticultural crops. The new scope is extended to issues on crop production and cropping systems, breeding, genetics and the release of genetic material adapted to tropical and subtropical environments, management, storage and market supply of underutilized crops, integrated management of pests and diseases, clinical relevant effect of tropical and subtropical horticultural species, peri-urban and urban tropical crop production, sustainable water and input use, capacity building in horticulture, value chain development in developing countries, seed science and agricultural engineering. *Fruits,* the *International Journal of Tropical and Subtropical Horticulture*, deals with such crops as vegetables, fruits, spices, ornamentals and medicinal plants growing in the tropical and subtropical environment.

PubHort – crossroads of horticultural publications
The PubHort platform aims to provide opportunities not only to ISHS publications but also to other important series of related societies and organizations. The ISHS and its partners welcome their members to use this valuable tool and invite others to share their commitment to our profession. The PubHort eLibrary portal contains over 78,000 downloadable full text scientific articles in pdf format.
Additional information can be viewed on the PubHort website **www.pubhort.org**.

Cover photograph: King protea, national flower of South Africa (Copyright: Ehrman Photographic/Shutterstock). See article p. 22.

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› ISHS and young minds: a future-oriented relationship

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

› Jens-Norbert Wünsche

The current Board of the ISHS decided early in its term to focus on students and early career scientists. The young scientists of today will not only be the scientists of tomorrow but will also be the future leaders and caretakers of the ISHS. As a Board we are passionate about building a strong and durable, future-oriented relationship with the next generation of young scientific minds to ensure that their voices are heard and taken seriously when determining and implementing future requirements of our Society. To do this we must actively seek their opinions and engage with them in a way that is supportive and contributes to the establishment of their careers in horticulture. To this end, it is crucial that we create opportunities for young scientists so that they get enthusiastically involved in the activities of the ISHS. Consequently, we would like to report on a range of new initiatives that we are about to launch.

Harnessing the opinions of young minds
ISHS questionnaire

ISHS questionnaire – harnessing the opinions and perceptions of young minds

We have constructed a questionnaire for students and young scientists that is aimed at understanding their motives for choosing horticultural studies and their expectations of a career in horticultural science. We also seek to understand the reasons for any reluctance they may feel about becoming members of our Society and what useful activities a scientific society might be able to provide that would encourage and excite them to join. Input into the preparation of the questionnaire was provided by the Institute of Communication Science for Media Research and Media Use and Journalism at the University of Hohenheim, Stuttgart, Germany.

We are seeking to capture the opinions of students, postdocs and early career scientists (≤ 35 years of age), who are invited to participate in the online questionnaire that will be accessible from 01/10/2016 to 31/07/2017 on the website http://www.ishs.org/YoungMinds. The questionnaire will take approximately 10 minutes to complete. The majority of questions are close-ended and can be answered with a simple "yes" or "no", a single or multiple choice, or the ranking of a given answer. However, there are also a few open-ended questions that will give respondents the opportunity to briefly state their opinions. There will be three focal points. Part A includes questions about choosing a career in horticultural science. Part B concerns ISHS membership and part C requests information on personal background. All information provided will be analysed anonymously. Statistical analyses will be employed to increase the conciseness, clarity and objectivity and to identify significant outcomes. All entries will be analysed and presented as a Masters thesis and results will be published in *Chronica Horticulturae* and presented at the International Horticulture Congress in Istanbul in 2018 (IHC2018).

A random draw will be conducted of those respondents willing to leave their e-mail address. Twenty will receive a one-year ISHS membership and ten will receive an electronic tablet. Winners will be notified by email prior to 31/12/2017.

Harnessing the creativity of young minds
ISHS ideas contest

ISHS Ideas Contest – harnessing the creativity of young minds

The Ideas Contest encourages early career scientists to express their creative and forward-directed ideas and thoughts. This will result in the development of promotional material that encapsulates both the many exciting opportunities in horticultural sciences and the benefits of engaging with our Society.

Students, postdocs and early career scientists (≤ 35 years of age) will be invited to provide an inspirational video clip (≤ 5 min) that demonstrates one of the following: (a) the attraction, beauty and diversity within the horticultural sciences; (b) their motivation, and the reasons for their interest in horticultural sciences; (c) the richness of career opportunities in horticultural sciences; or (d) potential benefits of being a member of the ISHS.

The ISHS Ideas Contest will be open from 01/10/2016 until 31/07/2017. Contributions can be submitted with full contact details under http://www.ishs.org/YoungMinds. A professionally qualified and broadly based committee will evaluate all contributions. Focus will be placed on constructive, innovative solutions to overcoming existing barriers and to attracting young minds to the beauty of horticultural sciences and engagement in the ISHS. The committee will assess the following criteria: closeness of the content to reality, richness of ideas, creativity and originality, persuasiveness of arguments, appeal to other young people, feasibility and applicability to many locations/situations.

The person/group with the best contributions from each continent will be invited to join the *Norm Looney Early Scientist Task Force*, to become ambassadors of the ISHS and to work closely with the Board and Executive Committee of the ISHS. The *Norm Looney Early Scientist Task Force* will be announced at the IHC2018 in Istanbul.

Summer School – providing opportunities for young minds

Another young mind initiative is to launch a biennial ISHS Summer School for graduate students interested in one of various horticultural topics. Twenty-five students from all continents (Europe, Asia, Oceania, North and Central America, South America, Africa), restricted to a maximum of one participant per country, will study for two weeks in an exciting location for horticulture. To make this event successful, active ISHS members will be needed who are scientific experts in a particular scientific field and who are committed to teaching with academic rigour and practical training.

Students will receive a certificate of attendance and in some cases it might be possible to gain credit for the study in a degree

at their home university. Students will be selected by a panel based on (i) an application letter; (ii) a letter of motivation, outlining their interest in horticultural research and why participation in the Summer School would be of benefit to their current studies and future professional career; and (iii) a CV, including study results (transcripts) and evidence of a very good command of English, which will be the course language.

The first Summer School will be held at Lake Constance, Germany, either prior to or directly after the IHC2018 in Istanbul. This inaugural Summer School will focus on "Pre- and Postharvest Physiology of Temperate Fruit Crops" and will involve horticultural research centres in Germany and Switzerland. A series of lectures, seminars and field trips will offer specific skills, tools and knowledge on best practice management of temperate fruit throughout the value chain. The registration fee will be covered by financial contributions of participants, donors and ISHS. The German Academic Exchange Service will be contacted to provide scholarships to participants and/or direct co-funding of the study program.

First European Conference of Post Graduate Horticulture Scientists

The First European Conference of Post Graduate Horticulture Scientists (ECPHS) was held in Palermo, 12-13 May, 2016. The conference was an excellent event with about 60 doctoral students from Europe. The quality of the presentations was very high and featured good interactions between participants. It was proposed to publish a thematic issue in the eJHS in 2017 comprising voluntary contributions from some of the presenting students. The students also decided to hold this event every 2-4 years in other attractive locations in Europe.

Professor Paolo Inglese is to be congratulated on initiating this meeting and making it successful, both academically and financially, while keeping registration costs low for the students!

Concluding remarks

Three of these four new initiatives have been created by the Board of the ISHS to ensure that the structure and benefits of our Society are aligned with the mindset of students and early career scientists. We announced an additional initiative in previous editorials (*Chronica Horticulturae 55* (*4*) and *56* (*1*)), to award a certificate to the best student oral and poster presentations at every ISHS symposium, and this is already in action.

Students and early career scientists are our future and in view of the major food challenges they will face in the years ahead, we need to support and encourage them. Only as we learn their opinions, needs and perceptions can we provide tailor-made programs and opportunities that will support their growth as scientists and make ISHS membership an attractive and relevant option for them. This is a two-way dialogue. Our Society is international and can testify to the worldwide value of horticulture and to the positive and exciting career pathways that horticulture can offer. For our Society to remain effective, relevant and viable it must be flexible, able to meet the needs of its current membership but also able to embrace the young horticulturists who will face the changing times and challenges of the future.

Issues

› Threatened relocation and closure of ARO-Volcani Center in Israel

The Agricultural Research Organization, Volcani Center, of the Ministry of Agriculture and Rural Development, Israel (https://en.wikipedia.org/wiki/Agricultural_Research_Organization,_Volcani_Center; http://www.friendsofvolcani.org/) celebrates 95 years of research excellence in 2016. Originally created in 1921 for the benefit of all the residents of the land, it has long been a world renowned agricultural science research center, responsible for the vast majority of Israel's achievements in agriculture. Research groups at Volcani Center, located near Tel Aviv in central Israel, collaborate worldwide on a broad range of topics involving agriculture, horticulture and the environment, including improvements in crop and animal production, soil and water resources, and food quality, storability and safety. The overall research effort has more recently focused on ways of mitigating global warming and its already devastating effects on food and water security.

In March 2016, the Minister of Agriculture and Rural Development in Israel announced a plan to relocate the Volcani Center from its current position in the center of Israel, where it serves the needs of farmers around the country, to a development area in the northernmost part of Israel, which is home to less than 20% of Israel's agricultural production. The current central location of the Volcani Center enables daily contact with leading universities, major R&D and agri-tech companies, and production areas nationwide. Relocating the Volcani Center to a remote outpost that cannot support its activities will significant affect the ability to perform high quality leading research, cause damage to agricultural production, education and outreach in all parts of Israel and result in closing of the Volcani Center and the end to Israeli agricultural innovation as we know it today.

The majority of mayors of regional municipal councils in Israel have petitioned the government of Israel to withdraw the plan, declaring that the move will cause irreversible damage to Israel's agricultural sector and agricultural research. More than 750 scientists world-wide have signed a petition to reject the proposed move and subsequent closure of the Volcani Center (http://www.ipetitions.com/petition/petition-to-save-the-volcani-center) and more than 1200 faculty members from all research and academic institutions in Israel have signed a parallel petition in Hebrew.

The international research community can be of great help by voicing their concerns.

Support as a signatory to the above petition to reject the proposed move of the Volcani Center will be gratefully welcomed. Letters of support from institutions or individuals can be sent to Nirit@volcani.agri.gov.il.

Nirit Bernstein

› Contact

Dr. Nirit Bernstein, Scientists committee, Volcani Center, Israel, e-mail: Nirit@volcani.agri.gov.il

Spotlight on Honoured ISHS Members

› Ian James Warrington

› Ian Warrington being inducted as a Companion of the New Zealand Order of Merit (CNZM) by the Governor-General of New Zealand, The Right Honourable Sir Anand Satyanand (2011).

Position or previous position

Emeritus Professor, Massey University, Palmerston North, New Zealand

ISHS honour

Fellow and Honorary Member

1. Tell us a bit about yourself.

I am a Kiwi and an avid All Black supporter! I grew up in Hastings surrounded by horticulture in the Hawke's Bay region of New Zealand but currently live in Palmerston North – the home of Massey University. I have been married for the past 45 years to my wife Blondie and we have four children and eight grandchildren. Gardening, home decorating, furniture restoration and carpentry keep me busy in my spare time. I have also been heavily involved in the local community in areas as diverse as motor racing, swimming, and education, and have served on a number of trusts that support the local science centre, biological research, and the New Zealand Rugby Museum.

2. What got you started in a career in horticultural science?

My upbringing in the Hawke's Bay developed a strong passion for horticulture. I was surrounded by industries involved with fruitgrowing (apples, pears, stonefruit, berryfruit), vegetable processing (peas, beans, sweetcorn, beetroot, asparagus) and the nursery industry. School holidays were spent working on commercial properties in the district. Local growers and field extension staff were always keen to share their knowledge and to encourage learning in the discipline. Significantly, staff at the local horticulture division of the Department of Scientific and Industrial Research (DSIR) were always open to showing a young school boy what they were doing. I had excelled in biology at secondary school (unlike my experience with French) and that, together with immersion in the horticultural industry during my formative years, led to an undergraduate degree in horticultural science at Massey University.

3. Give a brief overview of your career/achievements.

My first research project was to design the lighting system for the New Zealand controlled environment centre (the DSIR Climate Laboratory) that was being designed at that time. It was pioneering work with regard to the use of high pressure discharge lamps in combination with quartz halogen lamps as the main lighting source, together with a water barrier in each controlled environment (CE) room to filter out the heat load. We had experimental lamps from several of the international lighting companies for evaluation and a very short time-span to do the research. This was my Masters project! The research was very successful and was largely based on achieving a close simulation of the daylight spectrum. The light intensities achieved could match peak sunlight values. I went on to become the staff member responsible for all of the biological research projects that were run in that facility over the next 25 years. The CE laboratory was world-leading in many respects, with humidity and CO_2 control in each room, the ability to simulate daylight and shade light across a wide range of quantum fluxes, and low temperature frost facilities. It hosted projects from all areas of the biological sciences within the country. It also attracted a lot of international interest with scientists visiting and working in the facilities from the USA, the United Kingdom, Japan, Australia, Germany, and Canada. My research at that time covered horticultural, agronomic, pasture, forestry and native plant species and their responses to light intensity, light quality, daylength, temperature (including low temperature stress), and carbon dioxide.

A Harkness Fellowship (1974-76) to the University of California at Davis and to Duke University in North Carolina was very significant in terms of my professional development and in putting the research in New Zealand into an international context.

The experience in the controlled environment sciences and my continuing passion for horticulture saw me taking those skills and techniques into the field to tackle industry problems. This led to a lot of research into the impacts of light on the growth and development of crops such as apples, kiwifruit and grapes. Much of this research was done in collaboration with colleagues including Dr. Stuart Tustin, Dr. David Morgan, Dr. Jill Stanley and others. A sabbatical leave in 1986 to work with Dr. David Ferree at The Ohio State University (Wooster campus) further developed my knowledge and skills and allowed further development of this pomological research.

In 1995 I was appointed Chief Executive of The Horticulture and Food Research Institute of New Zealand (HortResearch) – one of the new government-owned Crown Research Institutes. By that stage of my career I had

› Ian Warrington (right) measuring apple photosynthesis in the field with Dr. Jim Schupp (left) at the Ohio State University, Wooster, Ohio (1986).

› Ian Warrington receiving a bouquet of apples, kiwifruit and nerines from Prof James McWha (University Vice-Chancellor) after the awards ceremony for an Honorary Doctorate in Literature from Massey University (2001).

become heavily involved in administration and the appointment was a logical transition. This was a period of major science reforms in the country. Previous government departments involved with science had just been amalgamated, a competitive research grant system was introduced, and scientists were suddenly immersed in writing, securing and reporting on grant applications for their very survival. These were challenging times! It was clear that commercial imperatives would be critical to ensure a buffer against the short-term whims of funding agencies. At that time the foundations were established of a very successful royalty income for new cultivars and innovative research discoveries. These royalties now provide several millions in revenue each year for the institute. A major highlight of that period was the commercialisation of the gold-fleshed kiwifruit 'Hort16A'. Until that time, the world industry was based solely on the green-fleshed 'Hayward', which had largely become a commodity with strong competition amongst different global producers. Nonetheless, the New Zealand industry was satisfied with its position in the world and was not inclined towards diversification. Consequently, getting the new gold kiwifruit commercialised was a major challenge, and a source of considerable satisfaction when we got this started. Current gold cultivars now attract considerable premiums.

In 2002 I moved to Massey University to become Professor of Horticultural Science and, soon after, Deputy Vice-Chancellor of the university with specific responsibilities for the Palmerston North campus. This led to being acting Vice-Chancellor (President) of the university during 2008. I became an Emeritus Professor in 2010.

4. What do you consider were your greatest achievements?

I have been fortunate during my career to work with a large number of very talented people who were prepared to collaborate, share their knowledge and skills, and to contribute to all facets of the research that was undertaken. It is not by accident that the majority of my published papers are co-authored, as many of the problems that were studied often required multiple disciplines from different areas of biology in order to achieve success. My biggest rewards on a personal level have been those where research findings were adopted by industry.

My research has been recognised three times with "best journal paper" awards by the American Society for Horticultural Science. This included research with Dr. Bob Norton on plant growth and development responses to daily light integral; research on apple fruit development responses to temperature with colleagues from the Climate Laboratory; and Dr. Ben Van Hooijdonk's PhD research on the physiological basis of apple rootstock responses. Nonetheless, the research that has been cited the most is the studies into corn growth and development responses to temperature and daylength (co-authored with Dr. Ed Kanemasu).

I have particularly enjoyed editing and that has been evidenced by the publication of two major texts – "Kiwifruit Science and Management" (with G.C. Weston) and "Apples: Botany, Production and Uses" (with D.C. Ferree), the publication of a number of *Acta Horticulturae* volumes, and the co-authoring of *Scripta Horticulturae* 14 "Harvesting the Sun – A Profile of World Horticulture". Until recently, I was editor of the Journal of the American Pomological Society and am currently editor of Horticultural Reviews. The publication of the kiwifruit text was particularly satisfying as it brought together for the first time, all of the international literature on this crop that had been published up until that time.

Nurturing young people in their careers was also most satisfying, particularly seeing MS and PhD candidates, who you have supervised, graduate.

5. Did you encounter difficulties along your career path and how did you deal with them or how did you turn them into opportunities?

I entered my research career at a time when governments were strongly committed to an investment in science and scientists committed their lives to serving the communities that supported them. The introduction of competitive funding systems rapidly eroded that loyalty from scientists, led to significant growth of R&D management structures and overall threatened career paths, not just in New Zealand but in many countries around the world. Learning to deal with change is a critical skill that can help to ensure longevity in such a challenging profession.

6. Tell us about one funny/exciting/interesting experience that happened to you during your career.

The funniest experience that I have had was hearing Jill Stanley tell young staff that they

› Ian Warrington in the field with a Thai mango grower (2016).

› Ian Warrington with Norm Looney (former ISHS President), Jozef Van Assche (ISHS Executive Director) and Anna Maria D'Onghia (CIHEAM – IAM Bari) visiting a table grape research orchard in Bari, Italy, as part of an ISHS Board meeting.

would get on well with me as long as they laughed at my jokes!

7. What made you become a member of ISHS and why did you keep the membership? What contribution or role has ISHS played in your career?

Science has no boundaries internationally and no one person has a monopoly on knowledge. In order to succeed in science, cooperation and networking are essential if you are to keep at the forefront of knowledge and developments in your field of specialisation. The ISHS embodies these principles. It is non-political, it is international in scope, its activities through symposia and the related proceedings in *Acta Horticulturae* allow individual scientists to stay at the leading edge of their relevant fields of endeavour. Its range of publications present up-to-date R&D findings to the world. Joining ISHS is essential for anyone who is serious about their careers in horticultural science. The investment in annual subscriptions is trivial in terms of the benefits that are gained over time.

My first involvement in a major ISHS event was transformational to my career. The event was the International Horticultural Congress in Sydney in 1978. The professional management of the event was impressive, the scientific program was comprehensive, and as a young scientist I was given every encouragement and support in my paper and poster presentations. Being able to make personal contact with the outstanding horticultural scientists of that era had a huge impact on my confidence and ability to correspond later one-on-one with a wide cross-section of the horticultural science community globally.

I went on to serve on the ISHS Council (12 years) and Board (12 years), to be involved with the organisation of a number of ISHS symposia and their proceedings, and to co-chair the 2014 International Horticultural Congress. In all instances, these activities allowed me to interact freely with colleagues worldwide, develop skills relating to my profession as both a working scientist and as a science administrator, and to put into perspective the changes in R&D that were occurring in New Zealand relative to other countries in the rest of the world.

8. What advice would you give to young people interested in a career in horticulture/ horticultural science?

Horticultural science is a dynamic and challenging sector within the plant sciences. Finding solutions to industry problems often requires the integration of skills across different disciplines. Strengths in areas such as physics, engineering, statistics and molecular biology can complement a skill base in plant science in very rewarding and unique ways. A career in horticulture can, therefore, present interesting challenges while also providing major rewards in seeing research discoveries and new technologies being adopted by a very diverse and interesting range of industries within the sector. Surround yourself with good people, be prepared to be flexible in terms of research direction and focus, and read extensively, not just in your own discipline but in related areas. Work hard but have some fun along the way.

9. What are the most interesting new roles or opportunities you see emerging in the future within horticultural science?

Horticulture and horticultural science have always been dynamic. The changes that occur within a lifetime are huge and the rate of change is likely to accelerate. The urbanisation of societies in every country is likely to see a rapidly growing ignorance about food production, food handling/processing and global food distribution. This will need to be countered by professional public relations initiatives involving both scientists and producers. The current posturing over genetically modified crops is just the start of many similar issues that will challenge the introduction of new technologies and their application. The current dependence on cheap labour for the production, harvesting and postharvest handling of horticultural produce will be severely challenged in the immediate future. Without doubt, robotic systems will become an essential element of horticultural production. The availability of resources – not just water but key fertilisers, good soils and the range of suitable pesticides – will also become scarcer. Research will be needed to meet the increasing demand for high quality horticultural produce in the face of such limitations. What is certain is that production methods, cultivars, postharvest technologies and transport methods will be very different within a few decades than what they are now.

Horticultural Science News

Life cycle assessment – an important tool for the evaluation of the environmental impact of an in vitro production system

Inês Ferreira

Over the last decade there has been an increasing demand for natural products and plant-derived drugs, which are considered by some people to be less toxic and free from side effects when compared to synthetic drugs. With worldwide growing interest in plant derived medicines, there has been a corresponding increase in the demand for raw materials. In vitro culture technology is a suitable method for large scale production of these plants within a short period of time. Micropropagation of plants using shoot tip or axillary bud culture enables multiplication of genetically stable and true-to-type progeny. Therefore, this technique has great potential as a production system for fruits, vegetables, floriculture, silviculture and plant biotechnology. Despite the importance of in vitro plant propagation, there appear to have been no studies on its environmental impact. However, studies on agricultural systems have revealed negative environmental consequences, including global climate change and energy use, water scarcity, biodiversity loss and the spread of 'super weeds'.

Life cycle assessment (LCA) methodology provides a tool to evaluate the environmental impact of current agricultural production systems and their respective products. Consequently, it is vital to perform an LCA on in vitro plant culture technology, in order to evaluate the environmental impact of the whole production chain and identify the impact and the importance of a specific process. The creation of a partnership between Voz da Natureza and BLC3 Association was established, with the aim of identifying the impact of each process within the in vitro production process. This knowledge would enable the production of added-value products from native Mediterranean flora, which is supported by quality criteria and sustainable production indicators.

In vitro plant culture systems and their environmental impact

The increase in population and unit energy consumption has led to an overexploitation of our natural resources. The world's population continues to grow and it is predicted that it will reach about nine billion people in 2050 (Hamuda and Patkó, 2010). The demand for agricultural products will continue to grow, needing twice the production by 2050, driven by population growth and food habit changes. New eating trends favor the consumption of nutraceutical foods, following an increasing request for natural products and plant-derived drugs. Consequently, plant, cell and tissue culture systems are of growing interest for the production of structurally complex and expensive plant-derived products, especially in the pharmaceutical industry.

In vitro aseptic culture of cells, tissues, organs or plantlets under controlled nutritional and environmental conditions is often used to produce clones, by true-to-type propagation of a selected genotype. Being an important tool in both basic and applied studies, as well as in commercial applications, in vitro plant culture systems have become of major importance for the horticultural industry, as well as for large scale plant multiplication (Hussain et al., 2012). This technique can be applied to several areas: i) micropropagation of fruit cultivars and rootstocks, forest trees, ornamental plants and vegetables; ii) plant breeding for the improvement of plant crops; and iii) production of bioactive compounds with various biological activities such as antioxidant, anti-inflammatory, antimicrobial, and anti-tumoral activity. As an emergent technology, in vitro plant culture systems have had a great impact on both agriculture and industry, providing the biological material needed to respond to the ever increasing worldwide demand. Additionally, these systems have made significant contributions to the evolution of agricultural science in recent times, and nowadays, they constitute an indispensable tool for modern agriculture.

The main purpose of this work was to provide an overview of the impact on the ecosystem of in vitro culture systems, which have not been evaluated up to this date. Being one of the major sectors of agriculture worldwide, horticultural production outputs would need to increase dramatically in order to cope with the increasing demand of food, arising from population growth. The horticultural industry, however, consumes a significant amount of energy for agricultural machinery operation, irrigation, chemical use, transport and refrigerated storage. This energy consumption contributes to greenhouse gas emissions (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) (Gunady et al., 2012), meaning that population growth would cause an increase of GHG emissions from the horticultural sector.

Environmental sustainability in horticulture is no longer an option but an imperative. Therefore, it is crucial to assess the global warming potential of in vitro plant culture systems, in order to identify strategies to reduce GHG emissions. This can be successfully achieved by performing an LCA, which compiles the inputs and outputs of an in vitro culture system in order to evaluate their potential environmental impact.

Life cycle assessment

LCA is an internationally standardized methodology (ISO 14040) that determines the environmental impact of products, processes or services, through production, usage and disposal. This technique is commonly used to assess the potential environmental aspects and potential aspects associated with a product or service, by: i) compiling an inventory of relevant inputs and outputs; ii) evaluating the potential environmental impact asso-

ciated with those inputs and outputs; and iii) interpreting the results of the inventory and impact phases in relation to the objectives of the study (ISO, 2006). A measure of environmental impact most often assessed by LCA is a product's global warming potential (GWP) (Ingram and Hall, 2015).

Many companies in the horticultural industry already use LCA in the framework of sustainability. It is increasingly applied to help reduce the overall environmental burdens across the whole life cycle of horticultural products and services. LCA is also used in decision-making, product improvement and business competitiveness. In fact, LCA allows for strategic benchmarking of product system options and can therefore be used in decision-making concerning purchasing and technology investments, innovation systems, and others. LCA provides a single tool that is able to provide insights into upstream and downstream trade-offs associated with environmental pressures, human health, and consumption of resources.

How to perform an LCA: a practical example

Conducting an LCA on an in vitro plant culture technology is essential, in order to evaluate the environmental impact of an activity along the entire production chain and identify the impact and the importance of a specific process. In fact, research on agricultural systems has proved that such processes cause environmental issues, from global climate change to land use, water scarcity, water quality reduction, soil quality, biodiversity loss, and spreading of 'super weeds', among others (Notarnicola et al., 2012).

Figure 1. In vitro production system of *L. multifida*, according to Zuzarte (2012) and Sales (2013).

Goal and scope definition

During this stage, the purpose of the LCA is identified together with the expected products. The boundaries, assumptions and functional units are also defined at this time.

The goal of this study was to carry out an LCA of an in vitro plant production system, using *Lavandula multifida* as a model species (Figure 1). The functional unit was set as one plant of *L. multifida* obtained at the end of the in vitro production system. The LCA system boundary of one plant of *L. multifida* (Figure 2) was defined, considering the "well-to-wheel" analysis (IPCC, 2007), in order to assess GWP of GHG produced during the in vitro culture technology system. GHG were expressed relative to GWP of CO_2 in a standard 100-year assessment period (Ingram and Hall, 2013).

Inventory analysis

The life-cycle inventory quantifies the energy, raw material inputs and environmental releases associated with each process of production.

The "well-to-wheel" approach takes into account the inputs (e.g., electricity, diesel and water consumption) during the six processes of the product's life cycle: establishment, multiplication, elongation, rooting, acclimatization and greenhouse (Gunady et al., 2012; Zuzarte, 2012; Sales, 2013). Input products and processes were based on the in vitro production system described (data not shown). The details are listed in Ferreira et al. (in press).

Impact assessment

At this stage, an assessment is performed on the impact on human health and on the environment, associated with the energy and raw material inputs, and with the environmental releases quantified by the inventory. For the present study, the impact assessment of GWP was based on the life cycle inventory analysis. Life cycle impact assessment involved two steps: (1) calculating the impacts produced and (2) converting the emitted gases to g CO_2 equivalent (Figure 3).

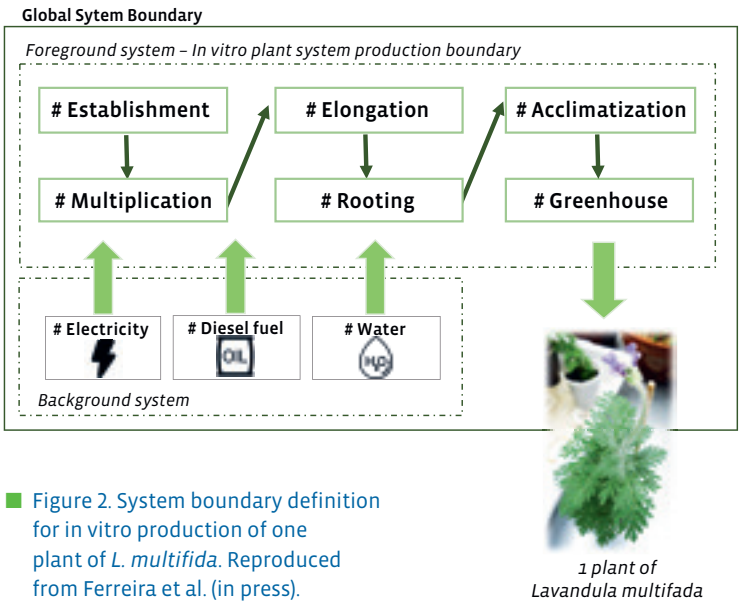

Figure 2. System boundary definition for in vitro production of one plant of *L. multifida*. Reproduced from Ferreira et al. (in press).

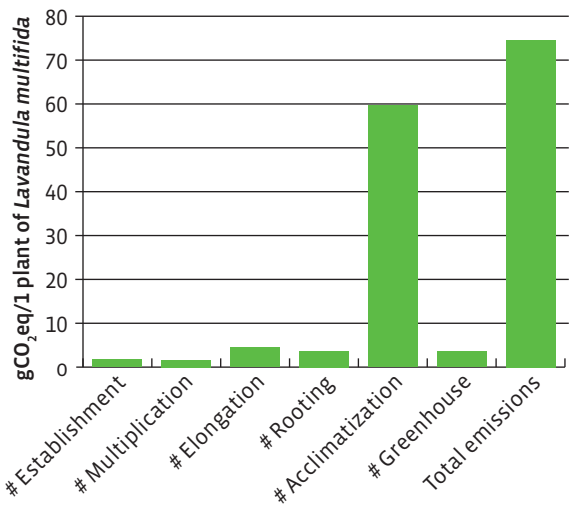

Figure 3. GHG emissions (g CO_2 equivalent) for one plant of *L. multifida*.

Interpretation

After calculating the impact for the in vitro production system of *L. multifida*, it is important to evaluate the opportunities within this system to reduce energy, material inputs, or environmental impacts, at each stage of the product's life cycle.

The production of one plant of *L. multifida* using this in vitro system caused a GWP impact of 74.61 g CO_2 eq (Ferreira et al., in press). Figure 3 illustrates the GHG emissions (g CO_2 eq) for each process, which indicated that the process with the greatest impact was acclimatization. Acclimatization was one of the most expensive processes in the in vitro culture technology in terms of the amount of energy used. In this process, there was a significant amount of energy consumption, mainly because of the use of a growth chamber. The optimization of the operational conditions of this equipment could reduce the financial and environmental costs, not only of this process but also of other processes involved in the life cycle of the analyzed in vitro production system. Therefore, it is critical to use more efficient technologies and renewable energy sources, as the use of eco-friendly solutions can allow for the optimization of highly energetic processes. One possible improvement could be the introduction of a renewable energy source for the environmental control unit. Another method could be to replace 20-W lamps used in a plant growth chamber with LED lights. It is estimated that using a 5-W LED lamp for the plant growth chamber could reduce the emissions of GHG associated with the use of light in this equipment by 68%. However, it should be noted that the classical approach for acclimatization in commercial laboratories, using tunnels in greenhouses, would be a more eco-friendly and less expensive alternative. For this reason, it would be worthwhile conducting the acclimatization process in a misted greenhouse, under plastic tunnels that are progressively opened, reducing the need and costs for temperature control using air conditioners and for artificial light.

The in vitro production system of *L. multifida* includes six processes that take seven months to complete, that is, to produce one plant of *L. multifida*. Reduction of the total production time and optimization of the in vitro production processes are essential to reduce the environmental impact.

Conclusion

This first study of the environmental impact of an in vitro plant production system will be the starting point for further research on this subject. Future research will be important to assess and compare the environmental impact of new plant species and their in vitro production systems. These findings also highlight the importance of performing an LCA on an in vitro plant production system, depending on the analyzed plant species and protocols used, in order to reduce financial and environmental impacts. In this example, the results obtained indicate that the acclimatization processes, made in a growth chamber, had the highest GHG emissions in the in vitro plant production of *L. multifida* and optimization of this step (e.g. carrying it out under plastic tunnels in a greenhouse) would have the greatest benefit.

The need for sustainable and cost effective production systems makes it necessary for the agricultural sector to provide more investment and research into current technologies used for the creation of added-value products. The work developed by Voz da Natureza and BLC3 Association aims at providing information needed to achieve this goal. The use of the LCA approach has proven to be effective as a decision supporting tool. However, other factors also need to be taken into consideration, including economic and social impacts and local environmental issues, in order to assist in identifying areas of potential improvement.

Acknowledgements

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› References

Ferreira, I., Sales, H., Rocha, B., and Nunes, J. GHG emissions life cycle assessment of an in vitro plant production system – *Lavandula multifida*. Acta Hortic. (in press).

Gunady, M.G.A., Biswas, W., Solah, V.A., and James, A.P. (2012). Evaluating the global warming potential of the fresh produce supply chain for strawberries, romaine/cos lettuces (*Lactuca sativa*), and button mushrooms (*Agaricus bisporus*) in Western Australia using life cycle assessment (LCA). Journal of Cleaner Production *28*, 81–87.

Hamuda, H.E.A.F.B., and Patkó, I. (2010). Relationship between environmental impacts and modern agriculture. Óbuda University e-Bulletin *1*, 87–98.

Hussain, A., Nazir, H., Ullah, I., and Qarshi, I.A. (2012). Plant Tissue Culture: Current Status and Opportunities (INTECH Open Access Publisher).

Ingram, D.L., and Hall, C.R. (2013). Carbon footprint and related production costs of system components of a field-grown *Cercis canadensis* L. "Forest Pansy" using life cycle assessment. J. Environ. Hort. *31* (*3*), 169–176.

Ingram, D.L., and Hall, C.R. (2015). Using life cycle assessment (LCA) to determine the carbon footprint of trees during production, distribution and useful life as the basis for market differentiation. Acta Hortic. *1090*, 35–38.

International Organization for Standardization (ISO). (2006). ISO 14040:2006(E) Environmental Management – Life Cycle Assessment – Principles and Framework.

IPCC. (2007). IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe, eds. (Japan: IGES).

Notarnicola, B., Hayashi, K., Curran, M.A., and Huisingh, D. (2012). Progress in working towards a more sustainable agri-food industry. Journal of Cleaner Production *28*, 1–8.

Sales, H. (2013). Ensaios de cultura *in vitro* e poliploidização de *Lavandula multifida* L. e *Lavandula viridis* L'Her L. Tese de Mestrado (Coimbra: Faculdade de Ciências e Tecnologia, Universidade de Coimbra).

Zuzarte, M. (2012). Portuguese lavenders: evaluation of their potential use for health and agricultural purposes. Tese de Doutoramento (Coimbra: Faculdade de Ciências e Tecnologia, Universidade de Coimbra).

History

Golden Jubilee for the Hellenic Society for Horticultural Science

George Manganaris, Miltiadis Vasilakakis, Athanasios S. Economou, Demetrios Voyiatzis, Athanasios Molassiotis and Stefanos Koundouras

Figure 1. Late Professors T. Raptopoulos (right) and I. Porlingis (left), first and second Presidents of the HSHS, respectively.

In Greece, the Hellenic Society for Horticultural Science (HSHS, www.cut.ac.cy/eeeo) is celebrating the 50th anniversary of its foundation. In 1966, on the initiative of the late Professor Thrasyvoulos Raptopoulos, twenty horticulturists from universities, research centers and governmental services created the HSHS in Thessaloniki, which became the headquarters of the Society. Dr. T. Raptopoulos, Professor of Pomology at Aristotle University of Thessaloniki (AUTh), was elected the first President and Chairman of the Board of HSHS, serving in this post until 1983. He was succeeded by the late Dr. Ioannis Porlingis, Professor of Biology of Horticultural Crops at AUTh, who devoted his life to the HSHS (Figure 1). He served as President and Chairman of the Board of HSHS for many years and, under his guidance, the Society grew and expanded all over the country. The Society is now governed by a committee (Board) of seven elected members consisting of the President, the Vice President, the Secretary General, the Treasurer and three committee members. A new Board is elected every two years.

During the first decade of the Society's life, a small number of scientific lectures were held in the classrooms of the Faculty of Agriculture in AUTh. Scientists, mainly from amongst the academic staff, who were experts on various disciplines of horticulture, were invited to speak. From 1976 onwards, the Society started organizing scientific meetings at the Faculty of Agriculture of AUTh. Meetings were organized on a small scale at first. The program was of 1-day duration and consisted of only two to four lectures given by experts in the field and were followed by discussion. The increasing membership with diverse interests made it necessary to expand these meetings to 2-day symposia, covering all possible scientific fields related to horticulture (pomology, viticulture, olericulture, floriculture, landscape architecture, etc.) (Figure 2). From 1993 onwards, the meetings evolved into 3- to 4-day congresses. The first 15 meetings took place in Thessaloniki and most of the attendees were from the Region of Macedonia, Northern Greece.

From 1993 onwards, several other major cities on the mainland and in Crete and Cyprus hosted congresses of the HSHS. The 16th meeting was the first to be organized outside Thessaloniki; it took place in Volos, Central Greece, and was the first PanHellenic congress, with scientists attending from all over Greece and Cyprus. Afterwards, all congresses of the Society were distributed to other cities, including Athens, Heraklion, Ioannina, Patra, Chania and elsewhere (Table 1). The congress takes place every two years in a different city of the country, and in Cyprus. In particular, two congresses have been organized in Cyprus, in 2001 (Larnaca) and in 2011 (Limassol). Notably, the latter attracted the highest number of delegates (330) and oral and poster presentations (276) (Figure 3). The increasing participation in these congresses is reflected in the number of papers presented over the years (Figure 4). The proceedings of the congresses and of all other activities of the Society comprise 16 volumes, some of which are in both printed and digital form.

The conveners of each biennial congress are responsible for editing the proceedings of the meeting. Over the last few years, distinguished researchers from abroad have also been invited to speak, thanks to donations/sponsorships from private companies. In the General Assembly during each congress, new Board members are nominated and the elections take place in December. The President is elected by the members of the HSHS and serves as Chair of the Board for a 2-year term, which may be renewed at the following election. To date, four professors have served as Presidents and Chairs of the Board of the HSHS (Figure 5).

In addition to the biennial national congress of the Society, 1- or 2-day workshops on special subjects of interest have also been organized by the Society. Some of these were organized in collaboration with the Goethe

Figure 2. Participants of the 11th Symposium of the HSHS, held at the premises of the Experimental Farm of Aristotle University (October 1983).

Institute in Thessaloniki (German Institute), with invited speakers from both countries, Germany and Greece (Table 2).

A milestone in the relationship between ISHS and HSHS was a joint meeting of members of the Boards of both Societies, held on April 16, 2004, at the premises of the Mediterranean Institute (CIEAM) in Chania (Crete). During that meeting, key topics of interest to both Societies were discussed and, at the same time, the Board members of the ISHS were informed about the history and the activities of the HSHS (Figure 6).

A significant number of ISHS co-sponsored international symposia have been organized in Greece (Table 3), after invitations were extended by Greek researchers at the previous symposia in a series within the regular framework of ISHS Sections, Commissions and Working Groups. Notably, in 2014, for the first time, a meeting (V Postharvest Unlimited Conference, 246 delegates from 43 countries, http://www.ishs.org/symposium/295) was

Figure 3. Participants of the 25th Congress of the HSHS during the opening session (Limassol, November 1-4, 2011, www.cut.ac.cy/horticulture).

Table 1. Host cities of congresses of the HSHS, from 1993 to 2017.

Congress no.	Year	City
16	1993	Volos (Thessaly)
17	1995	Athens (Attica)
18	1997	Thessaloniki (Central Macedonia)
19	1999	Heraklion (Crete)
20	2001	Larnaca (Cyprus)
21	2003	Ioannina (Epirus)
22	2005	Patra (Peloponnise)
23	2007	Chania (Crete)
24	2009	Veria (Central Macedonia)
25	2011	Limassol (Cyprus)
26	2013	Kalamata (Peloponnise)
27	2015	Volos (Thessaly)
28	2017	Thessaloniki (Central Macedonia)

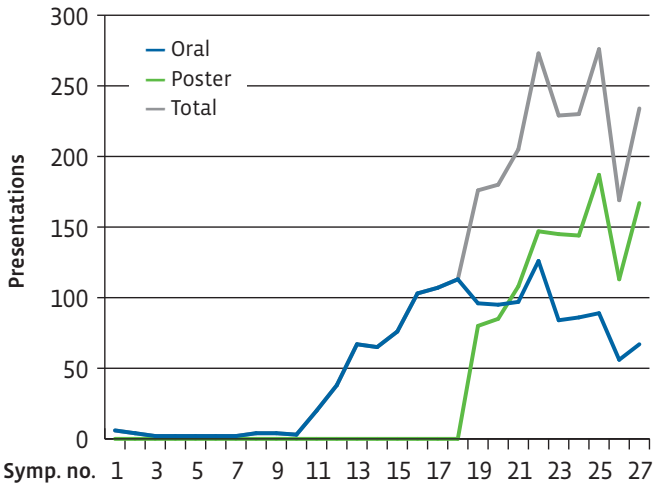

Figure 4. Number of papers presented at 27 meetings of HSHS (1976-2015).

Figure 5. Prof. A. Economou (left), former President of HSHS, presenting the HSHS honorary award to Prof. M. Vasilakakis (right), current President, at the venue of the 25th Congress (November 1-4, 2011, Limassol, Cyprus).

Figure 6. Joint meeting of ISHS and HSHS Board members in April 2004 in Chania (Crete). ISHS President in 2004, Dr. Norman Looney, is in the far right of the picture.

■ Table 2. Workshops organized by the HSHS.

No	Title	Place	Year
1	Special issues related to orchard establishment, pruning and postharvest technology of pome fruit (HSHS/Goethe Institute)	Thessaloniki	1983
2	Quality, transportation and postharvest handling of horticultural products (HSHS/Goethe Institute)	Thessaloniki-Volos-Chania	1987
3	Nurseries, mineral nutrition and cultivation techniques of fruit trees (HSHS/Goethe Institute)	Volos-Thessaloniki	1990
4	Integrated fruit production: benefits for grower, consumer, environment (HSHS/Goethe Institute)	Thessaloniki-Veria	1993
5	The role of horticulture in the well-being of the consumer (HSHS/Goethe Institute)	Thessaloniki	1996
6	Propagating material produced asexually in horticultural crops	Thessaloniki	2003
7	Sustainable fruit production in the global market	Veria	2003
8	Floral crops in Greece: production or trading?	Athens	2003
9	Alternative forms of horticulture: certified quality produces	Edessa	2004
10	Potentialities and perspectives of the Greek asparagus	Giannitsa	2004
11	The cherry tomato of the island of Santorini	Santorini	2005
12	Horticulture and international economic crisis	Thessaloniki	2010
13	The urban green areas in the sustainable development of the cities	Thessaloniki	2011
14	Modulation strategy of vegetable production in relation to market requirements	Giannitsa	2011
15	Tribute to late Professors Thrasyvoulos Raptopoulos and Ioannis Porlingis	Thessaloniki	2011

■ Table 3. International symposia of ISHS organized in Greece.

No	Acta	Symposium	Venue	Date
1	235	XIV International Symposium on Fruit Tree Virus Diseases	Thessaloniki	June 1988
2	236	V International Symposium on Small Fruit Virus Diseases	Thessaloniki	June 1988
3	287	II International Symposium on Protected Cultivation of Vegetables in Mild Winter Climates	Crete	October 1989
4	302	International Symposium on Compost Recycling of Wastes	Athens	October 1989
5	338	VI International Workshop on Fireblight	Athens	October 1992
6	379	International Symposium on Quality of Fruit and Vegetables: Influence of Pre- and Post-Harvest Factors and Technology	Chania, Crete	September 1993
7	408	International Seminar on Soilless Culture Technology Protected Crops Mild Winter Climates	Chania, Crete	October 1993
8	444	III International Symposium on Kiwifruit	Thessaloniki	September 1995
9	449	II International Symposium on Irrigation of Horticultural Crops	Chania, Crete	September 1996
10	474	III International Symposium on Olive Growing	Chania, Crete	September 1997
11	488	XI International Symposium on Apricot Culture	Veria, Macedonia	May 1997
12	541	IV International Symposium on New Floricultural Crops	Chania, Crete	May 1999
13	548	International Symposium on Growing Media and Hydroponics	Kassandra, Macedonia	August 1999
14	549	International Symposium on Composting of Organic Matter	Halkidiki, Macedonia	August 1999
15	579	II Balkan Symposium on Vegetables and Potatoes	Thessaloniki	October 2000
16	616	I International Symposium on Acclimatization and Establishment of Micropropagated Plants	Sani-Halkidiki, Macedonia	September 2001
17	661	I International Conference on Turfgrass Management and Science for Sports Fields	Athens	June 2003
18	698	VI International Symposium on Chemical and Non-Chemical Soil and Substrate Disinfestation – SD2004	Corfu	October 2004
19	850	III International Symposium on Saffron Biology and Technology: Forthcoming Challenges in Cultivation, Research and Economics	Krokos, Kozani	May 2009
20	952	International Symposium on Advanced Technologies and Management towards Sustainable Greenhouse Ecosystems - Greensys2011	Neos Marmaras-Sithonia, Halkidiki	June 2011
21		III EUFRIN Plum and Prune Working Group Meeting on Present Constraints of Plum Growing in Europe	Skopelos, Northern Sporades	August 2015
22		VI International Conference on Landscape and Urban Horticulture	Athens	June 2016

organized in Cyprus under the auspices of ISHS. The conference was a joint initiative of the Cyprus University of Technology, Department of Agricultural Sciences, Biotechnology & Food Science, and the Mediterranean Agronomic Institute of Chania. These institutions are responsible for the forthcoming III International Symposium on Horticulture in Europe, which will be held in Chania, Greece during the period of October 17-21, 2016 (http://www.ishs.org/symposium/448).

In an effort to preserve knowledge related to Greek horticulture, the HSHS undertook the task of cataloguing, in digital form, all published material (books, pamphlets, research papers) written in Greek. A total of 1655 titles have been catalogued, covering a time span of about 350 years (1650-2000 A.D.). Thus, an unfulfilled dream of the late Prof. I. Porlingis, second president of the HSHS, has been achieved. The appropriate software is in the public domain, free to use, for the benefit of all those interested in the evolution of horticultural knowledge in Greece.

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Apricot culture and breeding studies in Turkey

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Introduction

Apricots are outstanding summer fruits, with their beautiful attractive colour, delicious sweet taste, aroma and high vitamin and mineral content. Consumers can purchase and use apricots and apricot products almost year-round with diverse harvesting times, different colours, shapes, sizes and processed products. Apricots have always been considered a significant functional food source for human health in Turkey because of their high content of active compounds such as vitamin A, sugar, and minerals, and because of their phenolic content and dietary fibre. In addition to producing apricots for fresh fruit consumption, Turkey also produces various types of processed apricots, such as dried, preserved, pulp, jam, marmalade, nectar, and even pickles (Figure 1). The sweet kernels of apricot are used for cookies, and bitter kernels for cosmetics and pharmaceutical purposes.

Apricots originated from China, Central Asia and the Near East. Apricots arrived in Anatolia, and particularly in their second homeland of Malatya province, from these centres of origin via the Asian campaign of Alexander the Great or along the Silk Road. From there, apricots spread to the Balkans and Europe. Perhaps for this reason, apricots are called "*Kajszi*", "*Kajsija*" and "*Kajsi*" in various European countries, which is similar to their Turkish name of "*Kayısı*" (Faust et al., 1998).

Apricots have been produced commercially for centuries in Turkey (Figures 2 and 3) and production has been steadily increasing. According to the latest records, there are approximately 17.8 million trees, and fresh fruit production reached 700,000 t in 2015. Quite big fluctuations in fruit production have been observed over the years, mainly because late spring frosts sometimes affect the yield. For instance, the late spring frosts that occurred shortly after fruit set in 2014 resulted in significant losses and production dropped to 8,000 t that year (Table 1). The issue of spring frosts is the main factor that restricts expansion of the industry.

Figure 1. Various processed apricot products.

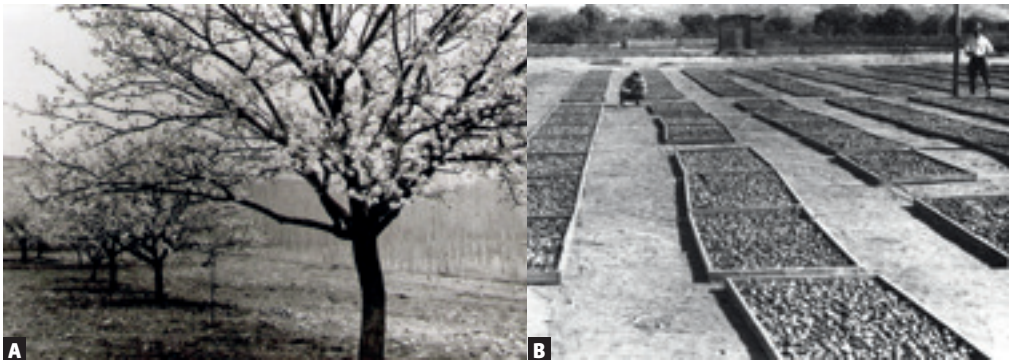

Figure 2. An apricot orchard (A) and fruit drying (B) in Malatya approximately 100 years ago.

Figure 3. A 130-year-old apricot tree in Malatya (apricot trees normally live for approximately 40-50 years).

The most important apricot production region of Turkey is eastern Anatolia. There are 123,000 ha in production, 10.3 million trees and an average of 413,000 t annual production in this region. Eastern Anatolia accounts for 59% of total production in Turkey, and the Mediterranean, Central Anatolia and Aegean regions are the other important apricot areas of Turkey (Table 2; Figures 4 and 5).

Malatya is especially suitable for dry apricot production because of its fertile soils and its climate, which includes cool winters and warm, dry summers. The majority of existing apricot cultivars in Malatya are suitable for producing dried apricots. Sixty-three percent of the trees are 'Hacihaliloğlu', 32% 'Kabaaşı' and 5% are other cultivars such as 'Soğancı', 'Hasanbey', 'Çataloğlu' and 'Zerdali' (Asma, 2011).

Figure 4. Various apricot orchards in different production areas in Anatolia: A) Malatya, B) Iğdır, C) Erzincan, and D) Nevşehir provinces.

Malatya province produces 400,000-600,000 t of fresh apricots and 100,000-150,000 t of dried apricots annually, some of which are exported (Table 3, Figure 6). Harvested at the stage that is very suitable for drying (Figure 7), high quality dried apricots are produced in Malatya, and are subsequently exported to about 100 countries (Asma, 2007).

Between 80 and 85% of the world's dried apricot exports originate from the Malatya province in Turkey. Malatya's high quality dried apricots are very well known and are preferred by consumers worldwide.

The other important apricot growing centres in Turkey are: Erzincan province, Aras Valley (Iğdır-Kağızman), Mersin province (particularly Mut district), Elazığ province, Kahramanmaraş province (especially Elbistan vicinity), Sivas, Çoruh Valley, Kayseri, Niğde, Hatay, Nevşehir, İzmir, Manisa (Salihli), Sakarya, Bilecik, Konya and Ankara provinces. In general, fresh apricots are grown in the southern and western regions, whereas dried apricot production is located in the eastern and central regions of the country. The Mut area in the Mediterranean region is well known for very early ripening apricots, and the outstanding cultivars are: 'Alyanak', 'Şam', 'Şekerpare', 'Aprikoz' ('Şalak'), 'Karacabey', 'Sakıt 2' and 'Tokaloğlu'. In the Mediterranean region, apricots are often planted together with olives in the same orchard (Figure 8).

The earliest harvests take place in the first week of May in the Mediterranean region (Mut county of Mersin province). These fresh cultivars are generally marketed domestically, although a few have been exported, mainly to European countries. Apricots grown in Malatya are harvested in July, and are generally dried in the traditional way, i.e. in the open field, although recently, advanced drying facilities are being utilised more often (Asma, 2007). The open field, traditional infrastructures for drying are still common because there is plenty of sunlight available and the humidity remains low during the drying period (Figure 9). Typically, women have become experts in the knowledge required to dry apricots for high quality products (Figure 10). The drying process is completed mostly within three to five days, and the end product is stored in suitable warehouses (Figure 11). Dried apricots are classified according to their drying types as follows: 'Şekerpare' (shaped without kernel), 'Çir' (SO_2 treated and dried with kernel) and 'Kabuk' (split into two parts with no kernel).

Turkish people love apricot trees with all of their beauties from flowers to the yellowing leaves in autumn (Figure 12). There is a very popular apricot culture associated with Turkey, especially in Malatya, where apricots are almost synonymous with the name of the city. A contest for the best quality apricot is organised every year (Figure 13), and an apricot statue has been erected by the Malatya Metropole Municipality (Figure 14).

As previously mentioned, the Turkish apricot industry is steadily growing, both in terms of overall production and in exports. Because of the suitable climatic conditions, soil and genetic resources, successful expansion of the industry in the future is anticipated.

Interest in organic products from many consumers around the world has also affected

Table 1. Fresh and dried apricot production in Turkey (TUİK, 2016; Anonymous, 2016).

Years	Fresh (t)	Dried (t)
2011	665,295	146,540
2012	776,940	187,469
2013	798,034	115,945
2014	288,520	8,210
2015	701,460	84,550

Figure 5. Geographical regions of Turkey. The region growing the greatest proportion of apricots, Malatya, is highlighted in green.

Figure 6. Apricot orchards in Malatya, the most important dried apricot centre in the world.

Table 2. The regional distribution of fresh apricot production in Turkey in 2015 (TUİK, 2016).

Regions	Area (ha)	Number of trees	Fresh apricot production (t)
Eastern Anatolia	94,673	10,346,521	412,730
Mediterranean	20,703	4,515,054	226,942
Central Anatolia	4,941	1,865,828	31,067
Aegean	1,790	698,341	13,485
South-eastern Anatolia	739	262,936	3,390
Marmara	539	339,611	6,245
Black Sea	247	193,270	1,911

Table 3. The fresh and dried apricot export figures for Turkey by years (FAO, 2016).

Years	Dried exports (t)	Dried export revenue (1000 US $)	Fresh exports (t)	Fresh export revenue (1000 US $)
2007	105,031	170,982	14,897	11,043
2008	98,178	313,496	22,101	31,968
2009	101,234	278,866	18,446	20,595
2010	92,687	350,602	25,845	26,641
2011	90,321	360,907	28,489	28,936

the Turkish apricot industry. Organic fresh and dried apricot production in Turkey dates back to the 1980s, and it has been steadily increasing. It is expected that production using Good Agricultural Practices and using organic practices will continue to increase, along with greater consumer demand for these products.

Apricot improvement studies in Turkey

Selections

Apricot breeding studies have traditionally been largely focused on selections from the rich diversity of natural flora in Turkey. Until about 30 to 35 years ago, about half of the apricot trees that were planted in commercial orchards were wild apricot types called 'Zerdali', because vegetative propagation was not widespread. For this reason, the words "*Zerdali*" and "*Hüdai*" are often used to refer to apricot trees that have been propagated directly from seed. However, over the last three decades, commercially registered cultivars have been almost exclusively used for new orchard plantings, and the 'Zerdali' population is sharply decreasing. Its share

Figure 7. Apricot fruit ready to harvest for drying.

Figure 8. Apricot and olive trees in the same orchard in the Mediterranean area of Turkey.

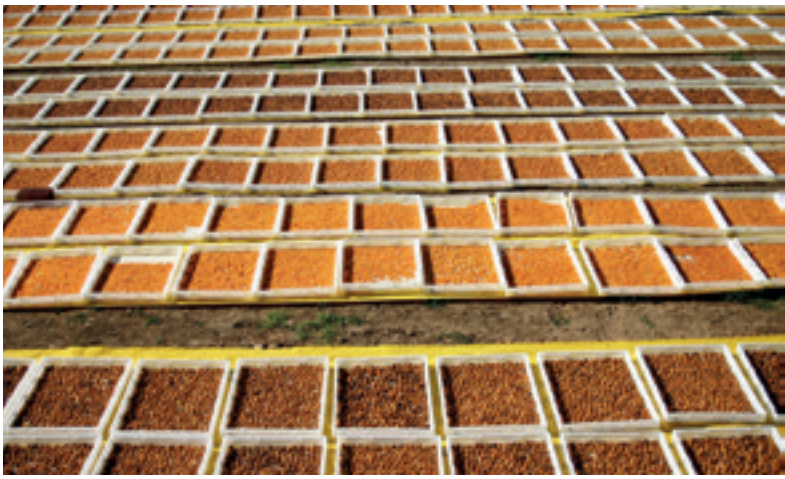

Figure 9. In Turkey fresh apricots are generally dried in open areas with direct sunlight.

Figure 10. Women are the masters of apricot drying in Turkey.

Figure 11. Dried apricots are among the rare fruit products that can be stored for a long period of time without losing nutritional value.

in Turkey is now less than 6%. For this reason, apricot improvement studies are concentrating on cross-breeding and, to some extent, advanced techniques.

The first apricot cultivar improvement program in Turkey was initiated in 1933 in the Malatya area by Professor Ülkümen, who focused on identifying morphologic, physiological and biological properties of natural apricot populations (Ülkümen, 1936). Following on from this work, the Malatya Apricot Research Station released some very successful commercial cultivars through intensive selection processes, including 'Şekerpare' and 'Alyanak' between 1941 and 1945; 'Soğancı', 'Kabaaşı', and 'Çataloğlu' between 1965 and 1971, and 'Kadıoğlu', 'Ağerik', 'Ordubat', 'Yeğen', 'Ziraat Okulu' and 'Adilcevaz' between 1974 and 1977 (Asma, 2015). Subsequently, 44 new cultivars were selected in the Mediterranean region (İskenderun, Mersin and Antalya) between 1979 and 1983. Of them, one type is extremely early (ripens on 20 April), and 15 are very early (1-15 May). A very popular apricot group called 'Sakıt'

Figure 12. The yellowing apricot leaves at autumn create a beautiful landscape.

Figure 13. Apricots selected as the highest quality at an apricot contest in Malatya.

Figure 14. Apricots are one of the most popular cultural icons of Anatolia. A 15-m tall apricot statue in Malatya.

has also been developed during this project period (Ayanoglu and Kaşka, 1995).

In addition, nine outstanding types were developed through another selection program using the local population in the eastern part of the country (Malatya and Elazığ provinces and Gürün district of Sivas province). A very interesting, extremely late ripening cultivar, called 'Levent', which requires 165-180 days to mature, was developed from this program.

Many other successful apricot selection projects have been undertaken throughout the country by various scientists from both the universities and the Ministry of Agriculture. A summary of the promising outcomes is as follows: 63 different apricot types from Malatya (Darende district), 14 late ripening types from Erzincan, a selection that has very suitable properties for drying from Elazığ (Baskil district), 28 types tolerant to late spring frosts from Van (Gevaş district), and seven drying and six fresh types in Malatya and its vicinity. All of them have been characterised and are being maintained within orchard germplasm collections.

Clonal selection studies have also been carried out. For example, in a clonal selection project implemented in Sivas (Gürün district), 17 superior clones from the 'Hacihaliloğolu' cultivar have been selected and registered (Akça and Aşkın, 1995). Seven clones from 'Kabaaşı' and 12 from 'Hasanbey' have been registered by the Apricot Research Institute in Malatya and evaluations on these clones are continuing (Anonymous, 2010).

Cross-breeding

The first cross-breeding program for apricot cultivar development was initiated at the Alata Horticultural Research Institute located in Mersin province in 1989, entitled "Table apricot variety development by cross pollination". The outcome of this project was five new registered commercial cultivars which are being propagated and planted, particularly in coastal areas. They are: 'Çağataybey', 'Çağrıbey', 'Alatayıldızı', 'Şahinbey' and 'Dr. Kaşka'.

Following this, eight promising new genotypes that are tolerant to brown rot disease (*Monilinia laxa* or *Sclerotinia laxa*) have been

developed in another collaborative program undertaken by Aegean University and Malatya Apricot Research Institute. These genotypes are suitable for both drying and fresh fruit consumption (Gülcan et al., 1999). Cross-breeding studies are being continued (Mısırlı et al., 2012). A research project titled "Development of late flowering apricots tolerant to the late spring frosts through cross-breeding" started in 1993 at the Malatya Apricot Research Institute, but, to date no selections that meet the target criteria have been identified among the 680 F_1 progeny (Şahİn et al., 2004).

Another project was initiated by the Apricot Research Centre of the Inönü University (Malatya) in 1999, with the multiple objectives of developing late ripening fresh cultivars, early and mid-season fresh cultivars, high quality dried apricot cultivars, and fresh and dried cultivars that are tolerant to Sharka disease. The first successful cultivars, 'Dilbay' and 'Eylül', have been released from this program.

Properties of some released apricot cultivars (short descriptions)

First cross-bred apricot cultivars in Turkey were developed by Dr. Ayla Yıldız within the framework of her PhD studies during the late 1980s and 1990s. Cultivars released from that program are: 'Alatayıldızı', 'Çağataybey', 'Çağrıbey', 'Dr. Kaşka' and 'Şahinbey'.

'Alatayıldızı'

Fruit weight is approximately 50 to 55 g, fruit skin and flesh are light orange in colour and fruit are firm. Soluble solids content at maturity ranges between 12.5 and 14.0%, fruit shape is elliptic and symmetrical, and kernels are freestone and elliptic but taste a little bitter. Fruits are juicy, highly aromatic, and attractive, and have a high eating quality (Bİrcan et al., 2010).

'Çağataybey'

Fruit weight at maturity ranges from 40 to 50 g, skin and flesh are orange/red in colour over the whole fruit surface. Fruit shape is elliptic and symmetrical, kernels are oval and freestone, and seeds are slightly bitter. Fruit flesh is firm, juicy, and aromatic. Both the attractiveness and the eating quality of the fruit are good. Fruit ripen in the first week of June and soluble solids content ranges between 13 and 15%.

'Çağrıbey'

Fruit weight at maturity ranges from 40 to 50 g, and soluble solids content ranges between 13.5 and 14.5%. Fruit skin and flesh are orange in colour, fruit shape is oval and symmetrical, kernels are also elliptical and freestone, and seeds are sweet. Fruit flesh is firm, juicy, and moderately aromatic, and attractiveness and eating quality of the fruit are quite good. They ripen in the first week of June (Figure 15A).

Figure 15. Some new apricot cultivars developed in Turkey: A) 'Çağrıbey', B) 'Alkaya', C) 'Dilbay', D) 'Eylül', E) 'Mihralibey'.

'Dr. Kaşka'

Fruit weight at maturity ranges from 40 to 50 g, and skin and flesh are orange in colour. Fruit shape is oblong and symmetrical, kernels are oval and freestone and seeds are sweet. Fruit flesh is firm, juicy, and moderately aromatic, and attractiveness and eating quality of the fruit are quite good. Soluble solids content ranges between 12.0 and 13.5%, and fruit ripen in the last week of May.

'Şahinbey'

Fruit weight at maturity ranges from 40 to 50 g, and skin and flesh are orange in colour. Fruit shape is oval and symmetrical, kernels are also oval and sweet but are not clingstone. Fruit flesh is moderately firm, juicy, and aromatic, and attractiveness and eating quality of the fruit are quite good. Soluble solids content ranges between 11.5 and 13.0%, and fruit ripen in the second week of June.

'Dilbay'

This is one of the early fresh apricot cultivars bred by Dr. Asma at the Apricot Research Centre in Malatya İnönü University. Fruit weight at maturity ranges from 55 to 65 g. Fruit are elliptical in shape and skin and flesh are light orange in colour. Soluble solids content ranges between 14 and 16%, fruit are medium firm and have a 30-60% red skin surface. Kernels are oval and sweet. Fruit take 80 to 83 days to ripen, and the chilling requirement is 730-840 hours (Asma, 2012) (Figure 15C).

'Eylül'

This is an extremely late ripening cultivar developed by Dr. Asma at the Apricot Research Centre at Malatya İnönü University. Fruit weight at maturity ranges from 30 to 35 g. Fruit are oval and fruit skin and flesh are yellow in colour. Soluble solids content ranges between 16 and 18 %. Fruit are medium firm and the period for their development is 150-155 days. Fruit ripen in the last week of August (Figure 15D).

'Alkaya'

This cultivar was developed through a clonal selection project carried out at the Malatya Apricot Research Institute. It is being used for both fresh and dried consumption purposes. Fruit weight at maturity ranges from 35 to 45 g and soluble solids content ranges between 22 and 24%. Fruit skin and flesh are yellow in colour, fruit are oval, firmly textured, juicy, highly aromatic, and are very attractive with excellent eating quality. Fruit ripen in the first week of July (Figure 15B).

'Mihralibey'

This cultivar was developed as part of an apricot seedling selection project carried out at the Erzincan Horticulture Research Institute. Fruit weight at maturity ranges from 30 to 35 g and soluble solids content ranges between 19-20%. Total acidity ranges from 0.50 to 0.55%, fruit skin and flesh are yellow in colour, and fruit are oval and firmly textured. Fruit ripen in the second week of September (Figure 15E).

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References

Akça, Y., and Aşkın, A. (1995). Clonal selection in apricot cultivar Hacıhaliloğlu. Acta Hortic. *384*, 169–172. http://dx.doi.org/10.17660/ActaHortic.1995.384.23

Anonymous. (2010). Project Summaries (in Turkish) (Malatya: Apricot Research Institute).

Anonymous. (2016). The provincial records of Malatya Agricultural Directorate of the Ministry of Food Agriculture and Livestock.

Asma, B.M. (2007). Malatya: world's capital of apricot culture. Chronica Hortic. *47* (*1*), 20–24.

Asma, B.M. (2011). Apricot with all aspects (in Turkish) (Ankara: Uyum Ajans).

Asma B.M. (2012). A new early-ripening apricot, 'Dilbay'. HortScience *47* (*9*), 1367–1368.

Asma, B.M. (2015). An historical perspective of apricot culture (in Turkish) (Ankara: Uyum Ajans).

Ayanoglu, H. and Kaşka, N. (1995). Apricot selection studies in the Mediterranean region of Turkey. Acta Hortic. *384*, 177–182. http://dx.doi.org/10.17660/ActaHortic.1995.384.25

Bircan, M., Pınar, H., Yılmaz, C., Paydaş Kargi, S., Kaşka, N., and Yıldız, A. (2010). The apricot breeding programme among some Turkish and foreign cultivars. Acta Hortic. *862*, 103–108. http://dx.doi.org/10.17660/ActaHortic.2010.862.15

FAO. (2016). www.fao.org.

Faust, M., Suranyi, D., and Nyujto, F. (1998). Origin and dissemination of apricot. Hort. Rev. *22*, 225–266.

Gülcan, R., Mısırlı, A., and Demir, T. (1999). A research on resistance of Hacıhaliloğlu apricot variety against *Monilinia* (*Sclerotinia laxa* Aderh et Ruhl) through cross pollination. Acta Hortic. *488*, 675–678. http://dx.doi.org/10.17660/ActaHortic.1999.488.110

Mısırlı, A., Evrenosoğlu, Y., Yolageldi, L., Yılmaz, K.U., Kokargül, R., Yiğit, T., Acarsoy., N., and Kacar, E. (2012). Studies on the Developing Resistance to Monilia (*Monilinia laxa*) by Cross-Breeding and Evaluations of the Existing F_1 Hybrid Population with respect to Resistance and Plant and Fruit Properties (in Turkish) (Ankara: TUBİTAK).

Şahin, M., Paydaş, S., Ölmez, H., Demirtaş, M.N., Altındağ, M., and Atay, S. (2004). Obtaining the late flowering and cold resistant apricot cultivars by cross-breeding (second phase, in Turkish). Project Final Report (Malatya: Apricot Research Institute).

TUİK. (2016). Turkish Statistic Council records (Ankara: TUIK). www.tuik.gov.tr.

Ülkümen, L. (1936). Studies on the Morphological, Physiological and Biological Properties of the Important Fruit Species of Malatya (in Turkish). (Ankara: Ankara Yüksek Ziraat Enstitüsü), pp.65.

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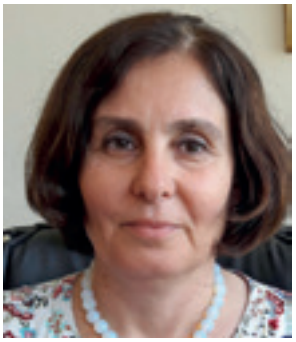

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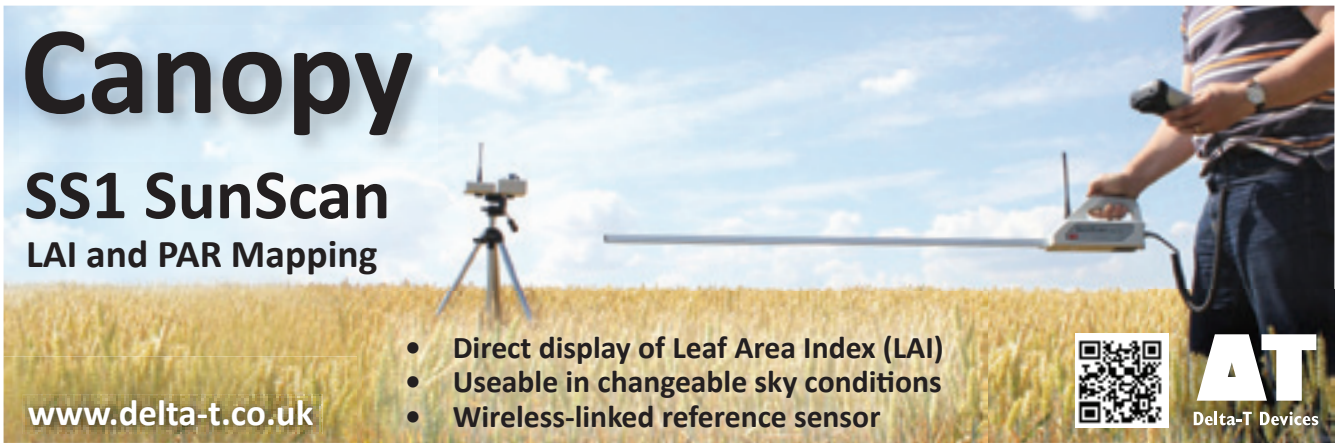

› Cape Flora – a hidden treasure of the Cape Floristic Kingdom claiming its place as exciting international floricultural products

Anton Huysamer, Karien Bezuidenhout and Lynn Hoffman

Introduction

The Cape Floristic Region (CFR) is the smallest of the six globally recognised floral kingdoms (Figure 1). Comprising a total area of only 87,892 km^2, the CFR boasts enormous biodiversity and endemism, where an estimated 70% of the region's 9000 floral species are endemic (Cowling et al., 2003). Most of this endemism is associated with the fynbos vegetation type (Haupt and Griffiths, 2008), meaning 'fine bush' or 'fine-leaved'. This term was already in common use by the 19th century, although rather misleadingly, in that most fynbos species exhibit ericoid leaves. Today, it has come to be an umbrella term, referring to the overall unique vegetation found in the southwestern Cape of South Africa. Iconic constituents include members of the floral families *Proteaceae*, *Ericaceae*, and *Restionaceae* (Reinten and Coetzee, 2002). The proteaceous element is particularly notable, not only because of its tendency to be a dominant member of these systems, but also in that it produces flower heads in an array of colours, shapes and sizes. South Africa has grown to be the leading global producer of fresh protea cut-flowers. Other floral components of the fynbos are also utilised, often as greenery and bouquet fillers, but the allure of the fynbos has always been tied to the exotic flora of *Proteaceae*.

The protea cut-flower industry has undergone enormous development within the last century, both from a national and international perspective. Originally opportunistic and supplementary products, the fynbos cut-flowers have evolved to become world renowned floricultural goods with a rich history. This article is focused on the emergence, development and current state of the South African fynbos cut-flower industry.

Figure 1. The Cape Floristic Kingdom refers to the overall unique vegetation found in the southwestern Cape of South Africa and represents the smallest of the six globally recognised floral kingdoms. Comprising a total area of only 87,892 km^2, the Cape Floristic Region boasts enormous biodiversity and endemism, where an estimated 70% of the region's 9,000 floral species are endemic (CEPF, 2016).

A history abroad

In Greek mythology, the aquatic deity Proteus had the power of physical mutability and was able to assume innumerable shapes and forms. It is from his powers that the adjective "protean" is derived, which is used to describe great "versatility" and "adaptability". In 1753, while inspecting dried specimens collected from the Cape, Carl Linnaeus witnessed the astonishing diversity of characters and colours, and so deemed it fitting to name the floral genus *Protea* after its protean traits (Blomerus et al., 2010; Janick, 2007). However, the antiquity of the floral family *Proteaceae* descends far further into the history books. The first protea ever to receive the attention of the scientific world was the Oleander-leaf protea (*Protea neriifolia*), collected in the Cape by a Dutch trade group in 1597, and then later drawn, described and published by the Dutch botanist Carolus Clusius in 1605 (Janick, 2007). Europeans were intrigued and enticed by the unique, vibrant and exotic flowers, and were drawn to the Cape to discover and describe more. For the next century, particularly after the permanent establishment of the 'Vereenigde Oost-Indische Compagnie' (United East India Company) in 1652, botanists and naturalists were ship-bound for the Cape. Honourable botanists and naturalists, such as Augustin Beaulieu, Paule Hermann and Hendrik Claudius, would often stop at the Cape en route to other colonies and collect and describe the fascinating Cape flora. Sir Hans Sloane first described the Common sugarbush (*Protea repens*) in 1693 (Janick, 2007), which was then presented to the Royal Society in London by Mr. Goddard later that year. Plukenett went on to describe the Thistle sugarbush (*Protea scolymocephala*) and King protea (*Protea cynaroides*) in 1700 (Janick, 2007), further sparking interest in the exotic beauty of the Cape flora.

As awareness of the existence of such unique flora grew, and with the increasing number of dry specimens circulating the European museums, there grew an almost frenzied compulsion to classify and categorise the

› Wild harvesting of Cape Flora. A. Mountainous natural vegetation of the Cape Floristic Kingdom termed 'Fynbos' in Afrikaans, meaning 'fine bush' or 'fine-leaved' (Photo: Anton Huysamer). B. Devastating fires during the hot summer months remain a constant threat to production units (Photo: Anton Huysamer). C. Because Cape Flora are grown within their natural distribution range, a wide variety of insect species can be found within and around the flowers, sometimes in massive quantities. This is particularly true with regard to wild harvested specimens, such as the flower depicted above. Correct sanitation procedures and spray programmes at production and postharvest stages ensure that export phytosanitary regulations are met for cultivated blooms (Photo: Anton Huysamer).
D. Many Cape Flora stems are harvested from the wild, especially as foliage products, following an assurance program for sustainability under the Sustainable Harvesting Program (Photo: Flower Valley Conservation Trust/Slingshot Media).

novel flora. Dried specimens from the Cape ended up in the hands of the reputable Carl Linnaeus (Reinten et al., 2011). Often referred to as the "father of modern taxonomy", he classified numerous specimens. By 1737, he was first to describe species under the genus *Leucadendron*, the Silver tree (*Leucadendron argenteum*) and Dune conebush (*Leucadendron coniferum*), and after publishing possibly his greatest contribution, *Species Plantarum* in 1753, had named the genus *Protea* and had already listed six proteas with use of the new binomial system (Janick, 2007). Carl Thunberg, possibly Linnaeus' most successful apostle, visited the Cape for three years from 1772 with the intention of learning Dutch and collecting plant specimens (van Sittert, 2007). He would later be given the prestigious title of "Father of Cape Botany" in 1781.

The first true cultivation of Cape *Proteaceae* outside of its natural distribution range occurred in Europe from achenes collected by Francis Masson in 1772. William Aiton successfully brought these to flower in the Royal Gardens at Kew in 1789 (Ziskovsky, 2015). About a decade later, in 1803, *Protea cynaroides* was brought to flower in the collection of the Earl of Coventry. The Englishman, Joseph Knight, was an avid botanist, who eventually mastered the cultivation of the *Proteaceae* then circulating Europe, and released the first guide to the successful cultivation of these plants titled "On the Cultivation of the Plants Belonging to the Natural Order *Proteaceae*". The largest collection of Cape Flora at the time belonged to George Hubbert, and boasted 35 species grown in the suburbs of London. Once retired, Hubbert donated his entire *Proteaceae* collection to his protégé, Joseph Knight, from which Knight established the Royal Exotic Nursery (Ziskovsky, 2015). This is the first known record of the commercial cultivation and selling of *Proteaceae* outside of the Cape.

Europeans were fond of these exotic plants, and many countries participated in their cultivation. This was not to last, as the industrial revolution of Europe in the early 1800s led to drastic changes in their cultivation systems. The introduction of steam engines as their power source gave rise to the humidity-based heating systems, an environmental factor that makes *Proteaceae* cultivation near impossible (Ziskovsky, 2015). The industrial revolution would ultimately result in the demise of *Proteaceae* production in artificial conditions in Europe for the next century.

Humble origins in the Cape

Despite the great success and subsequent failure of *Proteaceae* production abroad, South Africa remained infantile with regard to cultivation and production of its own wild flowers. The disadvantaged communities of the time collected and sold mountainous species on the street and in local markets, a practice still in existence today. European church entities created mission stations to empower local disadvantaged communities and international slaves, and these residents were the first exporters of dried wild flowers

› Cultivated production of Cape Flora. A. *Protea magnifica* selections and cultivars under cultivation at Berghoff in the Olifantsrivier mountains above the town of Porterville, at an altitude of between 850 and 1000 m above sea level. Flowering heads in the flower beds to the left are covered with paper bags to control frost and sunbird damage (Photo: Anton Huysamer). B. Year round access to good quality water is a critical element to ensure the successful cultivation of export quality Cape Flora SA products (Photo: Anton Huysamer). C. Cultivation of *Brunia albiflora* (*Bruniaceae*) provides the export market with high quality foliage (Photo: Gerhard Malan). D. Disbudding techniques are often required in *Leucospermum* spp. to extend the flowering window, in order to maximise marketing opportunities.

to the international markets of Europe in 1886 (Janick, 2007).

By 1910, the first commercial cultivation of *P. cynaroides* occurred on A.C. Buller's farm on the outskirts of Stellenbosch. The establishment of the National Botanical Gardens of Kirstenbosch in 1913 allowed for greater quantities and varieties of *Proteaceae*, and shortly after they began selling proteaceous seeds to the general public. The first commercial plantation in South Africa to be harvested was on Frank Batchelor's farm in 1948, also on the outskirts of Stellenbosch, which would later be named Protea Heights. A floral bouquet containing *P. cynaroides* was sent as a gift to Queen Elizabeth in celebration of her coronation in 1953, and is the first known export of fresh protea from South Africa to Europe.

By the early 1960s, South Africa was exporting cut flowers to Europe on a consistent basis, as the growing wealth of the European nations coupled with the drastic drop in airfreight costs promoted the market for ornamental wild flowers (Littlejohn, 2001). At the time, the majority of flowers were wild harvested because only a few pioneer cultivators of *Proteaceae* were established. The wild harvested blooms were inconsistent, often sporadic, and generally of lower aesthetic quality. Many species and variants were incorporated into the range of export flower types to ensure year-round supply (Littlejohn, 2001). Foreign markets began expecting higher quality blooms from the exporters and local suppliers, and so many of the smaller, inconsistent floras were removed from export consignments.

The industry was emerging from infancy at the same time that demand from foreign markets was growing. This meant that large-scale cultivation was becoming more and more necessary. Demand exceeded supply, but markets were demanding the higher quality, cultivated product (Gerber, 2008). Between the late 1950s and early 1970s, preferred species and "horticultural variants" were identified, and it was the development of these cultivars which truly drove the producers to convert to large-scale cultivation for both national and international sales (Littlejohn, 2001). These variants were initially chosen for their aesthetic appeal, and focused on features such as flower colour and bloom size. However, they inadvertently also selected for flowering times, productivity, and resistance to diseases and insects. Large-scale plantations enabled producers to provide year-round irrigation and chemical control of diseases and insects to their flower crops, which ultimately produced consistently high quality, desirable flowers.

The industry developed as a collaboration between producers and exporters, and much was learned and directed through trial and error. The ornamental cut-flower industry in South Africa has been fairly independent since 1993, with limited support from government for the export of wildflowers. The

› Postharvest and marketing of Cape Flora products. A. Cape Flora can provide products for a wide range of niche markets, such as those serving the dried industry (Photos: Floraland Dried Exporters). B. Proteas can be sold either as a straight line product or as bouquets. Tissue paper between high value products offers some protection during transport (Photo: Marius Huysamer). C. Cape Flora products being processed at Fynbloem, Riviersonderend for the UK and European bouquet market (Photo: Gerhard Malan). D. Floral products being evaluated by Nicole Windell, the floral technologist, at Fynbloem for their suitability to be used in floral bouquets (Photo: Jacobus Van Zyl).

industry itself was initially represented by the South African Protea Producers and Exporters (SAPPEX), an umbrella entity that represented the various sectors and stakeholders of the industry at the time. These included the Protea Producers of South Africa (PPSA), the Protea Exporters of South Africa (PEXA), the Dry Flower Exporters of South Africa (DEXA) and various smaller stakeholders such as researchers, small-scale producers and nurseries (Gerber and Hoffman, 2014).

The industry today

The production of South African *Proteaceae* occurs worldwide today. Typically, regions that experience Mediterranean or near-Mediterranean climates are more successful in large-scale production. Major production regions include Australia, Azores, California, Canary Islands, Chile, Ecuador, Hawaii, Israel, New Zealand, Portugal, and Zimbabwe (Gerber and Hoffman, 2014). A distinct difference between the protea industry in South Africa and those found around the globe is that the South African industry consists of both a cultivation sector, as well as a veld harvesting sector. The veld harvested, or flowers harvested in the wild, are obtained from the naturally occurring stands within the Western and Eastern Cape of South Africa, an area spanning approximately 200,000 ha (Gollnow and Gerber, 2015). These products may not be as consistent as cultivated products, in terms of quality and availability, but they form an important component of filler material for floral bouquets. There has been a recent spike in demand for these mixed bouquets in the UK. The CFR is under great strain and major threats to the environment include habitat loss and invasive exotic flora and fauna. Therefore, greater emphasis is being placed on sustainable practices within the veld harvesting sector. The Sustainable Harvesting Programme, functioning under the Flower Valley Conservation Trust, seeks to promote a sustainable approach to harvesting of these wild flowers, alleviating the pressure that the industry places on the already greatly threatened fynbos (Gollnow and Gerber, 2015).

Producing specialist, niche products, such as ornamentals, does pose certain challenges to growers and exporters alike. To date, the most seriously limiting factor to the South African protea export industry is the presence of insects inside cut flowers. A wide variety of insect species, estimated to be in excess of 200, associate within and around wild protea flowers (Coetzee, 1986). The presence of insects in cut flowers limits South Africa's ability to export because consignments to many foreign countries can be rejected if they fail to meet phytosanitary requirements (Wright, 2003). The protea industry does not attract the attention of the major agro-chemical companies because it is a niche product. Therefore, registered pesticides for protection of proteas remains minimal (Wright, 2003). Methyl bromide was the "go-to" pesticide until its disbandment in 2005, and so alternative, greener postharvest disinfestation methods are currently being

■ Table 1. Total area (ha) of protea production in 2012 (Ziskovsky, 2015).

Country	Area (ha)	Percentage (%) of global total
Australia	890	40.50
Azores	56	2.50
California	86	3.90
Canary Islands	60.5	2.80
Chile	20	0.90
Ecuador	36	1.60
Portugal	110	5.00
South Africa	900	40.90
Zimbabwe	41.5	1.90

investigated. These include the use of a GRAS (Generally Recognized as Safe) fumigant, as well as controlled atmosphere and temperature combination treatments, termed CATTS. Both are currently approved in other countries for application to export fruit to control phytosanitary insect pests.

There are many more issues that the industry must face to continue producing niche ornamentals. The country is currently facing a severe drought, which, coupled with a major El Nino, has serious implications for growers. Wild fires are more frequent and more intense than previously experienced because of the drought. The economic crisis of 2009 affected the industry significantly, and the effects are still felt today. Production costs are ever growing. Intensive manual input is required because automated systems are not yet feasible (Gollnow and Gerber, 2015), and rising labour costs compound this (Reinten et al., 2011). Fuel prices are increasing at rates higher than inflation, and this severely affects transport costs. Electricity costs have also increased drastically, and recently, availability has been intermittent. Whilst production costs are on the rise, exchange rates have remained steady since 2010 (Gerber and Hoffman, 2014).

Regardless of these drawbacks, South Africa is the leading protea exporting country worldwide (Table 1). The main floral products being cultivated are proteas (genus *Protea*: 59%), conebushes (genus *Leucadendron*: 17%) and pincushions (genus *Leucospermum*: 14%). The majority of flowers are exported to the European Union (EU), which receives 80% of total exports. Lately, direct sales to the United Kingdom (UK) have been on the rise, receiving another 10% of the exports. The remaining portion is exported and sold in African, Middle Eastern, North American, Eastern European and Far Eastern markets (Gerber and Hoffman, 2014). The area of cultivated production has remained steady in recent years, however, the number of stems exported is continuing to rise, particularly for *Leucospermum* (Table 2).

› Uses for Cape Flora products. A. The uniqueness of the Cape Flora provides it with speciality features ideally suited for creative floral designs (Floral design: Fayette Scherwinski, Photo: Leon Hugo). B. and C. Using *Protea cynaroides* (King protea) as a centre piece for bridal bouquets or in bridal arrangements is a firm favourite with South African brides (Photo: Nikki Meyer).

In 2014, a unified entity emerged as a result of the fusion of SAPPEX and PPSA, named Cape Flora SA. This industry body represents both producers and exporters, and provides a platform from which industry relations and communication are encouraged. Key goals include the development of an industry that: 1) produces sustainable, high quality products that are in high demand; 2) caters for

■ Table 2. *Proteaceae* export figures from 2012 to 2014 (Cape Flora SA statistics).

	Protea			*Leucadendron*			*Leucospermum*		
	2012	2013	2014	2012	2013	2014	2012	2103	2104
Total area planted hectares	661	601	595	132	143	134	200	206	201
Total number of stems exported ('000s)	2586	2744	3169	6173	6685	6611	6163	7678	9282

the needs of all its members; and 3) promotes ornamental wildflowers in foreign markets. This exciting unification of key role players in the industry brings with it the assurance of a directed and accessible industry for all involved. An increased interest in sea freight of floricultural products has allowed for larger volumes to be exported at lower prices (Gerber and Hoffman, 2014). Funding has been made available for various research projects to address key issues in the industry, such as efficient freighting, cost-effective storage and transport chains, postharvest quality longevity, as well as the ever-present phytosanitary insect issues.

The industry has come a very long way since the debut of protea in 1597. The constant challenges faced by producers and exporters alike promote an industry where innovative thinking is crucial, especially if it is to compete in the international arena. The future of the South African industry is brighter as a result of the unification of producers and exporters under a common entity, promising to not only protect the unique flora of the fynbos, but also to deliver it in a sustainable and desired manner to the world.

› References

Blomerus, L., Joshua, S., and Williams, J. (2010). Breeding *Proteaceae* varieties for changing market trends. Acta Hortic. *869*, 173–181. http://dx.doi.org/10.17660/ActaHortic.2010.869.21

Coetzee, J.H. (1986). Insects - a hazard to the protea industry. Acta Hortic. *185*, 209–216. http://dx.doi.org/10.17660/ActaHortic.1986.185.22

CEPF. (2016). http://www.cepf.net/where_we_work/regions/africa/cape_floristic_region/Pages/default.aspx (accessed June 2016).

Cowling, R.M., Pressey, R.L., Rouget, M., and Lombard, A.T. (2003). A conservation plan for a global biodiversity hotspot - the Cape Floristic Region, South Africa. Biological Conservation *112* (*1-2*), 191–216. http://doi.org/10.1016/S0006-3207(02)00425-1

Gerber, A.I. (2008). Contributions of research to the evolution of the protea industry. Acta Hortic. *805*, 15–20. http://dx.doi.org/10.17660/ActaHortic.2008.805.1

Gerber, A.I., and Hoffman, E.W. (2014). International Protea Association and current global *Proteaceae* production: achievements and challenges. Acta Hortic. *1031*, 17–28. http://dx.doi.org/10.17660/ActaHortic.2014.1031.1

Gollnow, B., and Gerber, A. (2015). International Protea Association: building on strengths and facing the demands of a dynamic international floricultural trade to secure a successful protea industry. Acta Hortic. *1097*, 73–84. http://dx.doi.org/10.17660/ActaHortic.2015.1097.8

Haupt, T.M., and Griffiths, C.L. (2008). The alien invasive land snail *Theba pisana* in the West Coast National Park: is there cause for concern? Koedoe *50*(1), 93–98.

Janick, J. (2007). Proteaceous Ornamentals: *Banksia*, *Leucadendron*, *Leucospermum* and *Protea*. Scripta Horticulturae 5 (International Society for Horticultural Science), pp.159.

Littlejohn, G.M. (2001). The Challenges of Breeding Wild Flower Cultivars for Use in Commercial Floriculture: African Proteaceae. Acta Hortic. *552*, 25–38. http://dx.doi.org/10.17660/ActaHortic.2001.552.2

Reinten, E.Y., and Coetzee, J.H. (2002). Commercialization of South African indigenous crops: aspects of research and cultivation of products. In Trends in New Crops and New Uses, J. Janick and A. Whipkey, eds. (Alexandria, VA, USA: ASHS Press), p.76–80.

Reinten, E.Y., Coetzee, J.H., and Van Wyk, B.E. (2011). The potential of South African indigenous plants for the international cut flower trade. South African Journal of Botany *77* (*4*), 934–946. http://doi.org/10.1016/j.sajb.2011.09.005

van Sittert, L. (2007). Making the Cape Floral Kingdom: the discovery and defence of indigenous flora at the Cape ca. 1890-1939. Landscape Research *28* (*1*), 113–129. http://doi.org/10.1080/01426390306529

Wright, M.G. (2003). Insect pests of *Proteaceae*: assessment of predictions of new pests internationally, and management implications. Acta Hortic. *602*, 167–171. http://dx.doi.org/10.17660/ActaHortic.2003.602.24

Ziskovsky, B. (2015). Expanding the seasonal potted plant floral market in North America with containerized *Protea cynaroides* L. Master of Professional Horticultural Studies (Department of Horticultural Science, University of Minnesota).

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› Tropical and subtropical fruits in Egypt

Ali R. El-Shereif and Doaa M. Abou Elyazid

Egypt is known as one of the oldest agricultural civilizations. Thousands of years ago, flooding of the River Nile deposited sediment in its floodplain that allowed the development of an agricultural society. Egypt lies between latitudes 21 and 31° North and longitudes 25 and 35° East with a total area of 1,001,450 km^2.

The climate in Egypt is generally moderate. It is mostly hot or warm during the day, and cool at night. In the coastal regions, daytime average temperatures range between a minimum 14°C in winter and maximum 30°C in summer. In the Egyptian deserts, temperatures vary considerably, especially in summer, when they may range from 7°C at night to 52°C during the day. Winter temperatures in the deserts do not fluctuate so wildly; they can be as low as 0°C at night, and as high as 18°C during the day. Egypt receives less than 80 mm of precipitation annually in most areas, although in coastal areas it can reach 200 mm per annum. It hardly ever rains during summer.

› Packing oranges for export at a commercial packhouse.

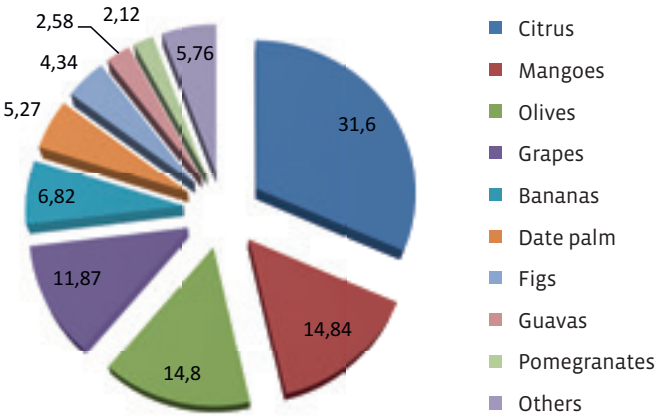


Figure 1. Cultivated areas of fruit trees grown in Egypt as a proportion of the total fruit tree area (%) in 2013 (Egyptian Ministry of Agriculture and Land Reclamation, 2014).

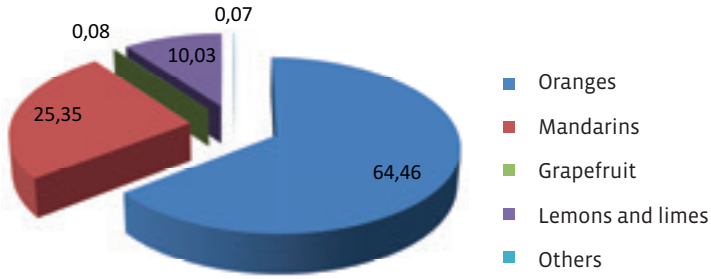


Figure 2. Proportion of production for each citrus fruit type in 2011 (Arab Agricultural Statistics Yearbook Vol. 31, 2011).

Egyptian agriculture is almost entirely dependent on irrigation. More than 90% of Egypt is desert. In 2013 the agricultural land base totaled about 3.8 million ha, which represented about 3.8% of the total area of Egypt (FAOSTAT Official data, 2013). Of this agricultural land, 676,771 ha were occupied with fruit trees, which represented 17.8% of the agricultural area (Egyptian Ministry of Agriculture and Land Reclamation, 2014). Egypt's climate has enabled successful cultivation of many tropical and subtropical fruit trees. The most important fruits are shown in Table 1. The fruit crop that covers the greatest area is citrus, followed by mangoes, olives and grapes (Figure 1).

Citrus

Citrus is a major export product of Egypt. Egypt is the sixth largest producer and the second largest exporter of oranges in the world (USDA Foreign Agricultural Service, 2014). Oranges represent around 30% of total Egyptian fruit production and about 65% of citrus production (Figure 2). Citrus is grown in almost all governorates: Delta, New Lands (Sharkia, Ismailia and Behara), Upper Egypt and Middle Egypt. The reason for the success of citrus is the suitable climatic conditions that lead to an earlier harvest than other major producers in the region. The harvest season for oranges begins in October and lasts until July depending on the cultivar. Several cultivars of citrus are grown in Egypt, including 'Baladi Orange', 'Valencia Orange', 'Blood Orange', 'Navel Orange', 'Sweet Orange' ('Sukhary'), 'Khalily Orange', 'Sour Orange', 'Egyptian Lemon' and limes. There are also small areas of other citrus such as grapefruit.

Russia, Saudi Arabia, United Arab Emirates, and The Netherlands are currently Egypt's top export destinations for citrus. Spain, South Africa and Morocco are Egypt's main competitors in the international marketplace. Other competitors include Turkey, the United States, China, Australia, and Argentina.

■ Table 1. Cultivated area and total production of the major fruit crops in Egypt (2013 estimates).

Fruit crop	Cultivated area (ha)	Total production (MT)
Citrus fruits	227523.7	1243568
Mangoes	101262.4	712537
Olives	100992.4	541790
Grapes	81006.66	1434666
Bananas	30640.26	1158224
Figs	29600.76	176595
Guavas	17593.38	315281
Pomegranates	14469	106260
Prickly-pear	1724.94	23069
Kaki	852.18	14207
Annonas	431.76	4341
Loquats	112.14	1421
Papayas	50.4	872
Kiwifruit	21	158
Avocados	3.36	38

Date palm cultivated area is not included. About 12.3 million trees are cultivated in Egypt.

■ Table 2. Number of date palms and their distribution in Egypt in 2013.

Region	No. of palm trees	Yield palm^{-1} (kg)	Total production (MT)
Lower Egypt	5174973	131.92	682665
Middle Egypt	2211388	112.32	248392
Upper Egypt	2553447	85.23	217638
Outside the valley	2356785	76.28	179773
Total	12296593		1328468

› Newly planted banana orchard outside the Nile Valley.

Dates

The date palm grows well in any arable land from the northern to the southern part of Egypt. Soft date cultivars such as 'Zaghlol', 'Bint Isha', 'El-Hayany', 'El-Amhat' and 'El-Samani' grow in Lower Egypt (North). Semi-dry dates (among the well-known cultivars are 'El-Sewi', 'El-Amry' and 'El-Aglany') are common in Middle Egypt. The semi-dry cultivars are preferred for export. Dry cultivars, which require a large amount of heat to ripen, grow in Upper Egypt. Among the well-known cultivars of dry dates are 'El-Ebremiy', 'El-Gondela' and 'El-Bartmoda'. The number of palm trees, yield palm^{-1}, total production and distribution of date palms throughout Egypt are shown in Table 2.

Mangoes

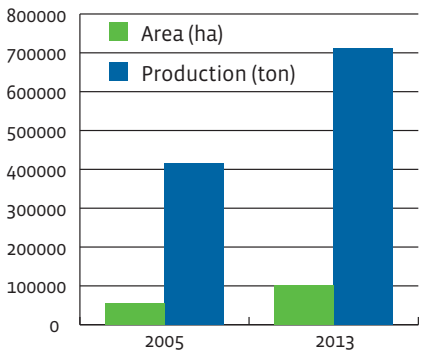
Mangoes grow well in Egypt, and are mostly grown in loamy or sandy, well-drained soils. Mangoes are ranked third in Egypt in terms of economic value, after citrus and grapes. They were first introduced from Bombay in 1825. The cultivars growing in Egypt have different origins. The cultivars 'Hindi Bicenara', 'Long', 'Ewis' and 'Mabroka' are from India and Sri Lanka, whilst 'Carrie', 'Glenn', 'Keitt' and 'Kent' are from Florida and South Africa. Moreover, local cultivars exist such as 'Zebda', 'Taimor', 'Mesk' and 'Dabsha'. Figure 3 shows the increase in area cultivated with mango and total production of mango.

Banana

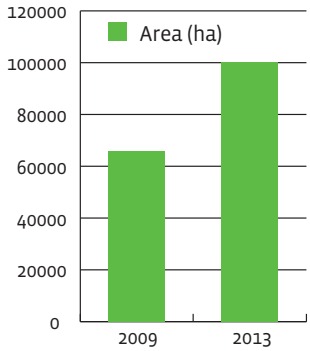
Bananas have been in Egypt for a long time. The well-known cultivars are 'Williams', 'Grandnain' and 'Maghrabi'. Recently, tissue culture became the commercial method of propagation to obtain virus-free plants. About 28% of the cultivated area is located in the El-Nobaria area and the highest yield per cultivated area is also found in this area (61.14 t ha^{-1}).

Olives

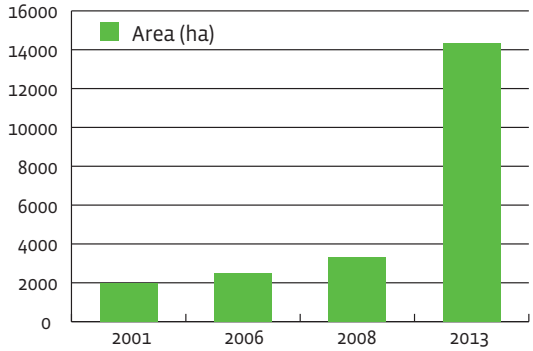
Olive trees are mostly grown in Middle Egypt, oases, and the coastal area from Alexandria to Libya. Because olives are tolerant to abiotic stresses such as drought and salinity, there



■ Figure 3. Cultivated area (ha) and total production (t) of mango in Egypt in 2005 and 2013.



■ Figure 4. Cultivated area of olives in Egypt in 2009 and 2013.



■ Figure 5. Cultivated area of pomegranate in Egypt from 2001 to 2013.

› A. Annona plantation surrounded by date palm trees, B. Fruit set due to GA_3 application as an alternative to hand pollination in the cultivar 'Abdel-Razik'.

has been a significant increase in cultivated area of olives in recent years (Figure 4).
Most olives are used for pickling, whilst almost 32% are used for oil extraction. Both table olives and oil cultivars are grown in Egypt. Among the well-known cultivars are local cultivars 'Toffahi', 'Aggezi Shami' and 'Hamed' and imported cultivars 'Mission', 'Picual', 'Coratina', 'Frantoio' and 'Manzanilla'.

Figs

Fig production occurs all over the country. In Upper Egypt, the cultivars 'Abid Asswan', 'El-Abbody' and 'El-Soltany' perform well. In the Delta, 'El-Addsy' and 'El-Abbody' are among the successful cultivars. Some new cultivars have been imported, such as 'Mission', 'Adriatic' and 'Kadota'. None of these cultivars require pollination for fruit set, which is important because the Blastophaga wasp failed to reproduce under Egyptian conditions.

› Different mango cultivars ready for sale in Kafr El-Sheikh wholesale market.

Guava

Guava was introduced from India in 1825, at the same time as mango. Since then, it has been developed through seed reproduction. Strains have been selected locally and budded or grafted. A seedless cultivar from India called 'Banaty' was imported in 1927 and has become well known. Guava cultivation is concentrated in the Lower Egypt region, especially in El-Beheira, Damietta, Kafr El-Sheikh, Alexandria and Qaliubiya governorates. The cultivated area increased from 16527 ha in 2007 to 17454 ha in 2013.

Pomegranate

The production area of pomegranates has increased rapidly during the last few years (Figure 5). Pomegranate has great potential as an export crop. Russia is currently the main export destination, and receives more than 20,000 t annually. Among the main cultivars are 'Malissi', 'Assiuty', 'Manfalouty' and 'Wonderful'. The pomegranate season runs from late July until the end of September by utilizing a range of early to late cultivars.

Annona

Annona was introduced to Egypt in the 18th century from India. However, the cultivated area has been limited (432 ha) because of an issue with poor fruit set, which necessitates artificial/hand pollination. 'Abdel-Razik', cherimoya and 'Finney' are the most common cultivars.

Conclusion

Several tropical and subtropical fruit species grow well in Egypt. The future of the Egyptian fruit industry will be mainly focused on tropical and subtropical fruits.

This has been adapted from an article that appeared in Newsletter no. 14 of the ISHS Section Tropical and Subtropical Fruits.

› References

Arab Agricultural Statistics Yearbook Vol. 31. (2011). http://www.aoad.org/eAAS-YXX.htm.

Egyptian Ministry of Agriculture and Land Reclamation. (2014). Bulletin of Economic Affairs Sector, Vol. 2, pp.325.

FAOSTAT Official data. (2013). http://faostat3.fao.org/faostat-gateway/go/to/home/E.

USDA Foreign Agricultural Service. (2014). GAIN Citrus Annual Report, Cairo, Egypt. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Forms/AllItems.aspx.

› Palm trees on the border of a citrus orchard. (A) Palm tree infected with red palm weevil showing how is it treated with pesticide, (B) small portion of the trunk remaining after healing (C).

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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

International Conference on Recent Trends in Biotechnology and Biodiversity Conservation for Sustainable Development, 25-29 October 2016, Kota Kinabalu, Sarawak, Malaysia. Info: Biotech2016 International Secretariat, No. 132, 2nd Main Rd, R R Nagar, Nagadevanahalli, Jnana bharathi, Bangalore, 560056, India, Phone: +91(080)-23212787, Fax: +91 (080) 23181443, E-mail: kkbiotech2016@gmail.com, Web: www.biotech2016.com

XXVIII Annual Meeting of the Thailand Society for Biotechnology and International Conference, 28-30 November 2016, Chiang Mai, Thailand. Info: Biotechnology Program, Interdisciplinary Program, The Gradute School, Chiang Mai University, Chiang Mai, 50200, Thailand, Phone: +66-53-942426, Fax: +66-53-942430, E-mail: TSB2016CMU@gmail.com, Web: http://tsb2016.oop.cmu.ac.th

III International Symposium on Coconut Research and Development (ISOCRAD 3), 10-12 December 2016, Kasaragod, Kerala, India. Info: Dr. K. Muralidharan, Secretary General ISOCRAD 3, ICAR-CPCRI, Kasaragod 671124, India, Phone: +914994232894/95 extn. 230, Fax: +914994232322, E-mail: isocrad3@gmail.com

› First European Conference of Post Graduate Horticulture Scientists

› Participants at the conference venue in Palermo.

The First European Conference of Post Graduate Horticulture Scientists (ECPHS) was held at the University of Palermo (Italy) on 12-13 May, 2016, as part of the activities of the Network of European Societies of Horticultural Science (NESHS) and under the auspices of ISHS. The conference was attended by 60 participants from 20 different countries, including Europe, Africa and Asia. In a very friendly environment, 20 oral presentations were given in five different sections: Plant physiology & response to abiotic factors; Plant propagation; Phytochemical constituents & quality of horticultural produce; Plant pathology, plant protection & plant-microbe interaction; and Genetic resources & molecular aspects on horticultural products. Three plenary lectures were also given by senior scientists Silvana Nicola, ISHS Vice President and Board Member, Jens Wünsche, ISHS Board Member, and Mark Rieger, Dean of the Agricultural College of the Delaware University (USA). A thematic workshop on 'Funding opportunities and hot topics in horticulture' was chaired by Prof. Boris Basile, Associate Professor of Horticulture at the University of Naples 'Federico II'.

The goal of organizing a conference for, and together with, young horticultural scientists (see *Chronica Horticulturae 55* (*3*), 13–14) was fully accomplished since the age of the participants ranged from 23 to 35. As planned, the final program, the topic of the workshop and the prize-giving were all discussed and decided by the Scientific Committee. This committee was chaired by Prof. Manganaris and Prof. Tagliavini, and comprised seven postgraduate students from the country members of NESHS, which was created by ISHS in 2012. This means that while we provided the 'hardware' for the conference, young postgraduate students were the 'software' who made it happen. Moreover, the conference had a very low budget, but with little reduction in services. The majority of the budget (6000 €) was covered by the participants' fees, which were limited to 100 € each plus 25 € for the social dinner. Private sponsors offered specialties from the local food industry, such as extra-virgin olive oil offered

› ISHS Vice President Silvana Nicola presenting the ISHS student award for the best oral presentation to Jonathan Vermeiren.

› ISHS Board Member Jens Wünsche presenting the ISHS student award for the best ePoster to Agnieszka Jasińska.

to each participant, wine, coffee, dried nuts, fresh orange juices, and strawberries. Within this small budget, we were able to cover full hospitality (lodging and meals) for the 20 oral speakers together with 3 coffee breaks, 2 lunches, congress bags with an ISHS package, and a social dinner for all participants.

Jonathan Vermeiren, Laboratory of Plant Ecology, University of Ghent, Belgium, received the award for the best oral presentation (Effects of LED assimilation lighting on everbearing strawberry plants monitored with leaf clips) and in recognition of the focus of this conference on young scientists, the award included registration fee and a contribution towards travel to one ISHS event chosen by the student, plus one year ISHS membership. Agnieszka Jasińska from Poznan University of Life Sciences, Poland, received the award for the best ePoster (Impact of composted waste paper casing in *Coprinus comatus* cultivation), which included a one year ISHS membership. Finally, because of the success and the high scientific level of the presentations, Jens Wünsche proposed that the most relevant seven ECPHS papers (selected from all oral and poster presentations) with the student as first author, be evaluated by the ECPHS Scientific Committee and then submitted to the ISHS Journal eJHS for potential publication. Students agreed that a second conference with the same conditions should be organized within two years and they indicated several locations for which they voted. ISHS will seek the opportunity to find a local convener in one of the preferred locations in the next few months. We hope the meeting helped young scientists to understand the importance of joining ISHS, because we need their enthusiasm and their willingness to follow new paths and bring new ideas into our community.

Paolo Inglese and Giorgia Liguori

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› XI International *Vaccinium* Symposium

Section Vine and Berry Fruits **#ishs_sevi**

› Symposium tour attendees at Thayer Blueberry Farms in Dundee, Florida, USA. Photo credit: Bernadine Strik.

› Dr. James Olmstead, Convener, XI International Vaccinium Symposium. Photo credit: IFAS Communications.

In 2016 we are celebrating the 100th anniversary of blueberry cultivation, and what better way to celebrate than by hosting an ISHS symposium? The University of Florida's Institute of Food and Agricultural Sciences served as host to the XI International Vaccinium Symposium on April 10-14, 2016. The location of the symposium was Orlando, Florida, USA, and highlighted the expanding subtropical blueberry industry in the Sunshine State.

Nearly 275 attendees from 30 countries gathered to learn about the latest in *Vaccinium* research. There were nearly 130 scientific presentations covering a diversity of *Vaccinum* species as well as discipline areas. The keynote address was given by world-renowned cranberry breeder and geneticist, Nicholi Vorsa from Rutgers University in New Jersey, and covered the timely topic of phytochemical compounds in *Vaccinium* species and their impact on human health.

In addition to the scientific presentations, symposium attendees took part in a day-long tour of blueberry production in central Florida. The blueberry industry in Florida grew from the pioneering work to develop low chilling requirement southern highbush blueberry cultivars at the University of Florida. Although Florida remains an important early-season source of fresh blueberries, the rapid expansion of blueberry production worldwide was also facilitated by the development of these low-chill cultivars. During the tour, participants learned about many of the challenges in growing, picking, packing,

› Symposium tour attendees at Five Star Family Growers in Auburndale, Florida, USA. Photo credit: Lori Johnson.

› ISHS student award for the best student oral presentation was given to Ms. Renee Allen (second from right) by Dr. James Olmstead (left), Dr. Bill Cline (second from left) and Prof. Dr. Bernadine Strik (right). Photo credit: Mercy Olmstead.

› ISHS student award for the best student poster presentation was given to Mr. Russell Ingram.

and marketing blueberries in a humid, subtropical environment.

The XI International Vaccinium Symposium was also the first to take part in the ISHS Student Awards. It was fitting that the topic area of both winning Ph.D. student presentations covered disease management in blueberry production in the southeastern United States. Ms. Renee Allen from the University of Georgia was awarded the best oral presentation titled "Management of Exobasidium Leaf and Fruit Spot Disease in the Southeastern United States". Mr. Russell Ingram, also from the University of Georgia, was awarded the best poster presentation titled "Symptomology and Epidemiology of Exobasidium Leaf and Fruit Spot of Blueberry". The awards were presented to the students by Prof. Dr. Bernadine Strik (Chair ISHS Section Vine and Berry Fruits), Dr. Bill Cline (former Chair ISHS Working Group Vaccinium Species), and Dr. James Olmstead (Convener). These excellent student presentations were among the many that served to enrich the symposium program.

At the ISHS business meeting, Dr. James Polashock, USA, was elected as the new Chair of the ISHS Working Group on Vaccinium Species, replacing Dr. Bill Cline, who served two terms. The members chose the location of the next meeting. The XII International Vaccinium Symposium will be held from August 30 – September 3, 2020 in Halifax, Nova Scotia and Charlotte, Prince Edward Island, Canada, and will be convened by Dr. David Percival, Dalhousie University.

James Olmstead

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ISHS

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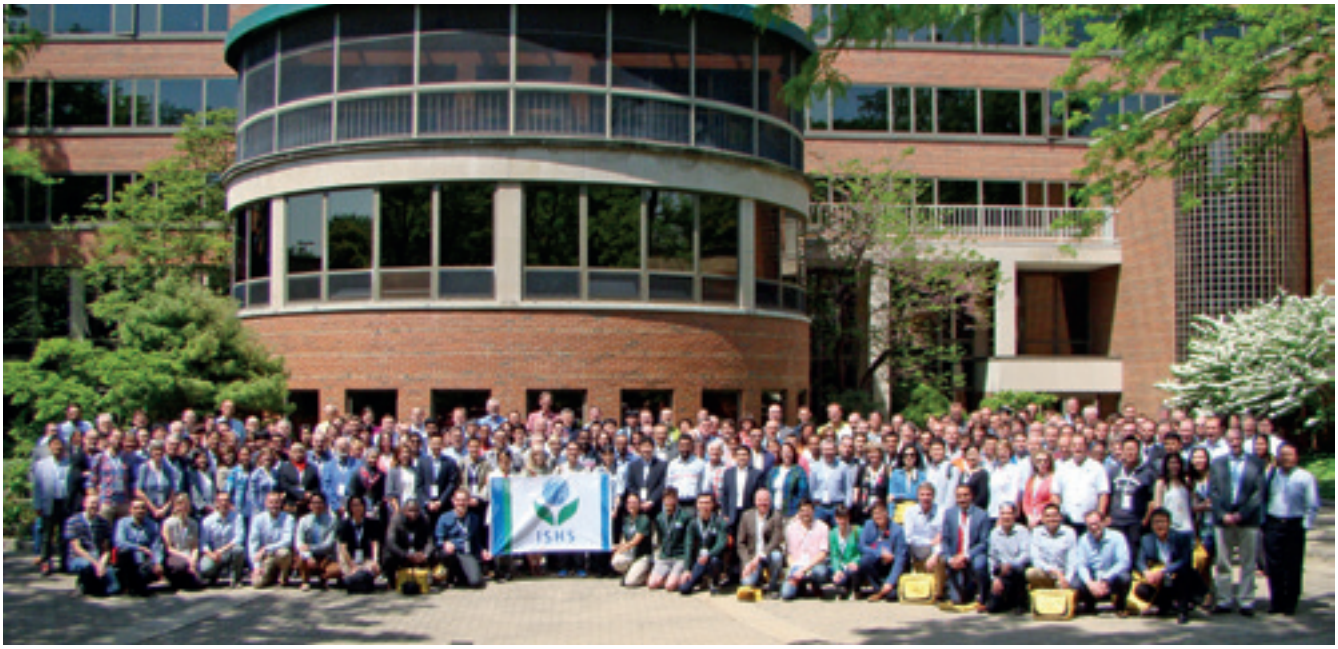
› VIII International Symposium on Light in Horticulture

Commission Horticultural Engineering #ishs_cmen
Commission Protected Cultivation #ishs_cmpc
Section Ornamental Plants #ishs_seop



› Over 250 people participated in the VIII International Symposium on Light in Horticulture in East Lansing, Michigan (USA) in May, 2016.

The VIII International Symposium on Light in Horticulture met on the campus of Michigan State University (MSU) in East Lansing, Michigan, USA from May 22 to 26, 2016. Convened by Dr. Erik Runkle and Dr. Roberto Lopez from MSU, it attracted over 250 attendees from 25 countries on 5 continents. The meeting drew scientists from academia, government agencies, and the commercial lighting industry, as well as specialty crop growers, breeders, and allied trade organizations, which allowed for a fruitful sharing of research-based information and ideas on the subject of light in horticultural systems. The symposium proceedings have already been published as ISHS *Acta Horticulturae* vol. 1134.

During the symposium, a diverse group of faculty, graduate students, other researchers and industry professionals delivered 52 oral and 78 poster presentations in concurrent sessions. The scientific program encompassed 11 oral and 3 poster sessions, with themes most relevant to current horticultural lighting research in greenhouses, growth chambers, and indoor vertical production facilities, such as light quality and optimization, lighting technologies and energy consumption, phytonutrients and growth control, coverings and pests, as well as supplemental, sole-source, and photoperiodic lighting of ornamentals and vegetables. In addition, panel discussions followed each oral session, which stimulated exchange of ideas and collaborations, generated interesting questions, and opened the door to future research directions.

Four invited speakers delivered some of the most engaging oral presentations, covering controversial and exciting topics in lighting. Dr. Bruce Bugbee from Utah State University, USA, discussed future approaches to better understanding the effects of light quality on plant growth and development. Dr. Jason Wargent from Massey University, New Zealand, talked about lighting applications outside of the visible spectrum, presenting many novel uses for ultraviolet LEDs in horticulture. Similarly, Dr. Kevin Folta from the University of Florida, USA, discussed controlling the spectrum to manipulate plant responses such as growth, flavor, and pigmentation. Lastly, Dr. Wim van Ieperen from Wageningen University, The Netherlands, explained that manipulating the lighting spectrum might expose plants to unnatural lighting conditions, resulting in unexpected negative effects. These topics, as well as the other presentations, stimulated conversation and debate as lighting concepts, technologies, and applications continue to develop and become implemented in the horticulture industry.

A total of 32 graduate students presented in the oral and poster sessions and 10 participated in the poster competition. Each participant in this competition delivered a short summary and answered questions from a panel of judges representing different areas of expertise. The winner of the ISHS student award for the best student poster presentation was Shuyang Zhen from University of Georgia with a poster on "Emerson's enhancement effect revisited: increasing photosynthetic rate and quantum yield of photosystem II with far-red LEDs". The conveners decided that the symposium would support two further student awards and organized sponsorship for this. Accordingly, Qingwu Meng from Michigan State University and Garrett Owen from Purdue University were second and third, respectively, in the poster competition.

Following the scientific program, two bus tours in west and southeast Michigan highlighted the State's diverse horticultural industry that utilizes supplemental and photoperiodic lighting to produce high-value specialty crops. Participants visited leading commercial floriculture crop producers such

as Mast Young Plants, Henry Mast Greenhouse, and Four Star Greenhouse, as well as local sites of interest such as the Fredrick Meijer Gardens, Founders Brewing Company, and the Ford Motor Company Rouge Factory, which is covered by one of the largest living roofs in the world.

This symposium would certainly not have been possible without strong industry support, with over 25 companies and organizations contributing to both sponsorship and participation in the symposium. Some of the highlighted industry-sponsored events included the welcome reception sponsored by Philips, the symposium banquet dinner sponsored by Osram Opto Semiconductors, the graduate student poster competition sponsored by DuPont Pioneer, and the post-symposium tours sponsored by Illumitex. More information on the symposium, including the program and abstract book, is available online at http://www.lightsym16.com.

Roberto Lopez and Erik Runkle

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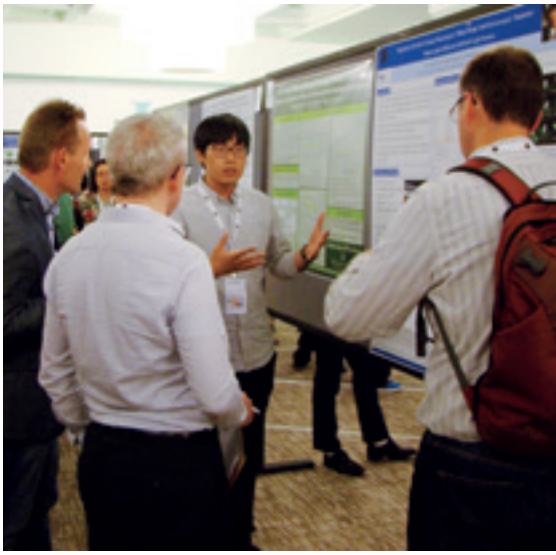
› Winners of the graduate student poster competition, Shuyang Zhen (3rd from left), Qingwu Meng (3rd from right), and Garrett Owen (2nd from left) with Conveners Erik Runkle (2nd from right) and Roberto Lopez (right) and head judge Ryan Warner (left).



› Participants viewing and discussing information presented during one of the poster sessions.

› III International Symposium on Organic Greenhouse Horticulture

Commission Organic Horticulture #ishs_cmor
Commission Protected Cultivation #ishs_cmpc
Commission Horticultural Engineering #ishs_cmen

Sustainable production systems have gained more and more importance in recent decades. Organic horticulture has doubled in the last decade because of increased consumer demand for organic fruits and vegetables. Although the worldwide organic horticulture area increases an average of 9% annually, representing around 1.9 million ha, organic horticulture in greenhouses is only 1.8% of the total greenhouse area. The organic greenhouse area is estimated to be over 8300 ha, of which 60% is in Europe. Therefore, there is a need for knowledge to encourage and support sustainable production, fair trade and consumption. Organic Greenhouse Horticulture symposia have been organized since 2010 to improve communication, exchange information and gather and disseminate all available expertise and knowledge in this area.

The III International Symposium on Organic Greenhouse Horticulture (OGH) was organized in Izmir, Turkey, on 11-14 April, 2016, by the Faculty of Agriculture of Ege University under the aegis of the International Society for Horticultural Science (ISHS), represented by the ISHS Commissions Organic Horticulture, Protected Cultivation and Horticultural Engineering, the ISHS Working Group Organic Greenhouse Horticulture and the COST Action FA1105 BioGreenhouse. It was also supported by the Ministry of Food, Agriculture and Livestock, the Turkish Society for Horticultural Science (TSHS), the Ecological Agriculture Organization (ETO) and IFOAM. As a side event, an FAO Workshop on "Good Agricultural Practices for Greenhouse Vegetables in SEE Countries" was organized on the 12th and 13th of April.

› Group photo.

The symposium was opened with an address by Prof. Dr. Y. Tüzel, Convener, who welcomed all participants on behalf of the Organizing Committee. A speech on behalf of Cost Action BioGreenhouse was given by Mr. Rob Meijer, Coordinator. Subsequently, Prof. Ayşe Gül – Chair of TSHS, Mr. Zafer Göynügür – Chair of the Ecological Agriculture Organization (ETO), Prof. Hülya İlbi – Vice Dean of Ege University, Faculty of Agriculture, and Dr. Martine Dorais – Chair of ISHS Commission Organic Horticulture, welcomed the participants. Mr. W. Baudoin, representing FAO, also welcomed the participants to the symposium and FAO workshop. After the opening ceremony, Rob Meijer, Chair of the COST Action BioGreenhouse, presented Prof. Dr. Uygun Aksoy of IFOAM International and Roger Hitchings of IFOAM-EU with a comprehensive set of publications of detailed and up-to-date knowledge on the organic greenhouse/protected sector in Europe.

There were 120 participants from 33 countries, namely Albania, Austria, Belgium, Canada, Croatia, Denmark, Egypt, Estonia, France, Germany, Greece, Hungary, Iran, Israel, Italy, Japan, Jordan, Macedonia, Moldova, Poland, Portugal, Romania, Saudi Arabia, Serbia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Turkey, United Arab Emirates, United Kingdom and USA.

In order to bring together researchers and industry stakeholders, parallel scientific and technical programs were held. Participants attended either scientific or technical sessions according to their interest. The scientific sessions addressed the topics of robust planting material, crop management and fertilization, beneficial microorganisms, soil fertility, crop health and disease/pest management, energy and greenhouse climate, and sustainability, and included eight keynote speakers, 43 oral and 36 digital poster presentations. Technical sessions focused on market and quality, resilience and sustainability, seed availability and quality, and a wide range of nursery concerns including growing media and plant health, foliar diseases, pest management, irrigation, soil fertility, compost production, use and quality, plant nutrition and irrigation in soilless OGH, energy and climate management, and sustainability. The technical sessions were chaired by moderators with presentations from scientists, advisors and the industry, and were attended by 20 to 40 people.

Among the participants, there were six PhD student candidates for the ISHS student award. The award committee, composed of the Conveners and the Chairs of three ISHS Commissions, evaluated the presentations and the ISHS student award went to Suzana Madzaric who is PhD student at CIHEAM, Bari, Italy, for the best student oral presentation, "How cultivation of agroecological services crops affects soil arthropod diversity in Mediterranean organic greenhouse horticultural production".

All participants agreed with the following concluding remarks of the symposium:

Organic horticulture has increased because of an increase in demand and interest from consumers. Premium values make organic production profitable. High consumer demand provides strong market opportunities. The increase in demand in 2014 compared to 2013 was 11 and 7.6% in US and Europe, respectively. However, the future of organic horticulture will depend to a large extent on consumer demand. In order to take advantage of this growing horticultural sector, increases in knowledge and innovation are needed. Specifically,

- Resource management (renewable energy cycling is key to reducing CO_2 footprint), tools and innovative greenhouse and cropping systems, system development, and quality. Crop protection and risk manage-

› A group in front of Ephesus library.

› ISHS student award ceremony at the farewell dinner. Dr. Murat Kacira, Chair of ISHS Commission Horticultural Engineering, presented the ISHS student award to Suzana Madzaric for the best student oral presentation.

ment are important issues for the expansion of OGH and to minimize the risks.

- Increase in food safety awareness in the supply chain is strongly needed.
- Sustainabilty of OGH should be measured and, when necessary, improved.
- There is a need for molecular research in disease monitoring of propagation material.
- Need for harmonisation of regulations governing the use of organic seeds (esp. for seed companies and nurseries).
- The limited efficacy of seed treatments is a major problem for growers.
- Plant growth-promoting rhizobacteria (PGPRs), mycorrhizal fungi and/or *Trichoderma* could be used as biostimulants and/or for their suppressive effect and/or against abiotic stresses.
- Problems originating from restricted rotations should be solved.
- Need to incorporate more biodiversity in the greenhouse production system.
- High concentration of production needs large amounts of nutrients. The gaps are
  - diversification of cropping systems;
  - nutrient inbalances and design of more balanced systems;
  - assesment of N minerilization rate of different N sources;
  - influence of soil fertility management of greenhouse gas emission (i.e. local landraces could be used as cover crops to reduce gas emissions).

  Therefore, we need more efficient use of external inputs.
- Compost is a key input in OGH in terms of soil fertility, plant growth and health. However, management of the composting process (i.e. selection of raw material) is important to obtain positive effects. The whole chain of compost production should be well managed in relation to use.
- Compost, organic amendments and solarisation play a major role in soil disease management and in building up soil fertility, although a lot still has to be done.
- Appropriate summer green manure crops could be adapted to the heat of Mediterranean conditions.
- Spent mushroom compost could be used after inoculation of PGPRs as plant biostimulants.
- Prevention of nutrient leaching and salinity demand further attention.
- The balance of different nutrients and soil amendments must account for plant needs, while maintaining focus on accumulation of nutrients and salt, and the prevention of leaching.
- Water management is a crucial topic and fertilization and irrigation management in OGH is still an open issue that requires more research.
- Soil surface should be moist in order to improve the efficiency of organic fertilizers as a base dressing.
- Mulching could be a tool to keep soil wet on the surface, and/or sprinkler irrigation could be used.
- Timeliness and the amount of water are management issues that should be improved (e.g. Decision Support System).
- Efficacy of biopesticides is often not high.
- The long process for commercialization of formulation of natural compounds is a limiting factor.
- Biological control can be a combination of augmentation and conservation of natural enemies. It does not only mean releasing natural enemies but also requires an ecosystem approach to create "standing armies". There is a strong need to further develop biological control.
- There are non-plant and plant feeding predator mites resulting in differentiation in predator establishment and biological control.
- Growers need to be educated about using biological control.
- Different factors, including greenhouse climate management, affect pest and natural enemies, resulting in better integration of climate control and disease management.
- Breeding is gradually offering more resistant cultivars.
- Economically viable methods are available for better control of the climate and for energy saving in heated greenhouses and unheated polytunnels. Passive techniques could be used to increase night temperatures and would fit well with the OGH concept.
- Energy input and CO_2 emission could be lowered in OGH by using resources more efficiently, however, this needs further research.
- Photovoltaic panels could be used to cover the electricity requirements of greenhouses and are promising tools for OGH.
- Soilless systems offer opportunities for a more balanced use of nutrients and for limiting the risk of disease in very intensive systems, however, there are different views about the organic status of this system.
- Consider the local conditions when using agroecological approaches.
- Ecologically based solutions are needed.

An evening with Turkish belly dancers accompanied the farewell dinner. ISHS medals and certificates were presented to the symposium conveners during the farewell dinner.
After the scientific and technical sessions, a one-day technical tour allowed the attendees to visit an organic farm including greenhouse vegetable production. The participants also enjoyed a visit to Ephesus antique city.

Participants from various countries expressed their appreciation to the organizers, for both the scientific quality of the presentations and the social activities. The organizers, on the other hand, would like to extend their thanks to all participants and contributors to a very fruitful and enjoyable meeting. We look forward to IHC2018.

Yüksel Tüzel and Gölgen Bahar Öztekin

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› International Symposium on the Role of Plant Genetic Resources in Reclaiming Lands and Environment Deteriorated by Human and Natural Actions

Commission Plant Genetic Resources	#ishs_cmgr
Commission Fruits and Vegetables and Health	#ishs_cmfv
Commission Irrigation and Plant Water Relations	#ishs_cmir
Commission Landscape and Urban Horticulture	#ishs_cmuh
Commission Protected Cultivation	#ishs_cmpc

› Participants of the symposium.

Introduction

The International Symposium on the Role of Plant Genetic Resources in Reclaiming Lands and Environment Deteriorated by Human and Natural Actions was conducted on 16-20 May, 2016, by the Department of Horticultural Sciences of Shiraz University, Iran, under the aegis of the ISHS Commission Plant Genetic Resources and in cooperation with the Iranian Society for Horticultural Sciences (IRSHS). The symposium was held at the College of Agriculture of Shiraz University, which was established in 1955. This college recently celebrated its 60th year of establishment and currently has 12 active departments, six different research centers, 130 academic staff, 1200 undergraduate and 500 graduate students.

Opening

At the opening ceremony, delegates were officially welcomed by Prof. Majid Ershad,

› Dr. Damiano Avanzato (second from left) and Prof. Dr. Esmaeil Fallahi (right), presenting the ISHS medal to Symposium Conveners Dr. Ali Gharaghani (center) and Prof. Morteza Khosh-Khui (second from right).

› Dr. Avanzato, Dr. Gharaghani and Prof. Khosh-Khui presenting the ISHS student award to A) Dr. Sasan Aliniaeifard from Iran for the best student oral presentation, B) Miss Fateme Khademi from Iran for the best student poster presentation.

Chancellor of Shiraz University, and by Dr. Damiano Avanzato, Chair of the ISHS Commission Plant Genetic Resources. This was followed by a report from the Organizing Committee presented by Dr. Ali Gharaghani, Symposium Convener, and a report by Prof. Morteza Khosh-Khui, Chair of the Scientific Committee.

The official opening was followed by three lectures, starting with 'Economic overview of the province with emphasis on the agriculture sector' by Dr. Mohamad Ali Afshani, Governor of the Fars province. Dr. Afshani stated that the agricultural sector is the largest economical sector of Fars province, producing about 10% of the country's agricultural products. He considered climate change, water shortages and greater dependency on underground water resources to be the most important challenges facing the agricultural sector in Fars province. The second speech entitled 'Horticulture industry in Iran' was presented by Dr. Mohammad Mehdi Ghasemi, head of the Agricultural Organization of the province. He stated that Iran has unique potential for production of horticultural crops, due to its rich and diverse climatic conditions. Dr. Ghasemi presented detailed statistics of horticultural crops in Iran, which has the 7th largest horticultural industry worldwide. He closed his talk by stating that Iran ranks first in production of pistachio and dates, second in apricots, third in walnuts and raisins, fourth in figs and almonds, and sixth in apple production worldwide. The opening session ended with the comprehensive keynote speech entitled 'Persia is the center of apple and pear diversity and this irreplaceable treasure needs to be protected' by Prof. Esmaeil Fallahi, Vice Chair of ISHS Commission Irrigation and Plant Water Relations and Research Director of Pomology and Viticulture Program at the University of Idaho, USA. He provided evidence of the richness of apple and pear genetic resources in Iran and emphasized the need to take appropriate action to preserve it.

Oral sessions

In total, 5 keynote and 33 oral presentations were given in six oral sessions as listed below:

- Modern technologies for characterization, preservation, maintenance and utilization of plant genetic resources.
- Role of plant biodiversity on food security and nutrition.
- Models of plant genetic resources for facing climate changes.
- Plant genetic resources for better management of drought, saline and infertile soils and utilization of unusual waters.
- Plant genetic resources suitable for restoring soils deteriorated by erosion, pollution and agricultural methods.
- Restoring and maintaining plant genetic resources of forests and rangeland deteriorated by human and natural actions.

Four of the oral sessions started with keynote lectures given by invited speakers. Session I began with a keynote speech, 'Spatial genetic structure of common walnut (*Juglans regia* L.) in Central Asia' by Dr. Sergio Mapelli from the Institute of Agricultural Biology and Biotechnology, National Research Council, Milan, Italy. The keynote speech of session II, entitled 'State of plant biodiversity in Iran; Developing a national strategy on conservation and use', was given by Prof. Javad Mozafari Hashjin, Director of Academic Relations and International Affairs in Agricultural Research, Education and Extension Organization (AREEO) of Iran. Dr. Damiano Avanzato was the keynote speaker of session III and the title of his speech was, 'Strategic uses of fruit tree genetic resources under water shortage conditions'. The last keynote speech, entitled 'Towards a regional approach for optimizing the use of plant genetic resources in the Near East for adaptation to climate change', was presented at the start of session IV by Prof. Lamis Chalak, Head of Plant Production Department, Lebanese University.

Dr. Sasan Aliniaeifard from the University of Tehran, Iran, received the ISHS student award for the best student oral presentation, entitled 'Natural genetic variation in stomatal response can help to increase acclimation of plants to dried environments'.

Poster session

Sixty posters were presented and discussed during the poster session and included most topics addressed in the oral sessions. Miss Fateme Khademi from Guilan University, Iran, received the ISHS student award for the best student poster presentation entitled, 'The comparison of NaCl salinity tolerance

› Visit to A) wild almond *Prunus scoparia* forest in Mian Jangal region, B) fig orchard managed in rain-fed conditions in Estahban County.

of three different olive cultivars based on growth characteristics and leaf sodium and potassium concentration'.

Round table

Because Iran is developing a national strategy on conservation and use of plant, animal and microbial genetic resources, a round table on 'Iranian national strategy for managing plant genetic resources' was organized as part of the scientific program of the symposium. At this round table, the national state of plant genetic resources was discussed, giving an overview of policies, strategies, progress and challenges affecting the conservation and use of these invaluable national plant resources.

Technical tour

During the one-day technical tour, participants visited the Maharloo pink lake. It is located 27 km southeast of Shiraz and has an area of 600 km^2. The water body of this salty lake is the exclusive habitat for the crustacean *Artemia* and the unicellular algae *Dunaliella*. This was followed by a visit to an advanced and well-managed commercial pistachio orchard in Sarvestan County. Four important Iranian commercial pistachio cultivars – 'Fandoghi', 'Kalleh-Ghouchi', 'Akbari' and 'Ahmad-Aghaei' – are produced in this orchard. Later, participants visited the Mian Jangal protected region, which is located 90 km southeast of Shiraz and covers an area of 58,125 ha. The flora of this region encompasses 325 species, 41 of which are endemic. Wild almond and pistachio species are the dominant forest trees in this region. The final destination of the technical tour was the world's largest rain-fed fig production area in Estahban County, which is located 170 km southeast of Shiraz and has an area of 23,800 ha. The fig cultivar 'Sabz' is the most famous and the dominant commercial cultivar in this region.

Social tour

A one-day tour to Persepolis and Shiraz was organized as a social activity. Persepolis, Museum of the Persepolis, Eram Botanical Garden, Hafez Tomb, Karim Khan Citadel, Vakil Mosque, Vakil Bath and Naranjestan Museum were among the visited sites on this tour.

Ali Gharaghani and Morteza Khosh-Khui

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› XIV International Symposium on Virus Diseases of Ornamental Plants (ISVDOP)

Commission Plant Protection **#ishs_cmpp**
Section Ornamental Plants **#ishs_seop**

The XIV International Symposium on Virus Diseases of Ornamental Plants (ISVDOP) was held at the National University of Singapore from 26-29 June, 2016. At the opening ceremony, Mr. Desmond Lee, Senior Minister of State for the Ministry of Home Affairs and the Ministry of National Development, was the guest-of-honor. During the symposium, invited plenary speaker, Professor Shyi-Dong Yeh from National Chung Hsing University, Taiwan, gave a lecture on marker-free transgenic approaches for generating resistant plants. There were 20 oral and 20 poster presentations. Topics of discussion included virus detection and characterization, diagnostic techniques, epidemiology and disease control, new and emerging diseases, viroids and phytoplasmas, and virus resistance through breeding of transgenic methods. The

› Participants of the symposium.

› Dr. Dag-Ragnar Blystad (Convener of the XIII ISVDOP) presenting the ISHS medal award to Dr. Sek-Man Wong (Convener of the XIV ISVDOP).

› ISHS student awards presented to A) Ms. Yoon-Hyun Bang for the best student oral presentation and B) Ms. Chung-Hwa Park for the best student poster presentation.

application of deep sequencing to find viruses that cause disease symptoms of unknown etiology will become a powerful method for virus detection and characterization. At the XIII ISVDOP, the deep sequencing technique was introduced and discussed. At the XIV ISVDOP, the Netherlands group described their use of the technique to identify a non-described virus in *Dracaena surculosa*.

The ISHS student awards for both the best oral and the best poster presentation were awarded to students from Seoul Women's University. Ms Yoon-Hyun Bang received the award for the best student oral presentation, "Characterization and genome sequence analysis of Lychnis ringspot virus", and Ms Chung-Hwa Park for the best student poster presentation, "Multiplex PCR assay for simultaneous detection of five different Potexviruses in cactus plants". Field trips to Singapore Botanic Gardens, Gardens-by-the-Bay, Temasek Life Science Laboratory/NUS Museum and Lee Kong Chian Natural History Museum were conducted. At the symposium dinner, Dr. Dag-Ragnar Blystad (Convener of the XIII ISVDOP) presented the ISHS medal award to Dr. Sek-Man Wong (Convener of the XIV ISVDOP).

› Field trip to Singapore Botanic Gardens.

During the ISHS business meeting, Dr. Tatiana Mitiouchkina from Nikitsky Botanical Gardens, Russia, was elected Chair of the ISHS Working Group Virus Diseases of Ornamentals.

Photos and program details can be found at the symposium website available at http://www.ishs.org/symposium/489

Sek-Man Wong

› Contact

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› III International Symposium on *Plum pox virus*

Commission Plant Protection Section Pome and Stone Fruits

#ishs_cmpp #ishs_sefr

Sharka, caused by *Plum pox virus* (PPV), is the most devastating viral disease of *Prunus* spp. The establishment of these meetings on PPV was motivated by the need for breeders and virologists to coordinate their fight against this disease and to discuss and exchange results of research in this field. The first "Middle European Meeting on *Plum pox virus*" was organized in 1994 in Prague as part of the 13th Czech and Slovak Plant Protection Conference. Since that time, the meeting has been organised regularly in different Middle European countries. Subsequent PPV meetings were organized in Austria in 1995, Hungary in 1996, Slovakia in 1998, Romania in 2001, Poland in 2004 and Croatia in 2007. The meetings were named "Middle European Meeting on PPV" from 1994 to 2001. The name was then changed to "European Meeting on PPV" for the meetings held in Poland in 2004 and Croatia in 2007. The first International Symposium on *Plum pox virus* was organized in Sofia, Bulgaria, in 2010, followed by the II International Symposium on PPV in Olomouc, Czech Republic, in 2013. Twenty-two years after the first PPV meeting, the III International Symposium on *Plum pox virus* was held for the first time in Antalya, Turkey, from 9-13 May, 2016. The symposium was jointly organized and convened by Prof. Kadriye Caglayan, Mustafa Kemal University, Antakya, and Assoc. Prof. Birol Akbas, General Directorate of Agricultural Research and Policies, Department of Plant Health Research, Ankara. The symposium was very successful and attracted 48 delegates from 13 different countries. Moreover, 24 oral communications were presented, with an additional 18 poster presentations. A full day was devoted to a field trip and sightseeing.

› Participants of the symposium.

› Symposium Conveners Birol Akbas (left) and Kadriye Caglayan (right) receiving the ISHS medal award from David Hunter, Chair ISHS Commission Plant Protection.

› Kadriye Caglayan (left), David Hunter (second from right) and Michel Ravelonandro (right) presenting the ISHS student award to Maryam Ghaderi (second from left) from Turkey for the best student oral presentation.

At the opening ceremony of the symposium, Prof. Caglayan expressed a cordial welcome to all participants. Dr. David Hunter, Chair of the ISHS Commission Plant Protection, and Dr. Michel Ravelonandro, Chair of ISHS Working Group Sharka, also welcomed the participants. They were followed by invited speaker Dr. Seyhan Kurcman from Turkey. Dr. Kurcman was one of the first scientists to carry out basic research on PPV in Turkey. She reviewed the past, present and future of PPV in Turkey together with Prof. Caglayan. Her presentation focused on the first survey studies of PPV in Turkey and then Prof. Caglayan explained the recent studies relat-

ed to epidemiology and PPV resistance studies in the country.

Four oral sessions and one poster session were held during the symposium. In the first oral session on PPV resistance, invited speaker Dr. Véronique Decroocq from France talked about the potential of the wild *Prunus* genepool to provide resistance to sharka. Other papers presented during this session discussed the possibility of controlling sharka disease by using artificial miRNA and small interfering RNAs, and also *Agrobacterium*-mediated transformation of PPV genes to *Nicotiana benthamiana*.

The second session on PPV detection tools started with the presentation of invited speaker Dr. Sebastien Massart from Belgium, who explained the current impact and future directions of high-throughput sequencing in plant virology. Most papers in this session concentrated on development and improvement of detection technologies to control sharka disease.

The papers presented during the third session on PPV distribution, diversity and epidemiology were mainly on strategies to manage PPV transmission in *Prunus* orchards, full genome analysis of some PPV strains and new PPV outbreaks in different countries. In this session Prof. Mariano Cambra from Spain gave an invited speech entitled "The guilty of sharka epidemics: specialized nonpersistent aphid female vectors". He underlined the key role of aphids in sharka epidemiology.

› Technical visit to Expo 2016.

› Technical visit to a nectarine orchard in Antalya.

In the last session on PPV control and management, Dr. Delano James from Canada was the invited speaker. He gave an interesting overview of recent perspectives on strategies for controlling the spread of PPV. He informed delegates that strategies for effectively controlling the spread of PPV must include simple, accurate and effective diagnostics that should be a part of any quarantine program, survey activity, or phytosanitary certification program.

In the poster session, 18 posters were presented showing results from very different fields of research, including distribution, diversity and epidemiology of PPV, but also PPV resistance, detection tools and control strategies.

Student participation is always important at a meeting like this. Eight students participated by giving either oral or poster presentations. From 2016 onwards ISHS decided to present "Student Awards" at every ISHS symposium. It was a great pleasure for us to give the ISHS Student Award to Maryam Ghaderi, who is a PhD student at Erciyes University, Turkey, for her oral presentation titled "*Agrobacterium*-mediated transformation of *Plum pox virus*-T genes to *Nicotiana benthamiana*".

The technical tours included a visit to Western Mediterranean Agricultural Research Institute (BATEM), where their program on production of citrus and temperate fruit trees was presented. Afterwards a nectarine orchard was visited and evaluated for PPV symptoms. At the end of the technical tour, Expo 2016 – an international horticultural exposition in Aksu-Antalya – was also visited. The motto of Expo 2016 is "A Green World for the Next Generation". The Expo fairground covers an area of 1,121 da (11,213 m^2) which has been planted with around 25,000 green plants representing 120 species.

In the evening, the gala dinner provided fun and an informal atmosphere to bring together researchers and students. The evening included a tasting of Turkish rakı and other Turkish wines, music and dances. As usual the dinner provided an opportunity for much networking across the international PPV community.

During the symposium, the ISHS business meeting was held, chaired by the ISHS representative, Dr. David Hunter. At the meeting, participants agreed that the next symposium would be held in Ljubljana (Slovenia) in 2019, organized by Dr. Mojca Virscek Marn from the Kmetijski Institute. Afterwards, ISHS medals were awarded to Prof. Caglayan and Assoc. Prof. Birol Akbas in recognition of their meritorious service to the Society as Conveners of the symposium.

During the closing ceremony, the Symposium Conveners thanked Dr. David Hunter, Dr. Michel Ravelonandro, the invited speakers, the participants and all members of the Organizing Committee.

Kadriye Caglayan

› Contact

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› V International Symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain – MODEL-IT 2015

Commission Quality and Postharvest Horticulture **#ishs_cmph**

› Participants of the symposium.

The fifth Model-IT symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain (www.ishs.org/symposium/538) was held on October 11-14, 2015 and organised by the groups Horticulture and Product Physiology, Biometris and Greenhouse Horticulture of Wageningen University and Research Centre, The Netherlands. The organising committee consisted of Rob Schouten and Leo Marcelis (Conveners), Pol Tijskens (one of the initiators of the first MODEL-IT symposium), Ep Heuvelink, Jaap Molenaar and Cecilia Stanghellini. Previous meetings took place in Wageningen (1998), Palmerston North (2001), Leuven (2005), and Madrid (2008). The symposium was held on the top floor of the Forum building, where there were excellent views of the Wageningen Campus. Four major topics were covered:

- Growth and physiology of crops (plant factories, greenhouses, open field, food, ornamentals)
- (Micro)climate and climate control (open field, greenhouse)
- Postharvest physiology and technology (harvest, storage, transport, retail)
- Aggregation level (cell, plant, crop, product, chain).

The scientific programme contained four keynote, 33 oral and 25 poster presentations. Special attention was given to the poster sessions as they were pitched during the oral sessions. Posters were displayed throughout the symposium and three dedicated poster sessions were held. Excursions to the experimental facilities of Wageningen University took place, which emphasized current research at the Horticulture and Product Physiology group (www.hpc.wur.nl). In addition to the poster sessions and excursions, OptiPa demo sessions (software for simulations, calibrations and validations of kinetic models) were organised by Maarten Hertog, who is also one of the initiators of MODEL-IT. The social programme included a visit to the Burgers' Zoo in Arnhem, where delegates experienced a cocktail reception in the Bush, had a tour through the Ocean, which has the largest living coral reef in aquariums outside of Australia, and enjoyed a splendid Braai & BBQ dinner in the Safari restaurant.

The symposium opened with a reception at 'Hof van Wageningen' on Sunday October 11 and the scientific program started the next day. The Conveners opened the symposium and welcomed the participants, followed by the manifesto, 'The fundamental rights of models', by Pol Tijskens. The first session, Timing and Ripening, started with an overview of 'Modelling in Postharvest Horticulture' by keynote speaker Maarten Hertog (KU Leuven, Belgium) in parallel with a session on Water and Nutrients. In the afternoon keynote speaker Ep Heuvelink (Wageningen UR) discussed the current status and outlook on modelling crop growth and yield in greenhouses in the session Crop Growth and Yield. The second day was filled with sessions on Metabolic Activity, Timing and Ripening and, finally, Climate Conditions during Cultivation. The second day started with a keynote presentation from Henrik Jönsson (Sainsbury Laboratory Cambridge University, UK) on the influence of tissue geometry on mechanical stem cell regulation, which emphasized the importance of system biology approaches. The third and last day started with a keynote lecture by Irineo Lorenzo López Cruz (Universidad Autónoma Chapingo, Mexico), followed by sessions on Sustainable Production Systems, 3-Dimensional Models and Postharvest Climate Conditions.

Many of the presentations and discussions were very well received, especially those with regard to the gap that still exists, but perhaps became smaller over the course of the symposium, between preharvest and postharvest modellers.

The organising committee is very happy to announce that the next Model-IT symposium will be organised in 2019 by Maria Luisa Amodio and Giancarlo Colelli from the University of Foggia, Italy.
The organising committee wants to thank the sponsors who made this symposium possible (Priva, Phyto-IT, Hortimax, B-Mex and Hoogendoorn). Also, PhD students Maarten Verhoog, Arian van Westreenen, Ningyi Zhang and Qianxixi Min from Horticulture and Product Physiology are heartily thanked for their helping hands. The work of the scientific committee is acknowledged. The proceedings of the symposium will be published soon as a volume of *Acta Horticulturae*.

Rob Schouten

› Contact

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Prof. Dr. Leo F.M. Marcelis, Wageningen University, Horticulture and Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, The Netherlands, e-mail: leo.marcelis@wur.nl

From the Secretariat

› New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Argentina: Assist. Prof. Valeria Blackhall; **Australia:** Helen Faber, Ian Folder, Kristin Groom, Dr. Anna McBeath, Mr. Martin Nash, Mr. thuan nguyen, Mr. Amrit Poudel, Dwayne Strochnetter, Dilnee Suraweera, Dr. Swaminathan Thalavaisundaram, Ms. Katharine Thornton, Dr. Navin Koosrajoo Veerapa; **Belgium:** Mr. Philippe Appeltans, Mr. Philippe Binard, Amaury Moens, Mr. Bart Vanhoutte, Andreas Verschueren; **Brazil:** Prof. Dr. Mônica Rosa Bertão, Ms. Débora Prudente; **Cameroon:** Geraldine Njumbe; **Canada:** Mr. Ian Ashdown, Ms. Stéphanie Fournier, Dr. T.A. Loeffler, Ana Sofía Medina Larqué, Ken Wall, Dr. Viliam Zvalo; **Chile:** Mr. Rafael Elizondo; **China:** Prof. Chonghui Fan, Prof. Dr. Qingmei Guan, Dr. Yeqing Guan, Ms. Jinfeng Huang, Assoc. Prof. Ni Jiheng, Fang Li, Ms. Fang Li, Jinjin Li, Assist. Prof. Mingjun Li, Prof. Dr. Pengmin Li, Dr. Zhengnan Li, Zhong Liang, Ke Liu, Prof. Dr. Deguo Lyu, Junpeng Niu, Prof. Dr. Dongliang Qiu, Prof. Xiaolin Ren, Mr. Wu Sheng, Prof. Guangyu Sun, Prof. Li Tianhong, Caiyun Wang, Dr. Deke Xing, Prof. Dr. Chizuko Yamamuro, Assoc. Prof. Hengtao Zhang, Prof. Dr. Junke Zhang, Assoc. Prof. Qiong Zhang, Assoc. Prof. Ruiping Zhang, Assoc. Prof. Xiaodong Zhang, Prof. Dr. Deying Zhao, Kathy Zhao; **Chinese Taipei:** Assoc. Prof. Kaiyi Chen, Ping-Lung Huang; **Colombia:** Mr. Juan Pena; **France:** Mr. Gru Gonzague, Mr. Cédric Martinotti; **Germany:** Dr. Manfred Buechele, Sattler Christian, Dr. Johanna Frotscher, Dr. Peter Grauert, Ms. Sonja Lützenkirchen, Inken Rabbel, Dr. Franz Ruess; **Greece:** Ms. Konstantina Giannopoulou, Dr. Anastasia Kyriakoudi; **Guadeloupe:** Mr. Fred Salmon; **India:** Mr. Dev Garg, Dr. Vikramaditya Pandey; **Indonesia:** Dr. Nurliani Bermawie, Dr. Slamet Riyadi, Mr. Rudi Suryadi, Octivia Trisilawati, Prof. Dr. Soesiladi E. Widodo; **Iran:** Ms. Marzieh Ahmadian, Prof. Dr. Masoud Sheidaei; **Iraq:** Assist. Prof. Hussam Khierallah; **Israel:** Dr. Nir Dai, Dr. Anat Elmann; **Italy:** Assoc. Prof. Fabio Gresta, Assoc. Prof. Benedetto Ruperti; **Japan:** Ren Abe, Hiroshi Asai, Takahiro Hasegawa, Akikazu Hatanaka, Hideo Hayashi, Koichi Hirata, Ryo Horikoshi, Makoto Ihara, Kenichi Ikawa, Takao Ishiwatari, Tomonori Iwasaki, Noriyuki Kajifusa, Shinji Kasai, Hitoshi Kawada, Mutsuo Kobayashi, Takeshi Kojima, Akira Matsubara, Kenji Matsui, Noritada Matsuo, Hideyuki Matsuura, Hisashi Miyagawa, Ryuta Miyaji, Masahiro Miyashita, Mr. Nobuki Miyata, Hajime Mizuno, Motonori Mizutani, Keiichi Mochida, Tatsuya Mori, Masanori Morimoto, Yoshiaki Nakagawa, Michiharu Nakano, Masahiro Nakashima, Ritsuo Nishida, Yoshiharu Nomura, Kazunori Okada, Keisuke Ozaki, Shigeru Saito, Koji Sakamori, Masako Satoyama, Mr. Kota Shimomoto, Yoshinori Shono, Akiko Suzuki, Junji Takabayashi, Keiji Tanaka, Naoki Terada, Hayato Teshima, Kenichi Tomi, Kazunori Tsushima, Kazumitsu Ueda, Shiro Ueyama, Keisuke Watanabe, Chihoko Yamazaki, Shizuka Yasumura, Kazuhiro Yoshida, Shinya Yoshida; **Korea (Republic of):** Mr. Yunsu Do, Jeong-Hee Kim, Mr. Hyoung-Rai Ko, YoungSoon Kwon, Mr. Ji Yul Lee, Ms. Sojin Lee, Dr. Soo In Lee, Sook Lee, Mr. Bueyong Park, Prof. Dr. Sin-Ae Park, Dr. Lee Sangmilee, Mr. Hao Wei; **Latvia:** Solvita Zeipina; **Madagascar:** Dr. Nirhy Lanto Rabibisoa, Prof. Dr. Sylvain Ramananarivo, Dr. Narilala Randrianarison; **Mexico:** Mr. Hector Flores, Dr. Juan Manuel Soto Parra; **Morocco:** Prof. Mohammed Amine Serghini; **Netherlands:** Mr. Rob Baan, Mr. Geerhard Holtkamp, Maarten Jongsma, Robert Stolker; **New Zealand:** Dr. Clive Cornford, Mr. Christopher Lees; **Nigeria:** Dr. Olufunmilayo Adesina, Mr. Thomas Chackunkal, Ms. Abosede Oduntan; **Norway:** Assoc. Prof. Anne-Berit Wold; **Philippines:** Guillermo Jimenez, Dr. Vivian Panes; **Portugal:** Dr. João Igor; **Romania:** Dr. Erzsebet Buta, Mihai Cosmin-Alexandru, Mr. Sergiu Iscu, Assoc. Prof. Elvira Oroian; **Rwanda:** Gabriel Bizimungu, Eugene Haguma; **South Africa:** Brian du Plessis; **Spain:** Ms. Vanesa Fernandez Membrillera, Dr. Antonio Jesus Melendez Martinez, Dr. Ana Morales, Dr. Silvia Valladares; **Sweden:** Dr. Ibrahim Tahir; **Tanzania:** Dr. John Macharia; **Thailand:** Assist. Prof. Sumana Neera, Ms. Natthamon Suwannaprom, Assoc. Prof. Aree Thongpukdee; **Tunisia:** Dr. Radhia Kasbi; **Turkey:** Prof. Dr. Hakan Aktas, Assoc. Prof. Selçuk Arslan, Dr. Hatice Filiz Boyaci, Assoc. Prof. Birsen Cakir, Nergiz Coban, Assist. Prof. Hatice ikten, Prof. Dr. Ahmet Korkmaz, Assist. Prof. Semsettin Kulac, Ms. Yesim Rehber Dikkaya, Deniz Sanal, Mr. Mehmet Ali Saridas, Mr. Mustafa Kemal Soylu, Prof. Dr. Semih Tangolar, Prof. Dr. Serpil Tangolar; **Ukraine:** Mr. Oleksandr Chumak; **United Arab Emirates:** Dr. Abdul J. Cheruth, Dr. Shyam Kurup; **United Kingdom:** Michael Birkett, Dr. Richard Boyle, Mr. Philip Harkness, Mr. Matthew Hill, Mr. Rupert Knowles, Prof. Philip Mullineaux, John Pickett; **United States of America:** Dr. Chad Aeschliman, Hal Bayless, Brice Besser, Ms. Helia Bidad, Mr. Jeff Blake, Ed Borger, Mr. Sergio Borquez, Dr. Gurreet Brar, Ms. Megan Brundrett, Ms. Olivia Caillouet, Mr. Elias Cannell, John Clark, Dr. Milka Datcheva, Kwamena deGraft-Johnson, Dr. Angelos Deltsidis, Ke Dong, Assist. Prof. Bruce Ferguson, Mr. Kenneth Gerhart, Dr. Loren Honaas, Masao Inoue, Jim Jackson, Steven Klaysmat, Gail Kociemba, Ms. Jane Kostina, Francisco Manzano, Amanda McWhirt, Dr. Ibrahim Michael, Laxminarayan Misra, Mr. Bob Nottelmann, Mr. Timothy Nourse, Thomas Osimitz, Bhavesh Shah, James Smith, Dr. Nate Storey, Robert Suranyi, Dr. Hillary Thomas, Dr. Jennifer Trapp, Dr. Brent Trela, Ms. Elizabeth Trotter, Mr. Graham Tucker, Michele Wiseman, Siyu Zhu

› In memoriam

Prof. Dr. Jung-Myung Lee

Members of ISHS and friends around the world record the unexpected passing of Prof. Dr. Jung-Myung Lee, Emeritus Professor of Kyung Hee University, South Korea, on Saturday, 25 June 2016. He was 75.

Prof. Lee was educated in Seoul and obtained a BS in Agronomy and MS in Horticulture in 1964 and 1966, respectively, at Seoul National University, College of Agriculture. After two years of field experience in a private company, he entered the University of Minnesota for a PhD in Horticulture under Dr. Paul Read from 1968 to 1973.

Prof. Lee returned to Korea as an Assistant Professor at the Department of Crop Science of Kyung Hee University in 1973 and made a big contribution to the establishment of the Department of Horticulture. Until his retirement in 2009, he served the university as Head of the Horticulture Department, Director of the Food Resource R&D Center, Director of the Research Institute for Life Science Resources, and Director of the Research Experiment Center. He was a recipient of the University Research Achievement Award in 2005. From 1974, he spent two years at the National Research Center in Canada with Dr. Norman Looney as a postdoctoral fellow. He was a visiting professor at Cornell University for seven months in 1983, funded by the Fulbright Senior Researcher Award. He was also a visiting professor at the University of Minnesota in 1993/1994.

During his career at Kyung Hee University, he trained 30 PhD and 74 MS students, published 20 books, including widely used college textbooks, 148 papers in Korean journals and 25 papers in international journals. He made 106 and 97 presentations at Korean and international conferences, respectively. His major contribution to horticultural science was focused on physiology, production and use of vegetables, plant hormone extraction and use, seed vigor and germination, nursery production and grafting, general horticulture, and international collaborations.

He was a member of the Korean Society for Horticultural Science (KSHS) since 1973 and served KSHS as an editorial committee member, chairperson of the international committee, executive committee member, and Vice-President. He was a world expert in grafting technology and became President of the Korean Cucurbit Vegetables Society from 2010-2015. He interacted successfully with growers, public, administrators and researchers because he perceived the importance of communication among growers, academia, and extension people. He served as an advisory committee member of National Seed Agency, Rural Development Administration, and Gyeonggi Agricultural Research & Extension Service. He was also a committee member of the Korean Agrichemical Society, the Korea Seed Research Society, and the Korea Federation of Science and Technology Societies. He was a regular member of the Korean Academy of Science & Technology since 1994. Because of his lifetime contribution to Korean agriculture, he was awarded the Korea Grand Prize in Agricultural Science in 2000.

Prof. Lee was a passionate supporter of the ISHS. He was a member of the Board for four years (2002-2006) in his role as President of the International Horticultural Congress that was held in Seoul in 2006 (IHC2006). Prof. Lee led a team that produced a highly successful congress with a full scientific program, excellent tours and a very memorable closing ceremony where the best of modern and traditional Korean culture was showcased. Notably, the congress also hosted a major horticultural exhibition within the public area of the convention center. The exhibition was strongly supported financially by the Korean government and showcased many aspects of horticultural science and production systems to the public, who attended in large numbers. The book "Horticulture in Korea", edited by Jung-Myung Lee, Geun-Won Choi and Jules Janick and published by the Korean Society for Horticultural Science, was presented to all delegates at the congress.

Prof. Lee was subsequently elected to the ISHS Board as the 'member at large' from 2006 to 2010, and he was the Board Secretary during that term having specific responsibility for membership. During the 2002 to 2010 period, the number of ISHS members doubled from around 3000 to over 6000. Prof. Lee was always very meticulous with his reports to the Board.

Prof. Lee was a strong advocate for horticultural scientists from the wider Asian region to play a greater role within the ISHS. This commitment resulted in the first Asian Horticultural Congress (AHC), primarily involving the Republic of Korea, China and Japan, that was held in Cheju, Korea in 2008. This meeting was to have had a sequel in Japan in 2012 but was disrupted because of the major tsunami event that struck the country in 2011. The second AHC will be held in Chengdu, China in September 2016.

The appointment of an additional member to the ISHS Board to cover the Asian region was realized in 2014, fulfilling Prof. Lee's vision. For his many contributions to the ISHS, Prof. Jung-Myung Lee was made an Honorary Member of the Society in 2010.

Prof. Lee was a member of ASHS and received a Member Recruitment Award three times, in 1989, 1990, and 1993.

We will never forget his generous and gentle smile. Our sincere sympathies go to his wife, son and daughter in Korea. We mourn your loss and ours also.

Ki Sun Kim, Seoul National University, Korea

Ian J. Warrington, former ISHS Vice-President

ISHS

PubHort – Crossroads of horticultural publications

› www.pubhort.org

› 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 2016

- October 5-7, 2016, Potsdam (Germany): **International Symposium on Sensing Plant Water Status - Methods and Applications in Horticultural Science.** Info: Dr. Werner B. Herppich, Leibniz-Inst. Agricult. Eng. Potsdam-Bornim, Max-Eyth-Allee 100, 14469 Potsdam, Germany. E-mail: wherppich@atb-potsdam.de or Prof. Dr. Manuela Zude-Sasse, Leibniz Institute for Agric. Engineering, Potsdam-Bornim, Max-Eyth-Allee 100, 14469 Potsdam-Bornim, Germany. Phone: (49)331-5699-612, Fax: (49)3315699849, E-mail: zude@atb-potsdam.de E-mail symposium: spws2016@atb-potsdam.de Web: http://www.spws2016.atb-potsdam.de/
- October 10-14, 2016, Split (Croatia): **VIII International Olive Symposium.** Info: Dr. Slavko Perica, Director, Institute for Adriatic Crops, Put Duilova 11, 21000 Split, Croatia. Phone: (385) 21 434434, Fax: (385) 21 316584, E-mail: slavko@krs.hr E-mail symposium: ios2016-info@krs.hr Web: http://ios2016.krs.hr/
- October 10-14, 2016, Montpellier (France): **X International Symposium on Banana: ISHS-ProMusa Symposium on Agroecological Approaches to Promote Innovative Banana Production Systems.** Info: Dr. Jean-Michel Risede, CIRAD, RU GECO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: +33(0)467617152, E-mail: jean-michel.risede@cirad.fr or Dr. Thierry Lescot, CIRAD, RU GECO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: (33)467615666, Fax: (33)467615821, E-mail: thierry.lescot@cirad.fr or Dr. Inge Van den Bergh, Bioversity International, C/O KULeuven, W. De Croylaan 42 bus 2455, 3001 Leuven, Belgium. Phone: (32)16377067, E-mail: i.vandenbergh@cgiar.org E-mail symposium: symposium@promusa.org Web: http://ishs-promusa2016.cirad.fr/
- October 10-16, 2016, Yangling, Shaanxi (China): **I International Apple Symposium.** Info: Prof. Dr. Zhen-Hai Han, Institute for Horticultural Plants, China Agricultural University, No. 2 Yuanmingyuanxilu, 100193 Beijing, China. Phone: (86)1062732467, Fax: (86)1062734391, E-mail: rschan@cau.edu.cn or Prof. Fengwang Ma, 3 Taicheng Road, College of Horticulture, Northwest AF University, Yangling, Shaanxi Province, 712100, China. Phone: +8613572076386, E-mail: fwm64@nwsuaf.edu.cn or Dr. Stuart Tustin, Hawke's Bay Research Centre, Plant and Food Research Ltd, Private Bag 1401, Havelock North, New Zealand. Phone: (64)69758968, E-mail: stuart.tustin@plantandfood.co.nz E-mail symposium: firstias@hotmail.com Web: http://ias.nwsuaf.edu.cn/
- October 16-20, 2016, Valencia (Spain): **VI International Symposium on Persimmon.** Info: Dr. Maria Luisa Badenes, Secretary General EUCARPIA, IVIA, 4 Apartado Oficial, 46113 Moncada (Valencia), Spain. Phone: (34)9634 24049, Fax: (34)9634 24106, E-mail: badenes_mlu@gva.es E-mail symposium: convener@persimmonsymposium.es Web: http://www.persimmonsymposium2016.es/
- October 17-21, 2016, Chania, Crete (Greece): **III International Symposium on Horticulture in Europe - SHE2016.** Info: Dr. Panagiotis Kalaitzis, Mediterranean Agronomic Inst. Of Chania, 85, Macedonia Str. P.O. Box 85, 73100 Chania, Greece. Phone: (30)2821035030, E-mail: panagiot@maich.gr or Prof. George Manganaris, Anexartisias 33, P.O. Box 50329, 3603 Lemesos, Cyprus. Phone: (357)25002307, Fax: (357)25002804, E-mail: george.manganaris@cut.ac.cy Web: http://she2016.org/
- November 10-12, 2016, Montevideo (Uruguay): **XIII International People Plant Symposium: Plants, Cultures and Healthy Communities.** Info: Dr. S. Norman Goodyear, 15 Parsons Rd, St. John's NL A1A 2H8, Canada. Phone: (1)7098642076, E-mail: norman.goodyear@mun.ca or Dr. Marta Chiappe, Garzón 780 CP 12900, Montevideo, Uruguay. E-mail: marbechiappe@gmail.com E-mail symposium: ipps2016@ipps2016.org Web: http://ipps2016.org/
- November 20-25, 2016, Cairns, Queensland (Australia): **International Symposia on Tropical and Temperate Horticulture.** Info: Prof. Dr. Roderick A. Drew, Griffith Sciences, Logan Campus, Griffith University, University Drive, Meadowbrook, QLD 4131, Australia. Phone: (61)733821291, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au or Dr. Robin Elaine Roberts, Griffith Asia Institute, Griffith University, 170 Kessels Road, Nathan Qld 4111, Australia. Phone: (61)7 373 57885, E-mail: robin.roberts@griffith.edu.au E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Urban Landscapes in Tropical Cities.** Info: Prof. Dr. Gert D. Groening, Universitaet der Kuenste Berlin Institut GTG, Gartenkultur und Freiraumentwicklung, Postfach 12 05 44, 10595 Berlin, Germany. Phone: (49)3031852278, Fax: (49)3031852499, E-mail: groening@udk-berlin.de or Prof. Patrícia Paiva, Universidade Federal de Lavras, Depto de Agricultura, campus universitario, Lavras-MG, 37200-000, Brazil. Phone: (55)35 38291786, Fax: (55)35 38291301, E-mail: patriciapaiva@dag.ufla.br E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-urban-landscapes-tropical-cities/
- November 20-25, 2016, Cairns, Queensland (Australia): **IV International Symposium on Guava and Other Myrtaceae.** Info: Prof. Dr. Sisir Kumar Mitra, B-12/48, Kalyani, Nadia, West Bengal 741235, India. Phone: (91)3325823017, Fax: (91)3325828460, E-mail: sisirm55@gmail.com or Andrew East, Massey University, Private Bag 11222, Palmerston North, New Zealand. E-mail: a.r.east@massey.ac.nz E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-guava-other-myrtaceae/
- November 20-25, 2016, Cairns, Queensland (Australia): **II International Symposium on Tropical Horticulture: Now is the Era for Tropical Horticulture.** Info: Prof. Dr. Roderick A. Drew, Griffith Sciences, Logan Campus, Griffith University, University Drive, Meadowbrook, QLD 4131, Australia. Phone: (61)733821291, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au or Prof. Dr. Robert E. Paull, Dept. Tropic Plant & Soil Sci., University of Hawaii, 3190 Maile Way, Honolulu, HI 96822-2279, United States of America. Phone: (1)808-956-7369, Fax: (1)808-956-3894, E-mail: paull@hawaii.edu or Dr. Alain Rival, CIRAD Resident Regional Director, Southeast Asian Island Countries, Graha Kapital 1 - Jl. Kemang Raya # 4, 12730 Jakarta, Indonesia. Phone: (62)217198641, Fax: (62)2171794652, E-mail: alain.rival@cirad.fr E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-tropical-horticulture/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Tropical Plant Genomes.** Info: Dr. Natalie Dillon, DAFF, 28 Peters Street, Mareeba QLD 4880, Australia. E-mail: natalie.dillon@daf.qld.gov.au E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-tropical-plant-genomes/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Tropical Plant Breeding.** Info: Dr. M.R Dinesh, Principal Scientist, Division of Fruit Crops, Sadashivanagar - IIHR, Bangalore, Karnataka, 560089, India. Phone: (91)80- 23611198, Fax: (91)80-28466291, E-mail: drmrdinesh@gmail.com or Dr. Wen-Li Lee, Taiwan Agricultural Research Institute, No.530, Wenlong E.Rd.,

Fengshan Dist., 83052 Kaohsiung City, Chinese Taipei. E-mail: leewenli@fthes-tari.gov.tw or Dr. Songpol Somsri, Senior Advisory in Plant Production, Department of Agriculture, Chatuchak, Bangkok 10900, Thailand. Phone: (66)25790574, Fax: (66)29405472, E-mail: dr.songpols@yahoo.com E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-tropical-plant-breeding/

- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Vegetative Propagation and In Vitro Culture of Tropical Plants.** Info: Dr. Maurizio Lambardi, IVALSA/Trees and Timber Institute, National Research Council (CNR), Polo Scientifico, via Madonna del Piano 10, I-50019 Sesto Fiorentino, Firenze, Italy. Phone: (39) 055 5225685, Fax: (39) 055 5225656, E-mail: lambardi@ivalsa.cnr.it or Prof. Dr. Renato Paiva, Alameda dos Flamboyants 103, Condominio Jardim das Palmeiras, 372000-000 Lavras-Minas Gerais, Brazil. Phone: (55)3538291359, Fax: (55)3538291100, E-mail: renpaiva@dbi.ufla.br E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/international-symposium-on-vegetative-propagation-and-in-vitro-culture-of-tropical-plants/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Protected Cultivation in Tropical and Temperate Climates & X International Symposium on Protected Cultivation in Mild Winter Climates.** Info: Prof. Dr. Gordon Rogers, University of Sydney, Biomedical Building 1 Central Ave, Eveleigh, NSW 2015, Australia. Phone: (61) 2 8627 1040, Fax: (61) 2 9544 3782, E-mail: gordon@ahr.com.au or Dr. Sophie Parks, Industry NSW, Locked Bag 26, Gosford, NSW 2250, Australia. Phone: (61)243481914, Fax: (61)243481910, E-mail: sophie.parks@dpi.nsw.gov.au or 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 E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-protected-cultivation-tropical-temperate-mild-winter-climates/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Poverty, Hidden Hunger and Horticulture & VI International Symposium on Improving the Performance of Supply Chains in the Transitional Economies.** Info: Dr. Detlef Virchow, GlobalHort, co Center for Development Research ZEF, Walter-Flex-Str. 3, 53113 Bonn, Germany. Phone: (49)228-734476, Fax: (49)228-731889, E-mail: dvirchow@globalhort.org or Prof. Dr. Umezuruike Linus Opara, University of Stellenbosch, Faculty of AgriSciences, Private Bag X1, Stellenbosch 7602, South Africa. Phone: (27) 21 808 4064, Fax: (27) 21 808 2121, E-mail: opara@sun.ac.za or Prof. Dr. Peter J. Batt, 3 Rodondo Place, Shelley, WA 6148, Australia. Phone: (61)401636242, Fax: (61)8 9266 3063, E-mail: peterjbatt@gmail.com or Dr. Hannah Jaenicke, Burghof 26, Schloss Gelsdorf, 53501 Grafschaft-Gelsdorf, Germany. Phone: (49)2225-8389895, E-mail: hannah.jaenicke@t-online.de E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-poverty-hidden-hunger-horticulture/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Beverage Crops.** Info: Prof. Dr. Roderick A. Drew, Griffith Sciences, Logan Campus, Griffith University, University Drive, Meadowbrook, QLD 4131, Australia. Phone: (61)733821291, Fax: (61)737357618, E-mail: r.drew@griffith.edu.au or Prof. Dr. Umezuruike Linus Opara, University of Stellenbosch, Faculty of AgriSciences, Private Bag X1, Stellenbosch 7602, South Africa. Phone: (27) 21 808 4064, Fax: (27) 21 808 2121, E-mail: opara@sun.ac.za or Prof. Dr. Renato Paiva, Alameda dos Flamboyants 103, Condominio Jardim das Palmeiras, 372000-000 Lavras-Minas Gerais, Brazil. Phone: (55)3538291359, Fax: (55)3538291100, E-mail: renpaiva@dbi.ufla.br or Prof. Dr. Yves Desjardins, Horticulture Research Center/INAF, Faculty of Agriculture and Food, 2440, Blvd. Hochelaga, # 2736, Laval Univ. Québec, QC G1V 0A6, Canada. Phone: (1)418-656-2131x2359, Fax: (1)418-656-3515, E-mail: yves.desjardins@fsaa.ulaval.ca E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-beverage-crops/
- November 20-25, 2016, Cairns, Queensland (Australia): **I International Symposium on Tropical Plantation Crops.** Info: Prof. Dr. Sisir Kumar Mitra, B-12/48, Kalyani, Nadia, West Bengal 741235, India. Phone: (91)3325823017, Fax: (91)3325828460, E-mail: sisirm55@gmail.com or Valerie S. Tuia, Secretariat of the Pacific Community, Suva Regional Office, Private Mail Bag, Suva, Fiji. Phone: (679)3379274, Fax: (679)3370021, E-mail: valeriet@spc.int or Dr. Luseane Taufa, Senior Plant Pathologist, Ministry Agric., Food, Forests & Fisheries, P.O Box 14, Nuku'alofa, Tonga. Phone: (676) 23038, Fax: (676) 24271, E-mail: luseane.taufa@mafff.gov.to E-mail symposium: istth2016@griffith.edu.au Web: http://www.istth2016.org/science/int-sym-tropical-plantation-crops/
- November 23-26, 2016, Agadir (Morocco): **V International Symposium on Saffron Biology and Technology: Advances in Biology, Technologies, Uses and Market.** Info: Prof. Mohammed Badraoui, Institut National de Recherche Agronomique, Avenue Ennasr, BP 415 Rabat, Morocco. Phone: (212)537772654, Fax: (212)537770049, E-mail: mohamedbadraoui@gmail.com E-mail symposium: saffronsymposium@gmail.com Web: http://www.vsaffronsymposium.com

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- March 7-10, 2017, Napier (New Zealand): **IV International Symposium on Molecular Markers in Horticulture.** Info: Dr. Vincent Gerardus Maria Bus, Plant and Food Research, Private Bag 1401, Havelock North 4157, New Zealand. Phone: (64)69758946, Fax: (64)69758881, E-mail: vincent.bus@plantandfood.co.nz E-mail symposium: Yvonne.McDiarmid@plantandfood.co.nz Web: http://www.molecularmarkers.co.nz
- March 27-31, 2017, 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 E-mail symposium: fruitbiotech@gmail.com Web: http://fruitbiotech2016.org
- March 28-31, 2017, Santiago (Chile): **III International Symposium on Bacterial Canker of Kiwifruit (Psa).** Info: Paulina Sepulveda, INIA-LA Platina Chile, Zurich 221 Depto 101, Santiago, Chile. Phone: (56)225779147, E-mail: pssr2009@gmail.com E-mail symposium: symposium.psa2017@gmail.com Web: http://www.psa2017.cl
- April 6-8, 2017, Kandy (Sri Lanka): **IV International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions.** Info: Dr. Chalinda Beneragama, Department of Crop Science, Faculty of Agriculture, University of Peradeniya, 20400 Sri Lanka Peradeniya, Sri Lanka. Phone: (94)812-395127), E-mail: chalindab@gmail.com E-mail symposium: pqmhp2017@gmail.com Web: http://pqmhp2017.org/
- April 24-28, 2017, Lavras, Minas Gerais (Brazil): **VII International Symposium on Production and Establishment of Micropropagated Plants.** Info: Prof. Dr. Renato Paiva, Alameda dos Flamboyants 103, Condominio Jardim das Palmeiras, 372000-000 Lavras-Minas Gerais, Brazil. Phone: (55)3538291359, Fax: (55)3538291100, E-mail: renpaiva@dbi.ufla.br or Dr. Diogo Pedrosa Corrêa da Silva, Rua América de Moura Maia, 57, apto 02, Lavras, Brazil. E-mail: pedrosacorrea@yahoo.com.br or Dr. Michele Reis, R. Misseno de Padua, 296 apt. 202, Centro, 37200--00 Lavras-Minas Gerais, Brazil. Phone: (55)035 38291619, E-mail: mvreis@yahoo.com.br Web: http://www.pempbrazil.com
- May 1-4, 2017, Ramsar (Iran): **International Symposium on Wild Flowers and Native Ornamental Plants.** Info: Dr. Pejman Azadi, National Institute of Ornamental Plants, PO Box 37815-137, Mahallat, Iran. E-mail: azadip22@gmail.com E-mail symposium: info@wildflowers2017.com Web: http://wildflowers2017.com/
- May 8-11, 2017, 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

- May 22-26, 2017, Fullerton, CA (United States of America): NEW **X International Workshop on Sap Flow.** Info: Prof. Dr. H. Jochen Schenk, Department of Biological Science, California State University Fullerton, PO Box 6850, Fullerton, CA 92834-6850, United States of America. Phone: (1)6572783678, E-mail: jschenk@fullerton.edu
- May 22-26, 2017, Cayo Guillermo, Ciego de Ávila (Cuba): NEW **III International Symposium on Plant Cryopreservation.** Info: Dr. Marcos Edel Martinez-Montero, Bioplantas Center, Plant Breeding Lab., University of Ciego de Avila, Car. a Moron km 9, CP 69450 Ciego de Avila, Cuba. Phone: (53) 33 22 5768, Fax: (53) 33 26 6365, E-mail: marcosem@bioplantas.cu E-mail symposium: cryo.ishs2017@gmail.com
- May 23-26, 2017, Pontevedra (Spain): **VII International Symposium on Brassicas.** Info: Elena Cartea, CSIC, PO BOX 28, 36080 Pontevedra, Spain. Phone: (34)986854800, E-mail: ecartea@mbg.csic.es or Pablo Velasco, Misión Biológica de Galicia (CSIC), Apartado 28, 36080 Pontevedra, Spain. Phone: (34)986854800, E-mail: pvelasco@mbg.csic.es or Pilar Soengas, Misión Biológica de Galicia (CSIC), Apartado 28, 36080 Pontevedra, Spain. Phone: (34)986854800, E-mail: psoengas@mbg.csic.es or Dr. Victor Rodriguez, Mision Biologica de Galicia, Palacio de Salcedo, Carballeira, 8 (Salcedo), 36143 Pontevedra, Spain. Phone: (34)986854800, E-mail: vmrodriguez@mbg.csic.es E-mail symposium: brassica2017@csic.es Web: http://brassica2017.com
- June 5-9, 2017, Yamagata (Japan): **VIII International Cherry Symposium.** Info: Prof. Dr. Satoshi Taira, Lab. of Pomology, Fac. of Agr., Yamagata University, Tsuruoka, Yamagata 997-8555, Japan. Phone: (81)235-282829, Fax: (81)235-282832, E-mail: staira@tds1.tr.yamagata-u.ac.jp or Prof. Dr. Ryutaro Tao, Lab. Pomology, Fac. Agric., Kyoto University, Kitashirakawa Oiwake-cho, Sakyo-ku Kyoto 606-8502, Japan. Phone: (81)757536053, Fax: (81)757536497, E-mail: rtao@kais.kyoto-u.ac.jp or Hideki Murayama, Faculty of Agriculture, Yamagata University, 1-23 Wakabamachi Tsuruoka, Yamagata 997-8555, Japan. Phone: (81)235282887, Fax: (81)235282812, E-mail: mhideki@tds1.tr.yamagata-u.ac.jp Web: http://cherry2017.jshs.jp
- June 18-22, 2017, Warsaw (Poland): **XII International Controlled and Modified Atmosphere Research Conference - CaMa2017.** Info: Dr. Krzysztof Rutkowski, Research Institute of Horticulture, Konstytucji 3 Maja 1/3, 96-100 Skierniewice, Poland. Phone: (48) 468345363, E-mail: krzysztof.rutkowski@inhort.pl or Prof. Dr. Franciszek Adamicki, Research Institute of Horticulture, Konstytucji 3 Maja 13 Str., 96-100 Skierniewice, Poland. Phone: (48)46 833 34 34, Fax: (48)46 833 31 86, E-mail: franciszek.adamicki@inhort.pl
- June 19-23, 2017, Palermo (Italy): NEW **International Symposium on Flowering, Fruit Set and Alternate Bearing.** Info: Prof. Francesco Marra, Department of Agricultural & Forest Science, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39)09123861236, Fax: (39)09123861211, E-mail: francescopaolo.marra@unipa.it or 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 Prof. Dr. Sisir Kumar Mitra, B-12/48, ◊alyani, Nadia, West Bengal 741235, India. Phone: (91)3325823017, Fax: (91)3325828460, E-mail: sisirm55@gmail.com E-mail symposium: info@fsab2017.it Web: http://www.fsab2017.it
- June 20-23, 2017, Maribor (Pivola) (Slovenia): NEW **VII South-Eastern Europe Symposium on Vegetables and Potatoes.** Info: Prof. Dr. Martina Bavec, Univerza v Mariboru, Slomskov trg 15, 2000 Maribor, Slovenia. E-mail: martina.bavec@um.si E-mail symposium: 7sees.vp@gmail.com Web: http://vp2017.um.si/
- June 25-29, 2017, Perth (Australia): **I International Symposium on Smart Horticulture for Sustainable Cities.** Info: Prof. Dr. Peter J. Batt, 3 Rodondo Place, Shelley, WA 6148, Australia. Phone: (61)401636242, Fax: (61)8 9266 3063, E-mail: peterjbatt@gmail.com Web: http://perthnrm.com/perth-nrm-programs/sustainable-agriculture/smart-horticulture-for-sustainable-cities.aspx
- July 2-6, 2017, Bucharest (Romania): **IX International Peach Symposium.** Info: Prof. Dr. Florin Stanica, University of Agronomic Sciences, Faculty of Horticulture, B-dul Marasti, 59, Sector 1, 011464, Bucuresti, Romania. Phone: (40)722641795, Fax: (40)213182888, E-mail: flstanica@yahoo.co.uk
- July 2-7, 2017, Angers (France): **VII International Symposium on Rose Research and Cultivation.** Info: Dr. Fabrice Foucher, UMR IRHS, Centre INRA, BP 60057, 49071 Beaucouze, France. E-mail: fabrice.foucher@angers.inra.fr E-mail symposium: secretariat.irhs@angers.inra.fr
- July 10-16, 2017, Tiandong County, Baise City, Guangxi Zhuang Autonomous Region (China): **XII International Mango Symposium.** Info: Wen-ming Huang, Tiandong County People's Government, Baise City, China. Phone: (86)776-5232669, Fax: (86)776-5232669, E-mail: tdxfb37@163.com or Prof. Dr. Xinhua He, 100 Daxue Rd, College of Agriculture, Guangxi University, Nanning, Guangxi, 530004, China. Phone: (86)771-3270184, Fax: (86)771-3235612, E-mail: honest66222@163.com or Prof. Cheng-xin He, Guangxi Institute of Botany, Chinese Academy of Sciences, Yanshan Town, Guilin city, China. Fax: (86)773-3550067, E-mail: 228268892@qq.com
- August 15-19, 2017, Atakum, Samsun (Turkey): **IX International Congress on Hazelnut.** Info: Prof. Dr. Celal Tuncer, Ondokuz Mayis University, Faculty of Agriculture, Department of Plant Protection, 55139 Atakum, Samsun, Turkey. Phone: (90)3623121919, Fax: (90)3624576034, E-mail: celalt@omu.edu.tr Web: http://www.hazelnut2017.org
- August 20-24, 2017, Beijing (China): **Greensys 2017 - International Symposium on New Technologies for Environment Control, Energy-Saving and Crop Production in Greenhouse and Plant Factory.** Info: Prof. Dr. Qichang Yang, 211, IEDA, CAAS, 12#, Zhongguancun South Street, Haidian District, Beijing City, 100081, China. Phone: (86)010-82105983, Fax: (86)010-82106021, E-mail: yangqichang@caas.cn or Prof. Dr. Weihong Luo, College of Agriculture, Nanjing Agricultural University, No 1 Rd Weigang, Nanjing, Jiangsu, 210095, China. Phone: (86)25-84399100, Fax: (86)25-84399100, E-mail: lwh@njau.edu.cn E-mail symposium: greensys2017@chinastargroup.com Web: http://www.greensys2017.org
- August 27-30, 2017, Chiba (Japan): NEW **XIII International Symposium on Plant Bioregulators in Fruit Production.** Info: Prof. Dr. Satoru Kondo, Gratuate School of Horticulture, Chiba University, Matsudo, Chiba, 271-8510, Japan. Phone: (81)-47-308-8800, Fax: (81)-47-308-8800, E-mail: s-kondo@faculty.chiba-u.jp E-mail symposium: pgr-fruit2017@ics-inc.co.jp Web: http://www.pgr-fruit2017.org/
- September 4-7, 2017, Potsdam (Germany): NEW **XIV International Asparagus Symposium.** Info: Mr. Jan Gräfe, Institute of Veg.& Ornam.Crops, Theodor-Echtermeyer-Weg, 14979 Grossbeeren, Germany. Phone: (49) 033701 78 353, E-mail: graefe@igzev.de or Carmen Feller, Inst. of Vegetable and Ornamental Crops, Theodor Echtermeyer Weg 1, 14979 Grossbeeren, Germany. Phone: (49)3370178368, E-mail: feller@igzev.de or Dr. Bernhard Brueckner, Leibniz-Institute of Veg and Ornamentals, Theodor-Echtermeyer-Weg 1, 14979 Grossbeeren, Germany. Phone: (49)33701 78252, Fax: (49)33701 55391, E-mail: brueckner@igzev.de E-mail symposium: ias2017@igzev.de Web: http://www.ias2017potsdam.org/
- September 4-7, 2017, Tehran (Iran): NEW **I International Conference & X National Horticultural Science Congress of Iran (IrHC2017) - Theme: Productivity of horticultural crops in Iran: potentials, production limitations, possible solutions and international collaborations.** Info: Prof. Kazem Arzani, Department of Horticultural Science, Tarbiat Modares University (TMU), P.O.Box 14115-336, Tehran, Iran. Phone: (98)2148292094, Fax: (98)2148292200, E-mail: arzani_k@modares.ac.ir E-mail symposium: IrHC2017@gmail.com Web: http://www.IrHC2017.org

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