

A publication of the International Society for Horticultural Science

Chronica Horticulturae



Horticultural highlights

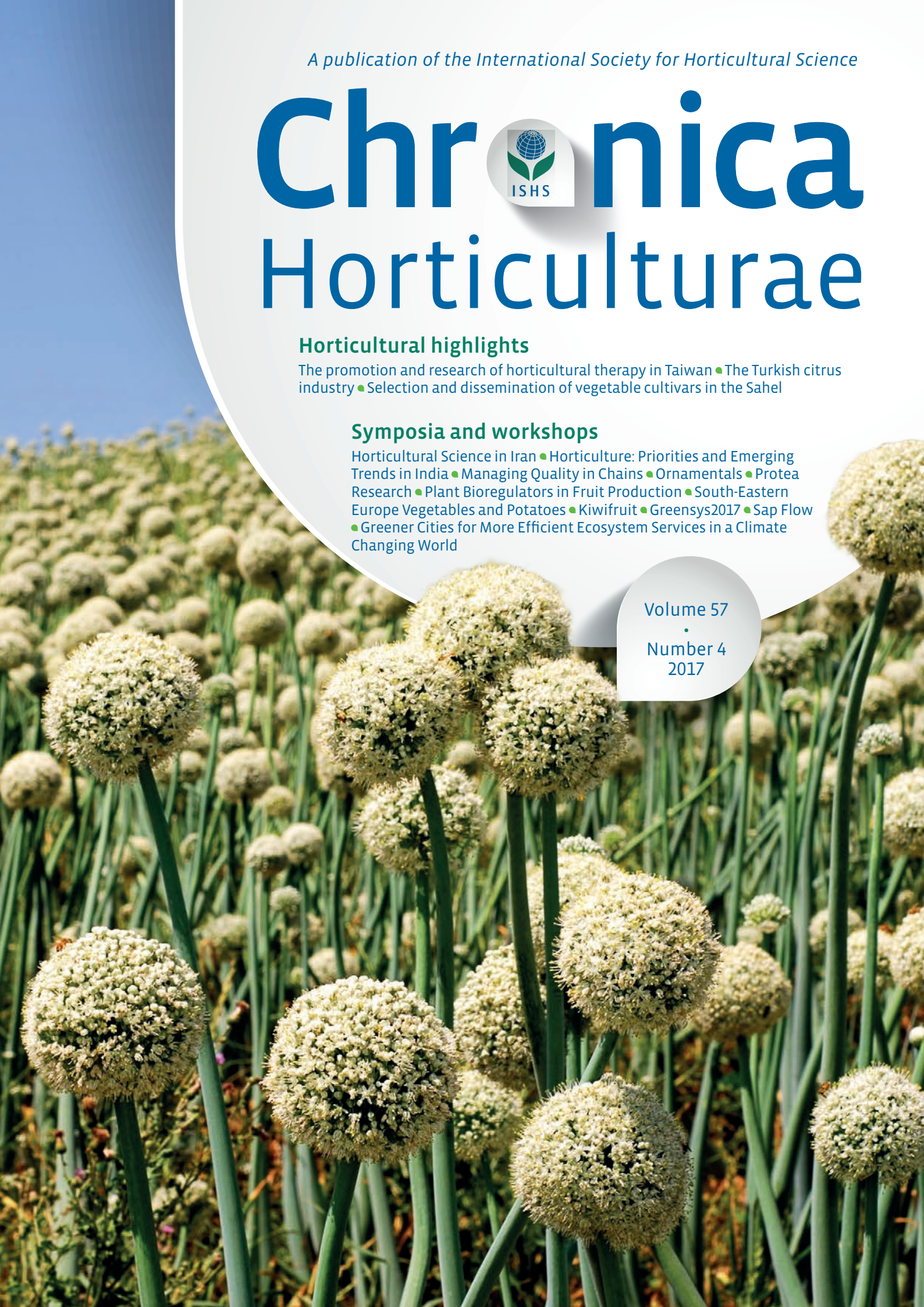
The promotion and research of horticultural therapy in Taiwan • The Turkish citrus industry • Selection and dissemination of vegetable cultivars in the Sahel

Symposia and workshops

Horticultural Science in Iran • Horticulture: Priorities and Emerging Trends in India • Managing Quality in Chains • Ornamentals • Protea Research • Plant Bioregulators in Fruit Production • South-Eastern Europe Vegetables and Potatoes • Kiwifruit • Greensys2017 • Sap Flow • Greener Cities for More Efficient Ecosystem Services in a Climate Changing World

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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 a discounted publishing charge. eJHS is available in print + online Open Access. Additional information can be viewed on www.ishs.org/ejhs.

Fruits – International Journal of Tropical and Subtropical Horticulture

Fruits – International Journal of Tropical and Subtropical Horticulture accepts original research articles and reviews on tropical and subtropical horticultural crops. The Journal is available in print + online. Additional information can be viewed on www.ishs.org/fruits.

Scripta Horticulturae

Scripta Horticulturae is a series from ISHS devoted to specific horticultural issues such as position papers, crop or technology monographs and special workshops or conferences.

PubHort – crossroads of horticultural publications

PubHort is a service of ISHS as part of its mission to promote and to encourage research in all branches of horticulture, and to efficiently transfer knowledge on a global scale. 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, and includes The Horticulture Journal, Journal of the American Pomological Society, Journal of the International Society for Mushroom Science, Proceedings of the International Plant Propagators' Society, Journal of the Interamerican Society for Tropical Horticulture, etc.

Additional information can be viewed on the PubHort website www.pubhort.org.

Cover photograph: Sensitivity to bolting was one of the traits evaluated when selecting the onion landraces most suitable for growing in West African Sahel (Copyright: epsylon_lyrae/Shutterstock). See article p.23.



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

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> Istanbul awaits you for IHC2018!

Yüksel Tüzel, President of IHC2018



> Yüksel Tüzel

In the year 2000, I was the Chair of the Turkish Society for Horticultural Science. I had asked my colleague, Prof. Uygun Aksoy, who was an ISHS Board member at that time, how we could host an International Horticultural Congress (IHC) in Turkey. The procedure was to make prior preparations, apply to the ISHS, and bid at the Council meeting. We fulfilled these requirements, presented our bid in 2002 in Toronto (Canada) to host IHC in 2010 unsuccessfully, and repeated our bid in 2006 in Seoul (South Korea) to host it in 2014, still without success. In 2010 in Lisbon (Portugal) we finally achieved our goal on our third attempt and the Council decided that the 30th IHC would be held in Istanbul, Turkey, in 2018. The reasons behind our goal for hosting IHC in Istanbul were based on three aspects: (i) Institutional and human capacity, (ii) Horticultural production and diversity, and (iii) Destination.

(i) Institutional and human capacity

The Turkish Society for Horticultural Science, founded in 1992 as a professional society, provides a common platform in Turkey for collaboration with individuals from both public and private sectors involved in horticulture. The Society has over 500 members.

The Ministry of Food, Agriculture and Livestock (MFAL), partnering with the Turkish Society for the organization of IHC2018, has very broad horticultural perspectives, managing a strong research capacity within central (9), regional (10), and thematic (40) research institutes.

Universities also represent an important pillar of the institutional and human resource capacity. There are 34 universities in Turkey maintaining an active Horticulture department. These universities have organized various symposia under the umbrella of ISHS over the last 25 years.

There are strong national horticultural networks extending to related fields. For instance, the horticultural science community has organized the National Horticultural Science Congress every four years since 1992, and has organised various conferences/symposia, including topics such as fruit growing, vegetables (since 1996 at two-yearly intervals), postharvest, mushrooms, and ornamental plants. It also conducts workshops, and prints books and conference proceedings.

(ii) Horticultural production and diversity

According to the Organisation for Economic Co-operation and Development (OECD) reports, Turkey is the seventh largest agricultural producer worldwide and a top producer and exporter of a number of crops, such as hazelnuts, chestnuts, apricots, cherries, figs, olives, tobacco, and tea. Agriculture is still an important part of the culture and tradition of Turkey, and horticulture is the livelihood for many rural families. Twenty-three percent of the population live in rural areas and agriculture represents 8% of Turkey's GDP.

Turkey is uniquely located at the convergence of two principal centres of gene origins: the Mediterranean and the Middle East gene centres. These two gene centres overlap in Anatolia, the meeting point of the European and Asian continents. For example, Turkey is the centre of origin of many cereals and of many fruits and vegetables. Anatolia is also the cradle of the world's agriculture. Genetic material has evolved and accumulated for thousands of years. Turkey ranks ninth in terms of richness in biodiversity. Over 33% of its flora is classified as endemic and approximately 75% of all wild plant species of Europe can be found in the Turkish flora.

(iii) Destination

Istanbul is located where East and West, Europe and Asia, meet, with relative proximity to Africa. Istanbul combines incredible history and cultural diversity with the remarkable beauty of the Bosphorus Strait. It is the meeting point and place of the great Roman, Byzantine and Ottoman civilizations. Istanbul is directly accessible from all parts of the world, and served by more than 50 airlines. Turkish Airlines offers direct flights from 99 cities around the world, including from distant cities and countries like Santiago in Chile and Auckland in New Zealand. All major European airports are a 1.5 to 4-hour flight away from Istanbul, and from the east coast of North America and Far East, it is about a 10-hour journey. Besides air, neighbouring Balkan, Mediterranean, and Middle Eastern countries may use other means of transportation.

Turkey does not require a visa for citizens of many developed/developing countries. Those who may need one can easily receive

their visa at the Ataturk Airport in Istanbul when attending an international congress. The Turkish Ministry of Foreign Affairs' website, www.mfa.gov.tr/visa-information-for-foreigners.en.mfa, will provide you with the relevant information.

The Congress venue is in the Istanbul Conventional Centre. Delegates will find as many as 15,000 beds within walking distance / 5-10 minute taxi ride / one-stop bus ride from the convention centre; and many more (16,000) are available within a 15-20 minute taxi ride, or public transport.

Preliminary agenda of IHC2018

IHC2018 will have a rich and innovative scientific program prepared in different formats: Two **colloquia**, of 2 hours each, will be held on 14 and 16 August 2018. They aim to bridge industry with research and production, and form a platform to share experiences to imagine the future. One colloquium entitled "Future technologies in horticulture" will link today and tomorrow in terms of technological innovation in horticulture. For instance, Ms. Maria Boey, President of Institute of Parks & Recreation Singapore (IPRS), is going to tell us the "Future of Cities", based on changes in designs and planning from a horticultural point of view. The second one, "Innovations: adoption of best practices", will host distinguished keynote speakers who will discuss how innovations could be successfully adopted in practice. Christine Zimmermann Loessi, chairwoman of the Association for Vertical Farming, will be one of our speakers to share her experience in Asian countries.

Symposia are the backbone of the IHC2018 and will be scheduled for seven hours per day over the four-day program. Thirty-nine symposia, covering all aspects of horticultural science, will be organized, each lasting 2-3 days. Some of the symposia will be the next symposium within a series that is held every four years. Everybody should be able to find one symposium within the Congress that covers topics of direct interest; and will be able to learn about the latest science of relevance to them, as well as network with colleagues. But at the same time, the diverse program will allow you to drop into a session that is completely outside your normal scientific interests, which can be stimulating and

provide you with some novel and fresh ideas to take home.

Workshops will be organized bringing the burning and important issues into the agendas of participants, and providing opportunities for further cooperation. For instance, “Biostimulants” currently make up over \$1.8 billion of the agricultural market and are becoming increasingly important tools in crop growth and development. “Vertical farming” is another example that has received a lot of attention in recent years. Twelve workshops are scheduled already. One workshop is devoted to young scientists and professionals, to enable interaction and further networking, and they will be able to meet daily to discuss relevant topics.

Training sessions, for example on “Good horticultural practices”, “Organic horticulture” and “ISHS Scientific Writeshop” will be held before and during the Congress.

On Friday 17 August 2018, six different daily technical tours will be offered to Congress participants according to their field of interest.

In addition, **pre- and post-Congress tours** will be organized, combining horticultural aspects, and historical or touristic sights in various regions of Turkey, e.g. Aegean, Antalya and vicinity, Çanakkale and Gallipoli, Black Sea and Cappadocia.

For **accompanying people**, half-day and day tours to areas of interest will also be organized.

Recent news

We have considered requests from different parts of the world and have revised the deadlines: ISHS members could register until 15 December 2017 at a super early bird registration fee. The standard early bird registration is still available until 31 January 2018.

Still abstract submission is open for poster presentations.

What's more...

Shuttle buses from the airport to the city will be available at a low cost. In addition, shuttle buses will be provided in the mornings and evenings between many of the major hotels and the convention centre.

Website

Please visit our website www.ihc2018.org for further information. I am sure the congress will meet all expectations and will be a fantastic occasion for sharing our horticultural science, and networking with colleagues. For further inquiries, please feel free to contact us!

We wish to bridge the whole world through horticulture. ISTANBUL AWAITS YOU! ●



XXX. INTERNATIONAL HORTICULTURAL CONGRESS

12-16 AUGUST 2018
ISTANBUL / TURKEY

www.ihc2018.org

Bridging the World through Horticulture



A number of *Chronica horticultrae* articles that feature Turkish horticulture and horticultural science may be found on the IHC2018 website at

<http://ihc2018.org/en/HORTICULTURE-IN-TURKEY.html>



www.facebook.com/ishs.org

➤ First ISHS Summer School on Pre- and Postharvest Physiology of Temperate Fruit Crops

FruitCRISP – Fruit Crop Responses to Innovations for Sustainable Production

This Summer School is proudly sponsored by the International Society for Horticultural Science, the German Academic Exchange Service and the University of Hohenheim

Are you interested in a complete overview of pre- and postharvest physiological aspects of perennial fruit tree species and in particular of pome (apple, pear) and stone fruit (cherry, plum) but also nut crops under different orchard management and environmental conditions? Then apply for this special Summer School and be introduced not only to the latest scientific findings, but also to innovative orchard practices, monitoring procedures of physico-chemical fruit properties to ensure quality and safety, supply chain management and marketing aspects.

Organised by: International Society for Horticultural Science (ISHS)

Hosted by:

- University of Hohenheim, Stuttgart, Germany
- Centre of Competence for Fruit Cultivation, Lake Constance, Germany

Date: 22 July - 4 August 2018 (2 weeks)

Our approach

The Summer School offers a full schedule of keynotes, discussions, group work, field trips and industry visits. The course, taught in English, offers interactive relationships between teaching fundamental and applied fruit science and practical components of the fruit production process. We will pay attention to the following subject areas:

- Principals of crop management
- Fruit and nut growth and development
- Stress physiology
- Product quality
- Postharvest physiology
- Market and supply chain management
- Modelling and scientific working

The “social factor” is an integral part of the Summer School with joint dinners and

special offers in the evening and over the weekend.

Target group

The Summer School is open for MSc students aiming for a career in the pre- and/or postharvest horticultural sector. The idea is to attract a maximum of 25 students from all over the world to:

- study for two weeks in very attractive locations for horticulture (University of Hohenheim and the Centre of Competence for Fruit Growing, Lake Constance);
- interact with scientific experts in pre- and postharvest physiology of temperate fruit crops who are committed to teaching and practical training;
- provide a certification of attendance to gain credit towards the study degree.

Result

After attending the FruitCRISP Summer School, you will:

- have developed greater knowledge of crop management and professional network opportunities;
- be able to identify horticultural challenges in your native country and formulate potential solutions for mitigation;
- be able to advocate for modern horticulture;
- have gained insights into German study/research programs/organisations and the German regional and cultural heritage.

Summer School leaders

- Prof. Dr. Jens Wünsche, Board member of ISHS, University of Hohenheim, Institute of Crop Science, Section Crop Physiology of Specialty Crops; <https://www.uni-hohenheim.de/>
- Prof. Dr. Chris Watkins, Chair of ISHS Commission Quality and Postharvest Horticulture, Director Cornell Cooperative Extension and Professor for Postharvest Science at Cornell University; <https://hort.cals.cornell.edu/people/christopher-watkins>
- Prof. Dr. Theodore DeJong, Chair of ISHS Section Pome and Stone Fruits, Pomologist Emeritus at the Department

of Plant Sciences, University of California; <http://dejong.ucdavis.edu/>

Admission requirements and registration

Admission requirements are a BSc degree in horticulture or related plant sciences and a complete registration until 28 February 2018. The application does not automatically entitle the applicant to participate in the course program. Applications should be sent to Prof. Dr. Jens Wünsche (jnwuensche@uni-hohenheim.de), University of Hohenheim, and include the following documents:

- short application letter
- CV (max. 1 page)
- study results so far (transcript)
- proof of English language proficiency (e.g. TOEFL, IELTS)
- a letter of motivation (1 page), outlining the interest in horticultural research and why the participation in the Summer School will be of benefit to the study degree and future professional career
- one support/recommendation letter

Notification

Successful applicants will be notified by the end of March 2018. About one month before the start of the Summer School, selected participants receive a more detailed programme.

Course fees

The course fee is 1500,- EUR and covers transport and accommodation in Germany, tuition, course materials, coffee/tea, lunches. A mobility allowance of up to 500,- EUR is offered for each participant. ●



➤ Centre of Competence for Fruit Cultivation, near Lake Constance, Germany.



Spotlight
on Honoured
ISHS Members

> Silvia Dorn

Position or previous position

Full Professor of Applied Entomology at ETH Zurich, Switzerland; Professor Emerita since 2013

ISHS honour

ISHS Fellow since 2010



> Teaching master students in an organic orchard on excursion near Zurich, Switzerland (2010).

1. Tell us a bit about yourself (hometown, current locale, family, hobbies, community involvement).

I grew up in a rural area of Switzerland, some thirty kilometers from Zurich. Now I live right in-between, in a nice and green environment. I have been married since my PhD studies and have raised two sons. All of us share – besides a passion for science – some hobbies including reading and hiking, so we always have lots of topics to discuss. I also like cooking for the family, and when preparing fresh vegetables, I typically add some tasty herbs collected from my garden. Flowers bloom nearly all year round in the garden, and there is even a small orchard nestled in a corner. This is where the pictures of apple trees I like to show at conferences originate from.

Conferences are, in my opinion, a cornerstone of an inspired scientific life. They are important for the development of ideas and the exchange of thoughts, and for technology transfer. This is why I served as an elected council member of the International Congresses of Entomology, and of the European Congresses of Entomology. I became a founding member and later the president of the Swiss Society of Phytomedicine, which encompasses all disciplines around crop health. Moreover I contributed to the establishment of the Swiss Centre for International Agriculture, a platform for scientific projects with developing countries. (It might be helpful to note that we generally use the term “agriculture”, which always includes horticulture as a subdiscipline.)

In 2013, after four decades of professional work in industry and then in academia, I became Professor Emerita. I continue with selected international projects and with my

commitment for greater gender diversity in science.

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

I like plants. This is why I like to protect them from damage caused by pests competing with humans for food. I graduated as a PhD in phytomedicine from ETH Zurich (Swiss Federal Institute of Technology) in 1974. Then, I accepted an attractive job offer from a Swiss-based international crop protection company. They hired me as the first woman research scientist and promoted me later to positions with increasing responsibility. I soon realized that fruits and vegetables rank top in insecticide consumption worldwide, thus I paid particular attention to these high-value crops with the goal to protect them from pest damage in more sustainable ways. My major achievements during these years were the decisive contributions in research and development that led to the first juvenile-hormone-type insect growth regulator for crop protection, fenoxycarb. In the 1980s, it triggered the rapid implementation of integrated cropping systems, especially in fruit orchards in numerous countries around the globe.

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

After nearly 20 successful years in the crop protection industry, including a postdoc/sabbatical in the USA, I was elected full professor and chair of Applied Entomology at ETH Zurich, the top ranked university on mainland Europe. I was the first female professor in the Department of Agricultural and Food Sciences, which I eventually led as Dean. ETH

leaves its professors much freedom, and concurrently expects responsibility, dedication and top results from research and teaching. This is a challenge, but it also opens great opportunities.

I continued to work towards more sustainable agro-ecosystems, particularly in fruits and vegetables. My research focused on insect-plant interactions in middle Europe and in developing countries. It resulted in over 250 peer-reviewed papers published in international journals, and in numerous book chapters. In teaching, I opened my courses designed for students in Agricultural Sciences also to students in Environmental Sciences, as I am convinced that there is one single message to all of them, irrespective of whether they are mainly interested in crop health or in environmental health: we need to simultaneously *use* natural resources while *preserving* such resources for future generations. I supervised over 100 students during their Master thesis, over 40 during their PhD thesis, and nearly 40 post-docs. My group has always been diverse regarding gender and country of origin, and I am convinced that mixed teams generate more innovative and meaningful results.

It came as a great satisfaction to me to be awarded with numerous honours and awards over the course of the years, the last one being a Doctor of Science *honoris causa* from Newcastle University (UK) in 2017.

4. What do you consider were your greatest achievements?

In addition to the above-mentioned main achievement in industry, three further achievements stand out from my work with my team at ETH:



> Professor Silvia Dorn in her office at ETH Zurich, Switzerland (2013).



> Presenting new research findings on the Oriental fruit moth, a globally invasive pest, at the International Congress of Entomology in Daegu, South Korea (2012).

Firstly, the design and proof of concept of a novel, two-winged approach to prevent post-harvest losses of stored grain legumes in the tropics. In a joint effort with partners from the Centro Internacional de Agricultura Tropical in Colombia, we combined natural host-plant resistance (crossed-in from wild beans) with locally collected parasitoids, yielding impressive added benefits. We also elucidated and documented the complex underlying mechanisms.

Secondly, the first detection of pre-imaginal olfactory learning in a parasitoid wasp. This discovery is key to more efficient biological control based on high-quality parasitoids to be released after mass-rearing. Supported by a Swiss governmental institution, I contributed to an efficient technology transfer to an international biocontrol company.

Thirdly, the elucidation of when, why and how insects move in agroecosystems, as a basis for more accurate monitoring and control. FAO, with its subsidiary fostering the Sterile Insect Release, profited from these findings on several continents. Moreover, some organisations caring for native pollinators use our findings on the movement of wild bees between nesting site and pollen sources for their recommendations to governmental institutions and NGOs.

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

Being the first, and for many years the only woman in various leadership functions required a lot of energy, particularly in the early stages of my career both in the industrial and in the academic environment. For example, it was challenging to cope with the repeated comment “she has a family and will

not stay long in this position”, and with the fact that infrastructure for child care was completely absent in our region. Meanwhile, clear progress has been made. There has been much improvement, but old stereotypes about women in science, and about women in leadership positions with children, are still hidden somewhere in our heads. Nowadays, many communities and institutions offer high-quality child care, but combining scientific work with a family remains demanding. This is where my commitment for women in science began. Some younger colleagues seeking advice started to contact me. Together with my husband, who held a demanding full-time position in industry, we usually invited the young couples to discuss hurdles and opportunities while combining scientific career and family. Later, I received many invitations to talk in panel discussions or at workshops on this topic. After our sons left high-school – both graduated with honours – I was able to invest some additional time to read new studies on women in academia and realised how widespread, even ubiquitous the same problems and questions were. I saw the need to champion women in science and to simultaneously advise university leaders, so I finally accepted invitations to give talks also in Asia and America. I could offer insight and encouragement and outline promising steps to achieve greater gender diversity in science. It really touched me to see how many wonderful friends from different countries I made in this process.

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

I like to remember this experience from 1998: The message arrived by fax. It had a professional layout resembling commercial adver-

tisements at that time, so I started to drop it into the waste basket, until I just caught a glimpse of the last line: “flight reimbursed, hotel accommodation paid, it would be an honour to have you as a speaker at The Crans Montana Summit in Monaco”. This looked remarkably exotic to me, so I contacted the organisers and learned that over twenty ministers from developing countries were expected at this summit. The topic was the export of profitable agricultural goods to developed countries in order to gain foreign currency. I accepted to talk on Integrated Pest Management, choosing high-value crops such as fruit and vegetables for illustration. Then I flew to Nice, where a conference assistant was waiting for me at the gate. He drove me swiftly to a helicopter whose propellers were revolving, making it windy and noisy. I climbed in, I fastened my seat belt, and off I went on a flight to the five star hotel in Monte Carlo. I felt as though I was in a James Bond movie. The next surprise followed at dinner. There were round tables with name tags fixed at the plates. I sat down and found myself suddenly surrounded by a group of perfectly dressed bankers, all of them from private banks, the names of which I unfortunately had never come across before. I felt slightly panicked: what should I talk about with these men for the next hour or two? Then, I remembered my recent visit to a horticultural area in Colombia and my discussion with a bean farmer there, and this saved me. “Economy and ecology can fit together well”, I told them, “and bankers can even be the drivers for a rapid implementation of an ecologically meaningful intercropping system in the tropics.” Their attention was caught, and I continued: “The bean farmer I visited in Colombia knew that her bank would lend her the money for purchasing bean seeds only if she agreed

to intercrop the beans with cassava. After a season with little rainfall and subsequently with a poor bean harvest, she could then sell at least some cassava, a drought tolerant crop, so she could pay the interests or even the lent money back to the bank.” The next morning, I was pleased to see all the bankers from my dinner table attending my talk, and they took notes when I emphasised to pay attention not only to product quality, but also to production quality.

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?

Three aspects render ISHS particularly attractive: it is the most important society dealing with fruit and vegetables. It is truly international with its impressive global network. And it brings the different scientific sub-disciplines together, from breeding to crop protection to economics and management. While choosing the societies of which I wanted to become a member, I always considered the potential benefits for my whole group. I am convinced that ISHS played a very helpful role in the career of one of my especially dedicated PhD students. This student was hesitant about whether she should follow a more practical- or a more basic science-oriented career.

› Visiting a field site in Northwestern China, which lays in the native region of different fruit boring insect species (2013).



I sent her then to one of the ISHS symposia, and afterwards, she could take her decision full-heartedly, and she is still successfully working in her application-oriented position. As for me, I am highly honoured to be among the first ten scientists elected as ISHS Fellows, and I felt strongly endorsed when ISHS emphasised that my way to connect basic science to future applications is particularly appealing.

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

Horticulture is very demanding, and challenges are changing, with new cultivars and technologies, and with changing consumer needs and regulations, so there will always

be new questions to solve. My advice: think ahead, observe the continuously changing environment, and be among the first to recognize the new challenges. Then address them with all your competence, creativity and courage. You can contribute to a healthier world.

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

Horticulture will play a key role for a balanced nutrition of a growing world population. Topics deserving particular attention include invasive organisms, climate change, and design of landscapes that allow all the native species to survive. ●

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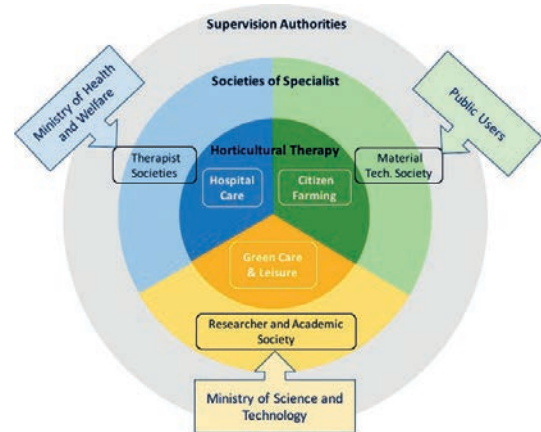


> The promotion and research of horticultural therapy in Taiwan

Y.-H. Lin and C.-Y. Chang

Taiwan has both strong developments in promoting associations and cutting-edge research in horticultural therapy (HT). For several decades, the HT associations in Taiwan have been active in promoting horticulture. Besides that, research in Taiwan has been strengthened with governmental support funding. Recent articles have been published in high quality academic journals of horticulture, landscape architecture, leisure, and psychology. East Asian countries share a unique cultural background from traditional medicine as presented within Confucianism, Buddhism, and Daoism. Thus, East Asia needs to develop HT in a way that is consistent with the region's cultural characteristics.

In this article, we briefly introduce the development of the HT associations and related studies in Taiwan. We believe that this summary might provide some solid scientific guidance in support of the practice of HT and the therapeutic nature of landscape activity.



■ Figure 1. Horticultural therapy (HT) organizations and their relationships in Taiwan.

Introduction

Anyone who devotes a lot of time to gardening understands the profound experience of interacting with plants and soil, and feeling the sense of inner peace that it can bring. *Chronica Horticulturae* has more than 6000 readers, the majority of whom are professional horticulturists and familiar with these experiences. However, beautiful and positive experiences with nature may be lacking in modern life. For those who are missing these experiences, gardening could have a profound impact.

Horticultural therapy (HT) is not a new practice. Historical documents demonstrate that humans have used landscaping or gardening as ways to pursue peace in life. Many famous gardens in East Asia were built imitating natural mountains and bodies of water for retired or sick people. In the Atayal tribe, an aboriginal tribe in Taiwan, for example, the traditional method to treat aches in the body is to have the witch doctor talk to the herb's roots before applying them to the patient's body. Horticultural activity continues to be an effective means of boosting health and happiness at a low cost, without side effects.

A short history of HT in East Asia

Most countries in East Asia, including Taiwan, are quite crowded. As these countries became industrialized and the agricultural economy became less labor-intensive, large numbers of people, especially the younger generations, moved to cities. These localities

became very urbanized and densely populated. The nature of work changed significantly as well. Work on assembly lines, and family members spending the day apart, replaced the traditional situation of earlier generations in which families worked together on their farms. Interpersonal networks broke down or were significantly reshaped. The rise of internet culture has further eroded and modified the nature of social interaction. Asian society is known to rely hugely on family activity, and the aforementioned changes have massively reduced outdoor activities and contact with nature. Therefore, activities involving social interactions, physical activities, and interaction with nature are imperative to improve the well-being of modern East Asian societies.

The aging of populations in developed countries is an issue of great concern to the World Health Organization (WHO) of the United Nations (UN). East Asian societies are aging more rapidly than most other developed countries. By 2025, Taiwan and South Korea will rank just behind Japan in terms of the countries with the most elderly people, according to research estimates, surpassing Germany and Italy (Huang, 2014). According to a UN investigation, the aging index is higher in more developed regions, their population aged over 60 will be about 32.8% in 2050 (United Nations, 2015). However, in Taiwan, South Korea and Japan, more than 35% of the population will be age 65 or above by then (Huang, 2014). In the face of such a

remarkable challenge, care for the elderly and their well-being has become a focus of social concern in East Asia. The governments and the civil societies of these countries have invested a great deal of resources and effort in trying to reverse the disregard for, and stereotypes of, the elderly and therefore improve their well-being in a variety of ways. This is not just a challenge of improving infrastructure but also social programs such as effective activity programs. These efforts in East Asia are bringing about major changes in these societies' vision of the future.

According to WHO, generally recognized important measures include: active aging, aging in place, age-friendly cities. Policies that facilitate active aging, or these kinds of activities, are a focal point for future social needs. Guidelines proposed by WHO include that the elderly must be able to participate, to practice good health, and to have secure and safe conditions in the activities they undertake (WHO, 2002). HT is now being considered as a great tool to achieve these objectives. Popularizing it will depend on intersectoral action¹ and core policy. In the past, horticulture has been considered an activity with economic goals within East Asian countries, and has seldom been seen as a leisure

¹Intersectoral action is a specific term that refers to actions undertaken by sectors outside the health sector in cooperation with the health sector on the purpose of improving public health. http://www.who.int/kobe_centre/interventions/intersectoral_action/en/



■ Figure 2. Street photos without or with trees shown to the experimental groups.



■ Figure 3. Biofeedback data collection after participation in an HT activity, both outdoor (left, right) and indoor (center).

activity, unlike Europe or the United States. Therefore, to promote HT or green leisure on a widespread scale, governmental and foundational investment must be made in building facilities and training professionals. But given the level of interest in promoting an active-ageing society, HT, as a green leisure or as a therapy aid, is the rising star in East Asia. East Asia is now recognizing and embracing HT. However, HT in East Asia is behind in its development compared with Europe and North America. For the past decade, human resource investment has been made. However, the East Asian region has unique religious and cultural practices, such as Chinese medicine, Daoism, Confucianism, and Buddhism. In East Asia, the idea that a person is healthy while he or she is in harmony with nature is key. Therefore, the best treatments for illness are natural ingredients. The interaction between people and plants, especially with the elderly, are rooted in nature. Horticultural therapists must understand these concepts, to consider how to design activities that harmonize with East Asian cultural practices. Copying practices directly from Europe or North America will not work. East Asia needs to develop HT in a way that is consistent with the region's cultural characteristics.

Because of the foreseeable potential demand for HT in East Asian society, the Asia Pacific Association of Therapeutic Horticulture (APATH) was founded in 2007. In 2015, the Horticultural Therapy Alliance in Asia (HTAA) was founded. Their objectives include providing a platform for scholars and practitioners to communicate with each other. They hold international conferences every year. In addition, they cooperate with hospitals and care facilities, where they educate and practice. In Taiwan, HT is divided into three categories: “green care and leisure,” “practical hospital care,” and “citizen farming.” Each of these are driven by different professional groups, focusing on theoretical research in some cases, practical application in others, and supervised by different parties (Figure 1). Taiwan currently has four professional groups involved in HT. The first, “the Society of People-Plant Relationship in Taiwan”, was founded in 2007, and its work is mainly researching and promoting “green care and leisure” theories. The core purpose is to connect relevant researchers, to promote the natural health of people, to manage academic activities, and to publish. Their membership mainly consists of northern Taiwan academic unit staff. They have successfully promoted six academic conferences, including interna-

tional symposia, and published three books (Chang, 2008, 2010; Society of People-Plant Relationship in Taiwan, 2009). Regarding “practical hospital care,” in 2010, the “Formosa Green Care Association” was established as an organization to promote the planning of activities for holistic health. It has focused on cooperation with medical units, particularly with Tzu Chi Hospital and rehabilitation centers. It is registered with APATH, and holds an international horticultural therapy conference each year in central and southern regions of Taiwan. In addition to the “Formosa Green Care Association,” the “Taiwan Horticultural Therapy Association (THTA)” was established in 2012, and is also one of the registered organizations of APATH. THTA mainly cooperates with Far Eastern Memorial Hospital and specializes in mental disorder patients and the elderly. THTA trains horticultural therapists with a solid framework. THTA is also responsible for holding the APATH International Horticultural Conference in northern Taiwan. It has also published three books of conference proceedings (Taiwan Horticultural Therapy Association, 2014, 2015, 2016). The third direction of HT in Taiwan is “citizen farming,” which is under the oversight of the “Horticultural Well-Being Promotion Associa-



■ Figure 4. The fMRI equipment (left) and an example of an image of brain scan (right).

tion,” and was founded in 2014. Members are known for their specialization in horticultural materials and technology. This association guides the government in building public farms in parks, plazas, and schools.

Relative studies in Taiwan

In 2014, according to the statistics of the Ministry of Health and Welfare, there were about 1.65 million psychiatric patients in Taiwan’s six major cities (New Taipei City, Taipei City, Taoyuan City, Taichung City, Tainan City and Kaohsiung City), accounting for 10.2% of the total population. More than half were neurotic disorder patients, e.g., anxiety, depression, fear, and other symptoms (Ministry of Health and Welfare, 2016). This suggests that the chronic pressure of the modern urban environment has been seriously affecting the health of the citizens.

The first stage

At the beginning of Taiwan’s extensive involvement in HT, researchers focused on the establishment of a wide range of assessment tools, through literature review, qualitative data analysis, and observation and interviews, with the aim of comprehensively exploring the outcomes through contact with plant materials (Chen et al., 2010; Tsao et al., 2008; Wang and Chang, 2008). The first stage of HT studies in Taiwan conducted on an ever-wider variety of issues, resulted in a new level of understanding of HT and its application. Significant effort is being expended on making HT design more diversified and more practical on the evidence base.

Contact with natural elements

Because of the excessive pressures of modern society, people are too often exhausted. Researchers want to figure out how HT activities can possibly combat psychological fatigue and help people recover from being

stressed, anxious, tired, and unable to focus (Chen et al., 2010).

Since the 1970s, evidence that natural landscapes or materials contribute to recovery from mental fatigue, improve mood and self-control, and effectively relieve stress, has been demonstrated (Chang et al., 2008; Kaplan and Kaplan, 1989; Korpela, 1992; Ulrich, 1979, 1984). Just by taking a break in a natural setting or simply by watching it, one can benefit from mental and physical restoration. Those who are highly active in natural settings may benefit even more. For example, practicing qi in a green space, compared with practicing it indoors, produces a higher flow experience, which means a person is full of energized focus and a feeling of joy (Hung, 2013).

Interacting with natural landscapes or materials, which is the core component of HT activities, could promote awareness of natural connectedness, which has been shown to heighten one’s feelings of security while interacting with nature. Feeling safer in nature will therefore promote positive environmental information awareness and enable people to experience richer details of the environment (Tang et al., 2015). An experiment that manipulated the level of awareness of street trees scenes (Figure 2) revealed that heightened awareness while contacting natural elements enhances one’s attentional capacity in general (Lin et al., 2014). This result suggests that activities such as HT have great potential to restore participants’ mental fatigue. Moreover, if there are natural sounds nearby, such as sounds of water, participants in HT show significant improvement in mood and give a more positive evaluation of the environment (Liao, 2014).

HT can affect a range of groups

HT activity applies to a wide variety of groups including the elderly, children, and patients

with mental illness. Through interviews and grounded processing, we’ve learned that the elderly in Taiwan are very receptive to HT activities. Through these operations, the elderly showed seven characteristics: the spirit of continuing, careers, personal efforts, sustainable benefits, unique ethos, sense of identity and reflection of life, of which the first six are similar to the serious leisure perspectives that were strong predictors for quality of life. Obstacles to the elderly continuing to engage in HT activities included: situations where the living environment was unsuitable, situations in which they experienced failure, or other alternative activities such as playing chess or any board game (Huang, 2013). Our survey also showed that dementia patients who are exposed to HT, received physical benefits (e.g. better physical health), psychological benefits (e.g. expressing thanks and modesty, increasing sense of pride and accomplishment, decreasing anxiety, improved positive emotion, thirst for knowledge, feeling fun), cognitive benefits (e.g. evoking past memories, improved observation and thinking, sensory stimulation, inspiring imagination, enhanced memory function), and social benefits (e.g. improved sharing, helping, engagement, and praise) (Tung, 2012).

A survey conducted across primary schools in Taipei showed that the cultivation of fruits and vegetables improved the mood of pupils and increased the motivation of primary school students. In addition, pupils were willing to eat more fruits and vegetables (Chang, 2017). Seven benefits that children can derive from HT in their school were identified, including increasing life skills, producing pleasant feelings, improving relationships, and having plants as companions, acquiring new knowledge, experiencing the aroma and flavor of fruits and vegetables, improving health, and increasing connection to nature.



■ Figure 5. Comparing visitors' responses to the diverse scenery in different leisure farms.

In Taiwan, girls and boys had different preferences for gardening (Chang et al., 2016). Also, interview data showed that outdoor activity benefited children with autism by promoting their communication, positive emotion, cognition, interaction, and physical activity, and decreasing hypersensitivity (Chang and Chang, 2010).

In a psychiatric nursing home in northern Taiwan, we also compared greening intervention effects, both indoor and outdoor. Our results showed that residents' satisfaction, attention recovery assessment, and mood improved significantly in the three weeks of experiencing green environments. As the nursing home is a care agency, the impact of environmental quality on the occupants could be profound. Thus, in addition to greening promotion, HT also encouraged the residents to participate in maintenance work, which gave them a sense of achievement and satisfaction (Lee, 2010).

Physiological recorded evidence

By recording the biofeedback – or psychophysiological – responses to viewing the landscape (Figure 3), we've learned that participants were relaxed and tranquil while viewing mountains, with their brain waves (EEG) showing a high incidence of right brain α wave activity. Showing a natural mountain view encouraged the viewer to effectively relax (Hung and Chang, 2002). In another study, by recording EEG, electromyography (EMG), and peripheral blood flow (BVP), we tested how perceived restorativeness might impact on our psychophysiological responses. The results showed that when restorativeness was observed by the participants, their psychophysiological relaxation response

was observed at the same time (Chang et al., 2008). Another experiment also showed that improved scores on the perceived restorativeness scale corresponded to increased EMG and EEG readings and lower BVP measurements. In this study, the potential importance of wilderness environments was highlighted (Chang et al., 2008). Besides photos, we also used a variety of experimental materials, including films, real sites, or even digitalized spatial texture (Ho et al., 2014; Lin, 2007; Yen, 2007), and we've learned that the perception of naturalness consistently predicted participants' sense of relaxation and restoration.

In the past, we "guessed" how benefits happened when interacting with nature. In recent years, thanks to technology, we are able to "look" at what is happening in one's brain. It is now possible to directly monitor the degree of activation of the brain through functional magnetic resonance imaging (fMRI) (Figure 4). For example, we have found that when a landscape designer is drawing, the left front frontal lobe is activated (Tsai, 2015), which is a highly activated area of top-down attention system (Corbetta et al., 2008). Furthermore, we compared activation of the brain while viewing natural versus urban landscapes (Tang et al., 2017). The results showed that brain activation was low when viewing natural landscapes such as mountains, forests, and water bodies, but highly activated when viewing city street images. To our knowledge, this study was the first one that revealed how the brain reacts to viewing landscapes, and was strong evidence that the brain could really "rest" when the person perceived a natural environment.

Will the setting be helpful?

Enjoy potted plants indoors. Exquisite potted plants are excellent indoor decorations. Our studies found that just by taking a break in a space where there was a green plant, participants could effectively reduce pressure and increase positive feelings (Peng and Chang, 2008). Potted plants or window views of greenery in the office promote stress relief and relaxation (Chang and Chen, 2005). Furthermore, potted plants in a waiting room help patients to relax and perform better spatial cognition (Hsieh, 2008).

Room with a natural scenery window. Our studies indicated that it is good for a space to have a window view of a natural landscape. Even in the forest, the perception of space and security will be different depending on the actual outlook. Participants who saw through the gap between trees reported better psychological evaluations than those whose view was blocked completely by trees or had no tree at all (Hsiao, 2011). More contextual information from the background setting may be able to effectively reduce the feeling of insecurity in the woods (Chiang et al., 2011). In addition, our experiment showed that the participants were less nervous or anxious when watching a window view of nature in the workplace environment than watching a view of an urban setting (Chang and Chen, 2005).

Agricultural leisure experiences. Surveys on agriculture tourism showed that most visitors expected to be close to nature on their trip. Activities which visitors would like to engage in included plant identification, plant cultivation, sliding on grass, running on grass, and interaction with animals. Farmland and crop landscape, natural water

bodies, wild birds, animals, and insects, all play an important role in environmental recreation experiences in agricultural areas (Chang et al., 2012). On the mountain farm, visitors' landscape preference was related to bird diversity (Hsiao, 2011).

In recent years, the Taiwanese government has vigorously encouraged the transformation of agricultural areas into leisure agricultural use and provided research funding to encourage the development of "green leisure". Research teams in National Taiwan University (NTU) cooperated to study multiple landscape compositions at the NTU Experimental Farm, NTU Mei-Feng Highland Farm and NTU Experimental Forest to identify their health values (Figure 5). The variety of agricultural land use in Taiwan now is a great resource for the future health care industry, and it can be developed into a diver-

sified green care facility and leisure base. In the future, through cloud technology, a health-reference library for public health might have great potential. We can attract public participation through promotion of these benefits.

Conclusion

The future trend of Taiwan's HT should include research on incorporation of different cultural theories, including additional participants from different focus groups, and utilization of Taiwan's natural resources. Firstly, applications of HT incorporating local cultural elements, such as Daoist five elements theory, Feng-Shui theories, and knowledge of Chinese medicine, should be tested. Next, there should be more research on how different participants benefit from HT in different ways, and how to customize the pro-

gram more effectively. And lastly, Taiwan has a huge amount of mountain forest resources and rural areas, and it would be worth the investment to determine how to best use HT to capitalize on these natural spaces.

In other parts of East Asia, such as South Korea, Japan, and Hong Kong, the study of HT is also ongoing. South Korea puts a strong emphasis on physiological evidence demonstrating how muscles react during HT, thus clarifying the physical rehabilitation value of HT (Park et al., 2017). Japan has been making in-depth studies of, and practical results for, the elderly care system. Hong Kong has had many achievements in the application of HT in palliative care. In the coming years, with the integration of the characteristics and expertise of each East Asian country, East Asia is expected to form an important base for progress in HT. ●

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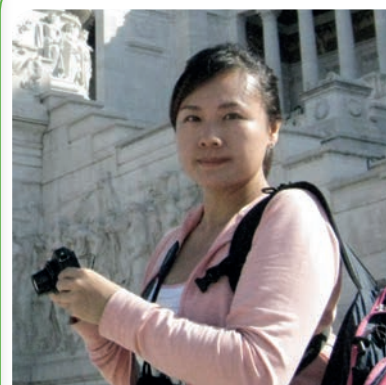
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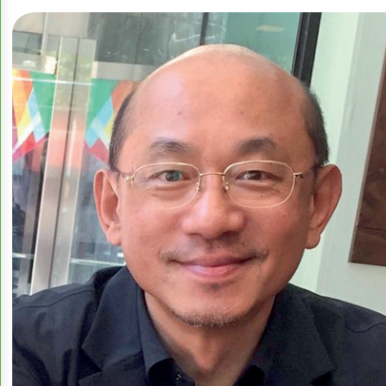
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Visualization of dynamics in woody tissue photosynthesis via positron autoradiography of xylem-transported $^{11}\text{CO}_2$



> Jens Mincke

Jens Mincke obtained his MSc in Chemistry and Bioprocess Technology at Ghent University in 2013 and obtained a second MSc in Biomedical Engineering at Ghent University & Vrije Universiteit Brussel in 2015. Jens is currently conducting PhD research under the supervision of Prof. Dr. ir. Kathy Steppe (research group: Laboratory of Plant Ecology) and Prof. Dr. Stefaan Vandenbergh (research

group: Medical Imaging and Signal Processing) at Ghent University. His research focuses on tracing radioactive molecules in xylem of plants to quantify the contribution of internally transported CO_2 to the total carbon budget. This locally respired internal CO_2 is substantially higher in concentration (<1 to >26%) than the atmospheric CO_2 concentration ($\pm 0,04\%$). It is known that a portion of this CO_2 escapes into the atmosphere during transport and that photosynthetic active cells in stem or leaves can fix another portion. A new approach for direct visualization of woody tissue (stem) photosynthesis has been developed and implies the use of a radioactive [^{11}C]-tracer. To this end, a cut branch is put in an aqueous solution containing dissolved ^{11}C -labelled CO_2 molecules. Uptake and transpiration of the enriched solution is triggered by illumination of the branch with light emitting diodes, which is also necessary for (stem) photosynthesis to occur. Afterwards, autoradiography is performed to detect the location and distribution of radioactivity inside the branch. Dynamics in woody tissue photosynthesis were investigated using different treatments, including wrapping of aluminium foil to exclude photosynthetically active radia-

tion from reaching a section of the branch. In addition, a similar treatment with dissolved [^{18}F]fluorine was applied to investigate water transport. Experiments were conducted on young branches of poplar, a species in which CO_2 refixation has been reported. Results demonstrated that woody tissue photosynthesis is a very dynamic process in young woody plants, implying that sap flow is not only important for understanding the water relations in plants, but also contributes to the carbon balance. Therefore, green stem tissues are important for the functioning of plants, and may be more important than previously thought under dry conditions.

Jens Mincke won an ISHS student award for the best oral presentation at the X International Workshop on Sap Flow in USA in May 2017.

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S-RNase allele identification and incompatibility group assignment in apricot cultivars



> Sara Herrera

Apricot (*Prunus armeniaca* L.) is a temperate fruit species cultivated in more than 60 countries. In recent years, an important renewal of plant material is taking place worldwide. Traditionally, pollination requirements have not been considered important because most cultivars in Europe were self-compatible. However, the use of self-incompatible cultivars from North America as parental genotypes in several breeding programs, with the objective of incorporating a source of resistance to *Plum pox virus* (sharka), is resulting in the introduction of an increasing number of new self-incompatible cultivars, whose pollination requirements are unknown. In *Rosaceae* self(in)compatibility is determined genetically by a gametophytic system (GSI) that acts by the inhibition of the

pollen tube growth in the style. This mechanism is controlled by a multiallelic locus *S*, which encodes two genes that determine the pistil and pollen genotype. In the pistil it is expressed as a ribonuclease, S-RNase, which determines the specificity of the style while the pollen determinant is a protein with an F-box, called SFB. When the *S*-allele in the pollen grain is the same as either of the two alleles expressed in the pistil, pollen tube growth is arrested in the style, preventing fertilization of the ovule.

In this work, we perform the S-RNase allele identification in a group of 48 cultivars from different breeding programs, in order to establish the incompatibility relationships among cultivars. The two *S*-alleles of each cultivar were determined by PCR amplifica-

tion of the *S-RNase* gene. The results enabled allocation of the cultivars into their corresponding incompatibility groups. To date, 33 different alleles have been identified in apricot, and one of them, identified as *Sc*, has been associated to the self-compatibility character. These results are valuable for the selection of parental genotypes in apricot breeding programs and for an appropriate

distribution of pollenizer cultivars in commercial orchards.

Sara Herrera is currently pursuing her PhD under the direction of J. Rodrigo (CITA-IA2-Universidad de Zaragoza), J.I. Hormaza and J. Lora (IHSM-UMA-CSIC). She won an ISHS student award for the best poster at the International Symposium on Flowering, Fruit Set and Alternate Bearing in Italy in June 2017.

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Study on pollen morphology and germination of 'Pavia' liliium (*Lilium longiflorum*)



> Narendra Singh Bhandari

Lilium (commonly known as lily) is one of the most important bulbous flower genera belonging to the family *Liliaceae*, and is native to temperate regions of the northern hemisphere. It is used for cut flower production, pot plant production and landscaping purposes. Each year the interest in lilies increases around the world. Presently they hold the fourth position among cut flowers in world flower trade.

Pollen is a unique plant tissue that potentially can be used and manipulated to the advantage of the geneticist, breeder, physiologist and germplasm curator. A pollen morphology and pollen germination study of *Lilium* 'Pavia' was carried out at ICAR-Indian Institute of Horticultural Research (IHR), Bengaluru. Various morphological characteristics like pollen shape, size of pollen, and exine ornamentation were studied. Shape of pollen was elliptical to ellipsoid with reticulate exine. The ability of pollen to germinate before and after anthesis was tested. An in vitro germination test of pollen was conducted by the wet room method; nutrient media for pollen inoculation had different concentrations of sucrose, poly ethylene glycol (PEG), and Brewbaker & Kwack's Salt. The pollen germination capacity was determined at set intervals, thereby establishing the dynamics of this process for three days. Germination was initiated within 45 minutes and the highest germination (70%) was recorded on a medium with 3% sucrose, 1.5% PEG and Brewbaker & Kwack's Salt after 24 hours. The pollen harvested 1 hour after anthesis gave maximum germination (70%). The pollen germinated poorly (5-10%) when harvested before anthesis or one

day after anthesis. During the first 24 hours after inoculation, pollen showed significantly improved germination as compared to second and third day germinated pollen on the same media. Based on this investigation, it was concluded that pollen harvested one hour after anthesis is the most suitable for hybridization, using the cut style method to overcome the self incompatibility barrier, for development of new lily hybrids under tropical conditions. Narendra Singh Bhandari won an ISHS student award for the best oral presentation at the International Symposium on Horticulture: Priorities and Emerging Trends in India in September 2017.

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The effect of soil depth heterogeneity on species diversity, biomass, and weedy species colonization on an extensive green roof



> Amy Heim

Currently, the majority of extensive green roofs are planted solely with species from the genus *Sedum*. These plants are extremely drought tolerant but are not as efficient at providing ecosystem services as other poten-

tial green roof vegetation. For example, taller species with wider leaves are more efficient at reducing storm water runoff and substrate temperatures than the short succulent *Sedum* species. However, this does not necessarily mean that *Sedum* should be excluded from green roof vegetation. Research has demonstrated that biodiverse green roofs, containing a mixture of growth forms, may improve overall green roof function. This three-year study examined how soil depth heterogeneity may increase plant diversity and increase biomass on extensive green roofs. This study was composed of three homogenous soil depth treatments (15, 10 and 5 cm) and one heterogeneous treatment (soil depth varied between 5 and 15 cm). Each treatment was planted with 20 different species, and measurements for species diversity and plant biomass were collected. Overall, soil depth heterogeneity resulted in an over-

all increase in plant biomass, compared to the homogenous treatment containing the same quantity of soil (10 cm treatment). However, for plant diversity and weedy species colonization, little difference was observed between these two treatments. More time is necessary to see if the trends observed continue in the future.

Amy Heim won an ISHS student award for the best poster at the International Symposium on Greener Cities for More Efficient Ecosystem Services in a Climate Changing World in Italy in September 2017. ●

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>The Turkish citrus industry

Turgut Yeşiloğlu, Bilge Yılmaz,
Meral Incesu and Berken Çimen



Introduction

Citrus are one of the most important tree fruit crop groups in the world, and these fruits are regarded as important household foods in more than 100 countries around the world, as well as the world juice industry, of which citrus juices have the greatest volume. Citrus is considered as the leading industry in some regions, such as the mountainous regions of China and coastal plains in several countries, such as California and Florida in USA, Valencia in Spain, Sicily in Italy, and the Cukurova region in Turkey (Cimen and Yesiloglu, 2016).

Alexander the Great introduced citrus to Turkey, as well as many other areas of the Middle East, in the fourth century BC. Since then, Turkey has planted considerable areas of citrus, including most of the cultivars grown in many other citrus production areas of the world (Faber et al., 2010).

In 2013, Turkey was among the top three citrus producing countries in the Mediterranean Basin and ranked ninth in the world, accounting for about 2.7% of the 137 million tons of citrus produced globally (Faostat, 2017). Total citrus production of Turkey was 4,293,007 t in 2016 (TUİK, 2017). Oranges are the main citrus fruit grown in Turkey, accounting for about 43% of total production (1,850,000 t). Orange production is followed by mandarins (1,337,037 t), lemons (850,600 t), grapefruit (253,120 t) and others (2,250 t).

Data on annual citrus production in Turkey since 1965 is presented in Figure 1. There has been a rapid and steady expansion in citrus

output in Turkey over the last fifty years, with approximately 2% increase per year. In 2015, Turkey's citrus production was nine times the production in 1965 (TUİK, 2017). Mandarins and their hybrids are currently the preferred citrus crop for new plantations. Therefore, while all citrus production is tending to increase, the proportion of mandarins is increasing more rapidly. Recently, field crops, such as cotton, are being replaced with citrus. However, citrus farming requires initial investments, and therefore not all farmers are ready for growing citrus. Unstable market conditions observed during recent years may be a factor that is limiting the trend of expansion of citrus.

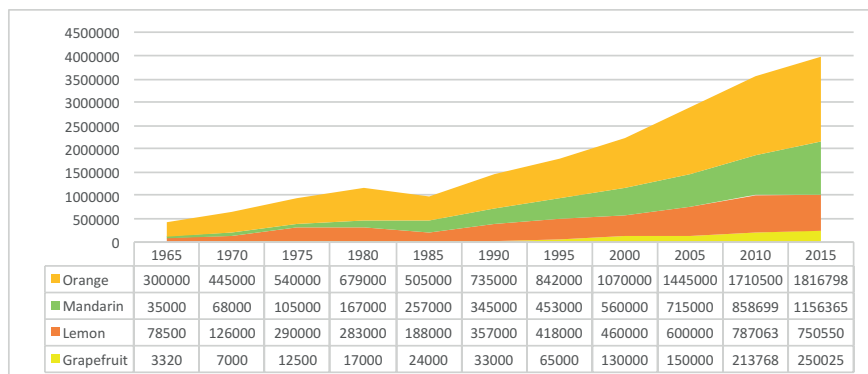
The citrus area in Turkey has expanded rapidly, increasing from 39,488 ha in 1970 to about 135,466 ha in 2016. This expansion is driven by domestic and export demands. It is believed that Turkey has a production potential at least five times the present level. The growers in major growing areas like Cukurova and Antalya, where the Mediterranean climate is more suitable for high quality citrus, continue to shift to citrus from field crops (cotton and grains) because of its more attractive returns. In these regions, high quality citrus fruit production is oriented particularly towards fresh fruit markets and consumption. According to statistics, 52,696 ha were planted in oranges, 46,569 ha in mandarins, 30,033 ha in lemons and 6,155 ha in grapefruits in 2016. Currently, Turkey has over 42,364,546 citrus trees. Non-bearing trees account for about 11.6% of the total trees (TUİK, 2016).

Citrus growing areas of the world are located mainly in tropical, semi tropical and sub-tropical regions, between the equator and latitudes 40°N and 40°S. Citrus growing areas of Turkey are situated in the northern hemisphere of this citrus belt. Frost risk exists to some extent in citrus farming. The major citrus producing areas are located along Turkey's southern Mediterranean and Aegean coastal plains, where typical mild or cool Mediterranean subtropical climate prevails. The majority of the citrus growing areas are located in the Mediterranean region (Figure 2). Approximately 85% of oranges, 85% of mandarins, 94% of lemons, and 98% of grapefruit are being produced in this region. The Mediterranean region is generally divided in two main sub-regions: Eastern and Western Mediterranean. The Eastern Mediterranean region covers mainly coastal parts of Cukurova plain and accounts for 73% of Turkey's total citrus production; 57% of oranges, 83% of mandarins, 87% of lemons and 96% of grapefruit. In Cukurova, production of late cultivars may be problematic because of frequent winter rains, which can increase fungal diseases and winter frosts. In Cukurova, the Mersin province specializes in lemon production, while oranges are mainly produced in Adana and Hatay provinces. Adana is also the main grapefruit-producing province. Mandarins are mainly produced in Hatay and Adana provinces. The western part of the Mediterranean is the second largest citrus area of Turkey. This sub-region includes the Antalya province, located in the western part of the Mediterranean coast. It produces about 14% of Turkey's total citrus crop, mainly oranges (about 28% of the total Turkish orange production).

The third largest citrus area in Turkey is the Aegean region, composed of Mugla, İzmir and Aydın provinces, encompassing 12% of the total citrus production, and specializing mainly in orange and mandarin production. This region provides 15% of the total orange production and 14% of the total mandarin production.

The other citrus areas, located in Western Marmara and Eastern Black Sea regions, have a negligible production (0.3 and 0.2% respectively).

In Aegean and Mediterranean regions, farm sizes are generally small. On the other hand,



■ Figure 1. Development of citrus production in Turkey.



■ Figure 2. Citrus production regions of Turkey. An increasing orange dot size represents higher production amounts.



■ Figure 3. The fruit of Valencia orange.



■ Figure 4. Cross-sections of the fruit of 'Cara Cara' (left) and 'Navelina' (right) navel oranges.



■ Figure 5. The fruit of 'Okitsu' mandarin.

there are big citrus farms of approximately 700-800 ha in Adana province. Because of the new plantations in the Eastern Mediterranean region, citrus trees are generally young in this part of Turkey. Modern agricultural techniques are being employed in newly established plantations and especially on the larger citrus orchards.

Recently, the division of farms by inheritance has been prevented by legal regulations. Regulations of the "soil protection and land use act" were published in May 15, 2014 in the Official Gazette. According to these regulations, the minimum land size has been determined by the Ministry of Food, Agriculture and Livestock and plots of land are not allowed to be divided any smaller than this minimum. In addition, land consolidation programs are being implemented by the Ministry more intensively in recent years.

Cultivars and rootstocks

Seventy-five percent of sweet orange production are navels such as 'Washington', 'Navelina', 'Lane Late', 'Navelate', 'Fukumoto', and 'Cara Cara' (Figures 3 and 4). The rest of orange production are Valencia cultivars, 'Shamouti' and other local selections. Sixty-three percent of the mandarins are Satsuma cultivars, such as 'Owari', 'Okitsu Wase', 'Mihowase' and 'Dobashi Beni'; the rest of the plantings include 'Clementine', 'Nova', 'Rob-

inson', 'Fremont', 'Minneola', 'W. Murcott', 'Tango', 'Ortanique' and 'Primasol' (Figures 5-8). Fifty percent of the lemons are 'Kutdiken' lemon (*Citrus limon* L., a local selection), and 20% are 'Interdonato' (Italy), which are less susceptible to a fatal fungal disease, Mal Secco (*Phoma tracheiphila*). The third most popular cultivar, 'Meyer', is gaining popularity rapidly because of high yields and even more resistance to Mal Secco and to cooler conditions (20%; Figure 9). The remaining important lemon cultivars are 'Aydın' (10%), 'Italian Memeli', 'Lamas' and 'Eureka'. 'Star Ruby' is the dominant grapefruit cultivar (about 43%) in Turkey. It is followed by 'Rio Red', which represents about 40% of production. The other main grapefruit cultivars are 'Henderson', 'Ray Ruby', 'Flame', 'Marsh Seedless' and 'Redblush'.

Lemons are the earliest citrus species to be harvested compared with other citrus crops in Turkey. The lemon harvest begins in September and continues through to late-March. Mandarins and their hybrids are harvested from mid-September through to mid-March. Most of the oranges mature during winter months, starting in late-October and continue through to early-April. The grapefruit are harvested from mid-October through to mid-March.

Citrus wholesalers often prolong the season by storing citrus, mainly lemons and some oranges and grapefruits, in cold storage in

the Mediterranean region or in natural volcanic ash dug caves, particularly in Cappadocia (Central Anatolia) and Mersin province.

Sour orange is the main rootstock (about 85%) used in citrus growing in Turkey, because it has resistance to root rot and tolerates the high soil clay content, high pH (causing iron, zinc and manganese chlorosis), and high rainfall (in places over 760 mm). It is followed by 'Carrizo citrange' (7%), 'C-35 citrange' (5%), 'Troyer citrange' (2%) and trifoliolate orange (1%). In recent years, use of 'Carrizo citrange' and 'C-35 citrange' rootstocks for oranges, mandarins and grapefruit has been increasing in the Mediterranean and Aegean regions.

Main uses

About 43% of the citrus production in Turkey is consumed in the Turkish market as fresh fruit. Turkey's citrus consumption per capita is about 24 kg. About 37% of the production is exported. Turkey's processing industry consumes a minor part of the citrus production. About 4% of citrus production is processed for juice. Turkey exports 8,191 t of citrus juice concentrate annually. However, Turkey imports some citrus juice concentrate as well (about 9,698 t) to support a rapidly growing tourism sector and for re-export (Faostat, 2013). Imports are mostly from Spain, Italy, Israel and Brazil.



■ Figure 6. The fruit of 'W. Murcott' mandarin.



■ Figure 8. A 'Tango' mandarin orchard in Adana.

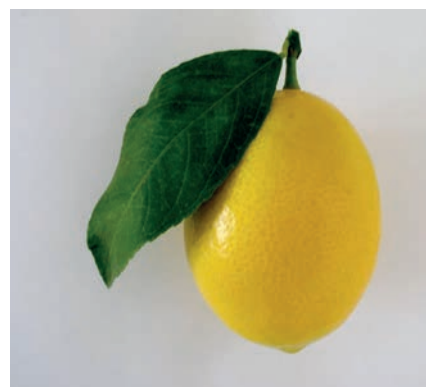
Importance of the citrus industry

Turkey has a comparative advantage in high quality fresh fruit production, compared with the other Mediterranean countries producing citrus, because of the suitable environmental conditions for fresh fruit production. Most of Turkey's citrus production is used for the local fresh fruit market and for export. Turkey has a significant place in international citrus trade, particularly in fresh citrus fruit exports. In the total global fresh citrus fruit export, Turkey was the third in the world and the second in the Mediterranean Basin in 2016. In recent years, exports of citrus, especially mandarin, have steadily increased (Figure 10). In 2016, about 1,672,205 t of citrus fruits were exported, of which 650,722 t was mandarin, 450,458 t lemon, 387,642 t oranges and 183,329 t grapefruit. The Commonwealth of Independent States was the top importer, importing 46% of Turkish citrus exports in 2016. It was followed by the Middle East countries (30%), European Union countries (18%), other European countries (4%) and other countries (3%). Russia and Ukraine import about 40% of Turkey's total citrus exports (AKİB, 2017a).

'Interdonato', 'Kutdiken', 'Italian Memeli', 'Aydin' and 'Meyer' lemons are exported mainly to Eastern (Russia, Romania and Ukraine) and Western European (The Netherlands, Germany and the UK) and Near East



■ Figure 7. The fruit of 'Nova' mandarin.



■ Figure 9. The fruit of 'Meyer' lemon.

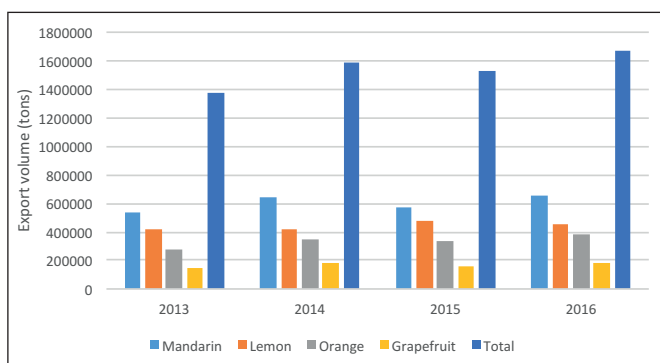
markets (Iraq, Saudi Arabia). Satsuma cultivars, 'Nova', 'Robinson' and 'Minneola' tangelo are exported mainly to the Eastern European markets (Russia, Ukraine and Belarus) and especially 'Fremont' mandarin to the Near East markets (Iraq, Saudi Arabia). Grapefruit exports are dominated mainly with colored flesh cultivars, especially 'Star Ruby' and 'Rio Red' to The Netherlands, Germany, the UK in Western Europe and Russia, Poland, Romania and Ukraine in Eastern markets. Main exported orange cultivars are navel cultivars, Valencia cultivars and 'Shamouti' to Iraq, Russia, Ukraine, Georgia, Romania, Germany and the UK (AKİB, 2017a).

In 2016, citrus exports accounted for 47% of total fruit and vegetable exports from Turkey (AKİB, 2017b). Export earnings were 880

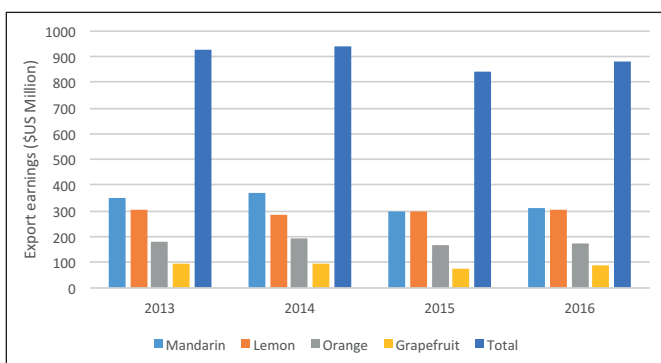
million US dollars (Figure 11). Mandarins and lemons have the highest shares with 35.5 and 34.8%, respectively, in total export earnings, followed by orange (19.7%) and grapefruit (10.0%). Fresh citrus imports to Turkey are approximately 50,000 t (Faostat, 2017).

New challenges and approaches

During recent years, environmental aspects of food production have become important issues. Hence, producers need to consider environmental dimensions of food products they produce in addition to traditional issues, such as quality, price, consumer demand and preferences, and standards. Although EU countries do not control food products according to HACCP, this certificate is considered an important assurance



■ Figure 10. Turkish citrus fruit export volumes (tons) (AKİB, 2017a).



■ Figure 11. Turkey's export earnings from citrus fruit (US dollars) (AKİB, 2017a).



■ Figure 12. Wind machine for frost protection of citrus fruit crops.



■ Figure 14. A general view of mechanically-pruned citrus trees.



■ Figure 13. A general view of ridge planted citrus orchard.

certificate. Large retailer groups in EU countries compiled all qualifications desired in agricultural crops in EUREPGAP protocol. EU countries also encourage adoption and application of EUREPGAP and HACCP systems in other countries and support the principles covered by them.

According to the “Turkish Food Codex Regulations” and “Regulation on Production, Consumption and Control of Food” issued by the Ministry of Food, Agriculture and Livestock, HACCP is a legal obligation for food processing companies. These regulations were published on November 16, 1997 and June 6, 1998 issues of the Official Gazette. The Ministry has given priority to meat, milk and fisheries products.

Another dimension to be considered in exports is the increasing demand for organic food. At present, Exporters’ Unions, Chamber of Agricultural Engineers, universities, etc. arrange seminars and training courses on HACCP and EUREPGAP for producers, processors, exporters, and all other actors in the marketing chain (Yeşiloğlu et al., 2007).

Abiotic and biotic constraints

Soil

In Turkey, citrus is grown mainly on clay-loam-textured soils, causing drainage and fungal disease problems. For this reason, ridge planting has become widespread recently, on both shallow soils and heavy soils that have drainage problems. Calcium content of the soils is generally high in the Mediterranean region. Soil pH is rather high and varies between 7.0 and 8.5. Soils have high calcium and hence bicarbonate ion. Bicarbonate ion adversely affects Fe uptake and hence efficiency of photosynthesis of citrus trees. In addition, Zn, Mn and Mg deficiencies are common problems because of high lime content. Therefore, use of sour orange rootstock is widespread since it is resistant to alkaline soils. ‘Trifoliolate orange’ cannot be used as rootstock in this region because it is very sensitive to Fe chlorosis. Our rootstock trials showed that ‘Carrizo citrange’ rootstock is suitable for soils with a pH up to 7.8. As a result, farmers have started to use this rootstock under suitable pH con-

ditions. It is reported that this causes some loss in quality, such as thicker skin formation and less desirable skin color. Heavy clay soils in the region have also been noted to result in similar quality issues. However, we determined that fruit yield and quality was high for orange, mandarin and grapefruit cultivars on ‘Carrizo citrange’ rootstock. So, this problem is being eliminated by choosing the most appropriate cultivars and rootstocks.

Climate

As previously mentioned, citrus growing areas of Turkey are situated in the northern hemisphere of the world citrus belt. Climate is typically mild or cool along the Mediterranean and Aegean regions of Turkey. There is a frost risk to some extent for citrus in some regions. In Cukurova, late cultivars are being grown in some sub-regions in order to avoid frost damage. In addition, wind machines are used in regions with frost damage risk (Figure 12). The Mersin province has a milder climate than some of the other citrus regions. Therefore, the great majority of the lemon production of Turkey is found in Mersin. On the other hand, in production regions like Aegean (covering İzmir, Muğla and Aydın provinces), growers specialize mainly in mandarin farming because of the high frost damage risks.

Production of late maturing cultivars is problematic due to frequent winter rains, which increases fungal diseases and makes fieldwork more difficult. This problem is solved by choosing favorable cultivars.

Hot and dry winds occur occasionally during flowering and early fruit development, which can cause flower drop, particularly in ‘Okitsu wase’ mandarin and ‘Meyer’ lemon cultivars, and yields can be significantly lower as a result. Hot and dry winds in June and July cause severe June drop in seedless (navel cultivars) and less seedy cultivars (‘Okitsu wase’ and ‘Ovari’ mandarins, ‘Shamouti’ orange, etc.). For this reason, the cultivars that have a tendency of fruit drop are sprayed with 10-20



■ Figure 15. A view of open field nursery production of citrus.



■ Figure 16. A range of citrus fruit.

ppm gibberellic acid during the flowering period.

Pests and diseases

The main fungal diseases are: brown rot gummosis [*Phytophthora citrophthora* (Sm. et Sm.) Leonian], mall secco [*Phoma tracheiphila* (Petri) Kanc et Ghik], *Alternaria citri* Ell. Pierce.) and citrus blast (*Pseudomonas syringae* Van Hall.). Main virus diseases are: psorosis, exocortis, xyloporosis, crinkly-leaf, *Citrus variegation virus* and a mycoplasma-like disease, stubborn (*Spiroplasma citri*). Tristeza has been present since 1920, but no vector transmission has been demonstrated yet. Main pests of economic importance are: citrus whitefly [*Dialeurodes citri* (Ashm.)], woolly whitefly [*Aleurothrixus floccosus* (Maskell)], California red scale (*Aonidiella aurantii* Mask.), citrus mealybug [*Planococcus citri* (Risso)], cottony-cushion scale (*Icerya purchasi* Mask.), Mediterranean fruit fly (*Ceratitis capitata* Wied.), citrus red mite (*Panonychus citri* McGregor), citrus rust mite [*Phyllocoptrata oleivora* (Ashm.)], and citrus leafminer (*Phyllocnistis citrella* Stainton). The citrus nematode (*Tylenchulus semipenetrans* Cobb) can occur in some citrus growing areas in Turkey (Yeşiloğlu et al., 2007).

Cultural practices

Irrigation

Because rains are not regularly distributed throughout the whole year, irrigation is necessary from mid-May to the end of October. Citrus growing areas also have favorable environmental conditions for other horticultural plants and field crops. Therefore, water demands in these regions are increasing and causing problems. This situation has forced farmers to use water more economically. Furrow irrigation systems are sometimes still used in old citrus orchards. However,

the majority of farmers has switched to drip irrigation systems. In all of the newly established orchards, drip irrigation is installed. This method is the only alternative irrigation system in ridge planted citrus orchards, which has become widespread recently (Figure 13). Farmers also want to apply fertilizers together with irrigation (fertigation systems). This is another reason why farmers prefer drip irrigation in newly established groves.

This is partly because the government pays for a portion of the system, on the condition that growers plant trees that have been certified as free of disease. Prior to 1992, plantings were often contaminated with diseases from the nursery. By subsidizing the pressurized irrigation systems, infection sources are being cleaned up. This is the only government support for growers.

Pruning

Pruning is a common cultural practice that is necessary for the economical production in citriculture as it is in many fruit tree crops. Most citrus trees are pruned; to invigorate the tree, to improve branch configuration (thus make branches less likely to split under a heavy crop), to improve fruit quality, and/or to reduce the crop load, which will improve the potential size of individual fruits. There are generally three types of pruning in citriculture, which can be described as canopy pruning, yield pruning and rejuvenation pruning. Briefly, sprouts, canopy density, and damaged and dead branches are the main issues to consider while pruning a citrus tree, in all types of pruning, in order to increase fruit yield, fruit quality and disease control. Hand pruning of citrus orchards is very labor-intensive, resulting in high production costs. On the other hand, mechanical pruning has numerous advantages over classical pruning, such as enabling control over the tree size and providing mechaniza-

tion in large and dense orchards. Therefore, mechanical pruning is often carried out in Turkey, especially on large farms (Figure 14).

Nursery

A citrus tree is normally composed of the rootstock and scion, and is vegetatively propagated. Citrus nursery stocks are commercially propagated through budding/grafting of the scion of the desired cultivar onto the seedling rootstocks (Figure 15). The rootstocks have a great impact on scion vigor and fruit size, fruit yield and juice quality, as well as tolerance to salt, cold and drought. Citrus rootstocks also have a considerable effect on leaf mineral content of the scion. Production of citrus nursery plants has greatly increased in recent years because of the increasing demand from newly established orchards, and there are several highly developed citrus nurseries in Turkey. The most important issues to consider in nursery stocks can be listed as follows: using virus and disease-free propagation material, nursery certification, sophisticated infrastructure, and healthy growing media for the plantlets. Older citrus orchards have some disease related problems. However, disease free young plants have been produced since 1992. The government is encouraging the use of disease free young plants in new orchards, and it is expected that it will become obligatory in the near future.

Breeding

At present, cultivars grown in Turkey are also being produced in almost all citrus growing countries in the world. Because of favorable climatic conditions, very high quality citrus fruit are grown in the Mediterranean region of Turkey. Germplasm resources are great, because of continued importation of new plant material and rootstock, and cultivar breeding is ongoing. Richness of genetic resources allows Turkey to develop new cit-

rus cultivars, acceptable for world markets (Figure 16). In the past decade, the world's citrus production has increased steadily to meet growing international demands. Seedlessness is one of the most important characteristics for citrus fruit, especially for mandarins sold on the fresh-fruit market, because of increasing consumer demand for this trait. In addition to seedlessness, excellent fruit quality (fruit size and yield, high sugar content, soft and juicy flesh, aroma, easy peeling, attractive appearance, uniform fruit shape and smooth rind) is the major objective in citrus breeding programs of Turkey. In addition, harvest timing is of great importance, especially for mandarins, in world fresh citrus markets. With late-maturing cultivars, cold-resistance is also needed.

Conclusion

Turkey has a great potential for expanding its citrus production because of the favor-

able climatic conditions and the opportunity for breeding new cultivars. Citrus areas, production and yields are steadily increasing. However, Turkey is still very far from reaching its full potential.

A good supply chain with traceability facilities requires investment in human capital, as well as in IT systems. The government needs to take necessary steps to encourage investments in these areas. Development of processing facilities is also required, to improve supply chain management systems.

Another problem is the lack of good connections between different actors within the market chain. At present, Turkish exporters rely on cultivars that are common in almost all citrus producing countries. However, Turkey should be ready to switch to the most preferred cultivars according to the changing demands resulting from changing tastes and preferences of consumers. ●

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> Selection and dissemination of vegetable cultivars in the Sahel

Dov Pasternak, Sanjeet Kumar and Issaka Housseini

Introduction

Vegetables are a major component of intensive agricultural systems in the West African Sahel. Most vegetables are cultivated under irrigation during the comparatively cooler dry season from October through April.

Until 2001, with the exception of the Senegalese Institute for Agricultural Research (ISRA), very few researchers attempted to systematically breed and select the best cultivars adapted for the Sahel. Neither did growers or farmers maintain true-to-type cultivars in the region. Most vegetable seeds sold in the local markets were bred in temperate climate countries, not adapted to the climatic conditions of the Sahel. In addition, the few named cultivars present varied greatly in quality and yield and were not true-to-type.

In 2003, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) initiated a program in Niger for the identification and standardization of vegetable cultivars for the Sahel. In 2006, the program was strengthened by the World Vegetable Center (formerly AVRDC).

Work started by identifying major quality parameters in the existing cultivars. Next, cultivars were selected for trait improvements. Cultivar selection was carried out from existing regional as well as international gene pools for those vegetables. Open pollinated homogeneous cultivars were selected, with the goal that farmers and local seeds

companies could easily regenerate their own seeds. After a specific cultivar with the appropriate traits was identified, the cultivar underwent several cycles of simple and recurrent selection to reach an acceptable level of uniformity in the offspring.

Annual training on vegetable seed production (Figures 1 and 2) was carried out for five years to technical officers and farmers of Niger, Burkina Faso, Mali, and Senegal. Dr. Dov Globerson, an Israeli vegetable seeds expert, was the external instructor.

This paper focuses on the approaches used for the selection of cultivars of the following vegetables: onion, tomato, lettuce, okra, watermelon and moringa. When work started, the available cultivars from each of these crops had individual limitations. Each crop required a different selection approach.

Onions (*Allium cepa*)

Niger is the leading producer of onions in the West African economic and monetary union area. The Agro-Pastoral Export and Market Development Project (PRODEX), based in Niamey, estimated that the average annual production of onions in Niger was 500,000 tons. According to the Federation of Market Garden Cooperatives of Niger (FCMN-Niyya), around 300,000 Nigerian farmers grow onions. Their collective revenue is equivalent to about \$100 million US per year; about 60% of their production is exported to West African countries (Figure 3).

The 'Violet de Galmi' onion was first stabilized in the early 1970s by Institut de Recherche Agricole Tropicale (IRAT) out of landraces prevalent in the Tahoua Region of Niger (Abdou et al., 2016). It is a tasty, short day cultivar with good storage life and yield. 'Violet de Galmi' is by far the most popular onion in West Africa.

However, a stabilized population was not maintained, and farmers resorted to seed production of multiple landraces.

The landraces available locally lacked uniformity in many traits like shape, color, bolting (Figure 4), splitting (Figure 5), number of scales, bulb size, storage life, and yield.

As a first step in purification, 'Violet de Galmi' seed was selected from local producers, who were recommended by officers of the Niger Agricultural Extension Service. A survey showed that many landraces had split bulbs (Figure 5). This probably occurred because split bulbs usually have a larger diameter than regular bulbs.

Most landraces of 'Violet de Galmi' were sensitive to bolting. Those landraces that bolted had undesirable flowering at the end of the first year after planting. Apparently, the bolting types were selected by the local breeders because seed production is carried out only during the second year. Sensitivity to bolting can be genetically transmitted (Díaz-Pérez et al., 2003). In total, 50 improved types were selected from four regions of Niger. Planting and selection from among these landraces was carried out at ICRISAT near Niamey, Niger. The trial field was planted in November 2003. The field was drip irrigated (Figure 6) and harvest occurred in March 2004. At harvest, the 50 landraces were analyzed for yield and



■ Figure 1. Group photo of annual course in vegetable seed production given by Dr. Dov Globerson (white hair and light blue shirt).



■ Figure 2. Seed production course. Evaluating percentage germination of tomato seeds.

■ Table 1. Selection for quality and yield among 50 landraces of ‘Violet de Galmi’ onion collected from seed producers around Niger. Score for bulb color, dry scales, split bulbs, bolting: number 1 is the “worst” and 3 is the “best”.

Landrace	Yield (kg m ⁻²)	% large bulbs	% medium bulbs	% discarded bulbs	Length/width ratio	Bulb color scoring 1-3	Dry scales scoring 1-3	Split bulbs scoring 1-3	Bolting scoring 1-3
1	4.58	25	33	41	1.3	3	2	1	2
2	5.15	15	38	47	1.34	2	1	2	3
3	5.36	47	33	20	1.5	3	2	2	2
4	3.54	19	31	50	1.31	3	2	2	2
5	3.62	17	48	35	1.2	3	1	2	2
6	4.20	26	32	42	1.25	2	3	1	1
7	4.07	18	41	41	1.32	3	2	2	1
8	4.26	27	30	43	1.4	2	2	2	1
9	5.44	25	22	53	1.3	3	2	2	1
10	2.47	15	30	55	1.45	3	2	3	1
11	4.93	21	44	35	1.3	2	2	2	1
12	4.28	22	25	53	1.3	3	1	2	2
13	6.14	33	30	37	1.25	3	2	2	2
14	3.68	23	19	58	1.3	3	2	3	2
15	3.61	26	15	59	1.3	2	2	2	1
17	3.82	18	33	49	1.27	3	2	2	1
18	2.82	16	16	68	1.23	3	2	2	1
19	3.83	23	28	49	1.28	2	2	1	1
20	1.34	6	28	66	1.35	White	1	1	1
21	2.99	6	30	64	1.37	2	2	2	1
22	2.94	0	30	70	1.3	2	2	2	1
23	5.84	26	38	36	1.3	2	2	2	1
24	3.26	0	32	68	1.37	3	2	2	1
25	3.47	31	38	31	1.5	3	2	2	2
27	2.4	13	56	31	1.3	2	1	1	2
28	4.65	43	37	20	1.3	2	2	2	2
29	3.31	23	33	44	1.38	2	2	2	1
30	3.33	20	14	66	1.4	2	2	2	1
31	4.51	25	50	25	1.4	2	2	1	2
32	4.09	18	44	38	1.4	2	2	2	1
33	3.07	23	60	17	1.42	3	2	2	1
34	3.43	41	22	37	1.45	3	3	1	1
35	4.52	15	23	62	1.3	2	2	2	1
36	3.75	8	49	43	1.4	1	2	2	2
37	3.81	36	28	36	1.5	2	2	0	2
38	2.23	0	0	100	0	White	0	0	3
39	1.64	0	0	100	0	White	0	0	2
40	2.14	0	0	100	0	White	0	0	3
41	2.38	0	0	100	0	White	0	0	2
42	1.81	0	0	100	0	White	0	0	2
43	4.73	41	24	35	1.18	3	22	2	2
44	4.8	22	28	50	1.3	2	2	2	2
45	4.34	0	0	100	0	White	0	0	1
46	3.69	16	44	40	1.44	Red	23	1	1
47	1.7	0	0	100	0	2	0	0	3
48	1.935	0	11	89	1.43	2	1	2	3
49	2.65	6	12	82	1.25	2	2	2	3

■ Table 2. Fruit yield, percentage of fruit set and number of flowers of two tomato cultivars exposed to two night temperature regimes.

	Negev			Xina		
	Day/night temperatures (°C)		Significance*	Day/night temperatures (°C)		Significance*
	34/29	34/18		34/29	34/18	
Fruit yield (kg plant ⁻¹)	1.28a	4.13b	S	2.24a	4.73b	S
Fruit set (%)	8.7a	64.9b	S	17.3a	60.15b	S
No of flowers plant ⁻¹	57.4a	26.2b	S	134.4a	121.6a	NS

Means for the different treatments for each cultivar with a common letter are not significantly different (P=0.05). *Significance: S = P<0.05; NS = not significant.



■ Figure 3. Exporting ‘Violet de Galmi’ onions from Niger to Ivory Coast.



■ Figure 4. Bolting is typical for many ‘Violet de Galmi’ landraces.



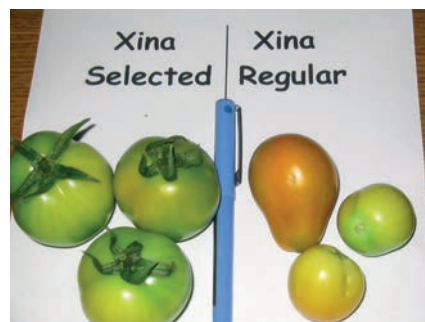
■ Figure 5. Splitting affects onion bulb quality and is an issue for some ‘Violet de Galmi’ landraces.



■ Figure 6. Selection trial for the best ‘Violet de Galmi’ onion landrace.



■ Figure 7. The breeder of landrace No. 28 helps ICRISAT select the best bulbs, including long shelf life.



■ Figure 8. Fruit of ‘Xina’ selected by ICRISAT (left) and of ‘Xina’ from seeds bought in the market (right).

quality using 9 quality traits (Table 1). The results indicated that landrace No. 28 (Figure 7) was the “best” of the 50 genotypes. This landrace was purified by ICRISAT for uniformity and shelf life.

Tomato (*Solanum lycopersicum*)

In Niger, fruit set of many tomato cultivars is very poor during the rainy season. High temperature is one of the causes of poor fruit set in tomatoes (Charles and Harris, 1972; Rudich et al., 1977; Abdul-Baki, 1991; Abdul-Baki and Stommel, 1995). The two main reasons for low fruit set at high temperatures are: extension of the style above the pollen sacs, and low pollen fertility. Researchers have identified tomato cultivars that can set more fruit at high temperatures despite these difficulties. At the time when cultivar selection was carried out in Niger, two cultivars were recom-

mended for the rainy season: ‘F₁ Mongal’, and ‘Xina’, an open pollinated cultivar bred by the Senegalese Institute for Agriculture Research (ISRA). ‘Xina’ was developed during the late 1970s using germplasm from the World Vegetable Center (formerly AVRDC), Taiwan. ‘F₁ Mongal’ was discarded because it was decided to concentrate efforts only on open pollinated cultivars.

An analysis of year-round maximum and minimum temperatures in Niger showed that from December to March the daily maximum temperature was as high as 40°C, but the minimum usually remained below 20°C. During this period the high day temperature did not prevent the tomatoes from setting fruit. During the rainy season, when fruit set is poor, daylight average temperatures are much lower, ranging from 32 to 34°C. Night temperatures are higher than during

February/March, ranging from 22 to 24°C. The similarity between day and night temperatures during the rainy season could also be responsible for low fruit set.

Issaka Housseini (2004) conducted an investigation examining the low fruit set in other tomatoes during the rainy season, and the high fruit set by ‘Xina’, despite these conditions.

Ten plants of ‘Xina’ and 10 plants of a heat tolerant tomato line, ‘Negev’, selected at the Ben Gurion University in Israel, were planted in June 2004 in 5-kg pots in a well-ventilated screen house. During July and August half of the pots from the two cultivars were moved each afternoon to an air-conditioned room and were returned back in the morning, while half remained in the screen house day and night. The mean screen house day temperature for the above period was 34°C

■ Table 3. Yield and yield components of 30 watermelon cultivars in order from highest to lowest yield.

Cultivars	Marketable fruit yield (t ha ⁻¹)	Fruit number ha ⁻¹ (x 1,000)	Individual fruit weight (kg)
Early Arizona	31.1	12.5	4.24
Starbrite	31.5	6.7	4.88
Tom Watson	30.5	9.6	3.48
Stars-N-Stripe	30.1	7.9	4.05
Regency	29.1	6.3	4.54
Charleston Gray	25.8	8.8	2.59
Crimson Sweet	27.3	7.1	3.94
Legacy	24.5	7.1	3.54
Desert King	24.6	8.3	3.04
Mountain Hoosier	24.3	6.7	3.44
Jubilee	22.6	7.1	3.18
Stone Mountain	23.3	6.3	3.81
Calhoun Gray	18.4	5.0	2.35
Mackle	20.5	8.3	2.63
Black Diamond	18.1	5.4	2.03
Mali	17.8	7.5	2.38
Peacock WR-60	14.8	5.8	2.73
Big Crimson	15.1	4.2	3.97
Malali	15.6	8.3	2.04
Kaolack	14.8	5.0	2.85
Georgia Rattlesnake	12.6	3.3	3.92
Sangria	13.4	5.8	1.97
Early Canada	13.2	6.3	2.08
Congo	10.8	3.8	2.91
Sugar Baby	8.8	5.4	1.49
Allsweet	8.9	2.9	2.57
Sugarlee	3.7	2.1	2.27
Sweet Princess	3.6	1.7	1.58
Minilee	3	1.7	2.09
Graybelle	0.7	1.3	0.43
Probability (0.05)	0.001	0.044	0.004
Lsd (0.05)	7.9	2.4	1.9

and mean night temperature was 29°C (the 34/29°C treatment). Night temperature in the air-conditioned room was 18°C (the 34/18°C treatment).



■ Figure 9. 'Icrixina' tomatoes in Niamey market during the rainy season.

The effect of the two temperature regimes on yield, percentage of fruit set and number of flowers per plant for the two cultivars are given (Table 2).

The results indicated that low fruit set during the rainy season was related to the higher night temperatures during this season, rather than to high day temperatures (Table 2). The higher fruit set of 'Xina' was related to both a higher percentage of flowers that produced fruit, combined with a very high number of flowers per plant. Therefore, cultivars with abundant flowers should give higher yields during the rainy season.

The original 'Xina' was sold by local seed companies. However, because this cultivar was not maintained, both quality and fruit

yield have deteriorated through subsequent generations of production. After seven cycles of purification, plants achieved higher yields and the fruit became more uniform in shape and color (Figure 8). The improved 'Xina' was named 'Icrixina' (to distinguish it from the unimproved 'Xina' available on the market. 'Icrixina' produced a heavy load of fruit over 7 to 8 months. Fruit of this new cultivar is now available on Niger markets during the rainy and the dry cold seasons (Figure 9).

Lettuce (*Lactuca sativa*)

Lettuce is a cumulative long day plant. Waycott (1955) demonstrated that lettuce bolts readily during periods of high temperature that are

■ Table 4. Vegetable cultivars for the Sahel selected by ICRISAT/AVRDC.

Species	Cultivar	Selection traits	Species	Cultivar	Selection traits
Tomato	Icixina	Rainy season fruit set, high yields	Roselle	Sadore	Very early flowering, high yield, good quality
Tomato	Sadore	Firm, long shelf life	Onion	Violet de Galmi #28	Good quality, high yield, long shelf life
Okra	Konni	Early fruit set, year-round production, determinate, high yield	Lettuce	Maya	Non bolting, year-round production
Hot pepper	Safi	High yield, long duration, hardy	Sweet pepper	Diffa	Tolerance to environmental stress
Melon	Ein Dor	Heat tolerance, high quality	Watermelon	Charleston grey	High yield, tasty, good shipping
Moringa	PKM 1	High yielding, tasty	African eggplant	Gaya	High yield, good quality
Sweet corn	True Gold	Heat tolerance	Cassava	IITA No. 92B/00068 91/02324	High yield, cooking cultivars

combined with long days (Figure 10). These environmental conditions exist in the Sahel during the rainy season. In Niger, when lettuce bolts, farmers remove the leaves along the stems. The taste is bitter and the yield is low. Dr. Globerson, an Israeli lettuce breeder, selected hot summer bolting-tolerant cultivars (Globerson et al., 1980). This included a Romaine-type lettuce cultivar called ‘Noga’. This cultivar grew well in the Sahel rainy season but because the leaf color was green (Figure 11), it was not accepted by the local market where yellow-green lettuce heads predominate. Dr. Globerson identified a bolting-tolerant cultivar with yellow-green leaves from his lettuce germplasm collection. He named it ‘Maya’ (Figure 12). ‘Maya’ lettuce has become a very popular cultivar for the Sahel over a short period of time (Figure 13).

Okra (*Albemoschus spp.*)

Okra is one of the top four important nutritious vegetables in West Africa. About 75% of total okra produced in African continent originates in West Africa. There are four

species of okra, and most commercial cultivars belong to the species *A. esculentum* (Kumar et al., 2010). Okra is mainly produced by women farmers in West Africa during the rainy season. Recently, however, farmers started irrigating okra to get year-round production at reasonable prices. Okra is usually a day length sensitive species, with most cultivars flowering during short days. Long day cultivars and those neutral to photoperiod also exist (Kumar et al., 2010). In 2007, an okra breeding project was initiated jointly by AVRDC and ICRISAT programs in Niger. In the first phase, about 250 international okra accessions were introduced, regenerated, and characterized for morphological data. Surprisingly, a local okra landrace, from the town of Birnie N’Konni in Niger (Figure 14), was the most suitable for immediate promotion for the following reasons:

- It is a day length neutral genotype, thus can be planted and produce fruits year-round.
- Fruit has a regular shape acceptable by the market (Figure 15).

- It is early fruiting and maturing, therefore highly successful under rain-fed cultivation in the rainy season.
 - The plant is short and therefore suitable for production under moringa plantations that reduce radiation load during the hot season (Figure 16).
 - Harvesting of shorter plants is also more comfortable i.e. no itching from stem spines.
- The landrace was purified through recurrent selection over seven growing cycles and was given the name ‘Konni’. ‘Konni’ production is expanding quickly in Niger (Figure 16). This cultivar is an integral and very remunerative component of Bioreclamation of Degraded Land (BDL) system developed by us and adopted by the Sahelian Women associations (Pasternak et al., 2009).

Watermelon (*Citrullus lanatus*)

Watermelons are an important crop in the Sahel and their popularity is steadily increasing. In 2014, Mali and Senegal produced watermelons on > 28,000 and 21,000 hectares respectively (FAOSTAT, 2017). In Sen-



■ Figure 10. Many lettuce cultivars bolt during the rainy season.



■ Figure 11. ‘Noga’ lettuce is bolting-tolerant but it is green and therefore not accepted in Niger markets.



■ Figure 12. 'Maya' lettuce is bolting tolerant with yellow-green leaves.



■ Figure 13. 'Maya' lettuce can bring very high yields during most seasons in the Sahel.



■ Figure 14. 'Konni' okra. The plants are short and sturdy. First fruit are produced about 50 days from sowing.



■ Figure 15. Typical 'Konni' fruit produced by women in the rainy season.



■ Figure 16. 'Konni' okra can be intercropped with moringa, which reduces radiation load on the plants.

egal, it replaces rain fed millet in some areas because of its higher profitability (Fatondji et al., 2008). There are many cultivars of watermelon. Most were developed in the United States from over 100 years of breeding (Gusmini and Wehner, 2008).

Research on rain-fed watermelons at ICRISAT was carried out over a period of four years. In the first year, it was found that watermelons sown in June, July, and August produce very little yield, if any. The probable reason is the suppression of female flower production by the long days of the rainy season, coupled with high temperatures (Rudich and Peles, 1976). A technology for production of watermelons on stored rainwater was developed over a period of two years (Fatondji et al., 2008).

In 2010, using the above technology, a trial was performed to identify watermelon cultivars most suitable to the Sahel. Most cultivars were provided by Prof. Tod Wehner from North Carolina State University. In addition to the American cultivars, the most popular cultivar from Senegal called 'Kaolack', a very popular landrace from Mali called 'Mali' (Figure 17), and a drought tolerant cultivar from

Israel called 'Malali', were also tested. The results were analyzed and given in a dissertation by Issaka Laouali (2010).

The trial demonstrated that the watermelon cultivars differed greatly in yield (Table 3). Marketable yield of the most common non-irrigated cultivars, 'Kaolack' and 'Mali' the prominent cultivars of the Sahel, produced about half the yield of top yielding American cultivars. 'Charleston Grey' was selected for further promotion because of its high yield, good shipping traits, taste and trueness-to-type open pollinated seed (Figure 18).

Moringa (*Moringa oleifera*)

Moringa is a common leafy vegetable in Niger and parts of northern Nigeria. It is also produced in other Sahelian countries. It was introduced to Niger at the beginning of the 20th century (Saint Sauveur and Hartout, 2001) and invasively spread throughout the country. In 2002, *Moringa oleifera* cultivars 'PKM 1' and 'PKM 2', developed in the Periyakulam Horticultural Research Station of Tamil Nadu, India, were provided by Dr. Sambanda Murthi from Tamil Nadu, India. The two cultivars were

planted at ICRISAT. The yield of 'PKM 1' was much higher than that of 'PKM 2' or the local cultivars. An organoleptic test showed that both farmers and city dwellers preferred 'PKM 1' over other cultivars. The leaf yield of 'PKM 1' original population (Figure 19) varied from plant to plant. Thus the next step was to select individual plants with higher leaf yields.

Four high yielding plants were selected and propagated from cuttings, producing a mother plantation of uniform and high yielding plants (Figure 20).

The dissemination of the 'PKM 1' in Niger was carried out in partnership with Cooperative League of USA (CLUSA) (Pasternak et al., 2017). CLUSA technicians were trained at ICRISAT on caring for the plants and seed production of moringa 'PKM 1'. CLUSA provided seeds of the cultivar throughout Niger. This effort doubled the area of moringa production within six years.

Cultivars selected and purified

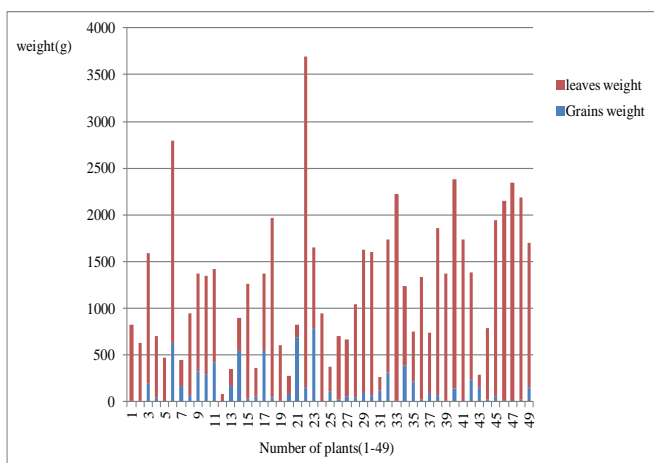
The names of the cultivars of a range of vegetables that were selected and purified by ICRISAT over a period of 10 years are shown in Table 4.



■ Figure 17. 'Mali' watermelons exported to Ghana.



■ Figure 18. 'Charleston Gray' was selected because it is open pollinated, and has high yield and good shipping traits.



■ Figure 19. Mean seed and dry matter production of 49 individual moringa 'PKM 1' over a period of two years (adapted from Pasternak et al, 2009).



■ Figure 20. Mother plantation of the 'PKM 1' moringa cultivar. Uniform, high yielding plants served as a basis for dissemination in Niger.

Discussion and conclusions

This paper describes a range of strategies to improve vegetable cultivars for the Sahel. The program concentrated on the selection of improved traits. Then recurrent selection was applied to develop open pollinated cultivars so that farmers could continue the production of their own seeds.

During the process, many farmers were trained in seed production and were given seeds for multiplication. A private seed production company in Niger was trained on vegetable seed production and given foundation seed.

The plan was that this company would supply second stage breeder seeds on a regular basis to the growers. Unfortunately, this objective was not fully achieved. The individual seed producers stopped seed production and the local seed company is not reaching many customers.

The main vegetable seed suppliers to Sahelian countries are French based companies that have market outlets to seeds of both open pollinated and hybrid cultivars. Most farmers continue to buy seeds from these companies. Perhaps ICRISAT could partner with these companies to guarantee the availability of the improved quality seeds that were selected and named.

The moringa cultivar 'PKM 1' has been promoted by a 6-year project in Niger, resulting in adaptation of this cultivar by many farmers. This kind of promotion should have been done with other vegetable cultivars.

Four of the vegetable cultivars, 'PKM 1' moringa, 'Konni' okra, 'Maya' lettuce and 'Sadore' roselle, have increasing production in Niger. These cultivars have significant advantages over other cultivars for production in the Sahel. In addition, seeds of these cultivars are easy to produce and remain true-to-type

through seed propagation. Seeds of these improved cultivars can be obtained from ICRISAT-Niger and from the Ainoma Seed Company in Niamey, Niger.

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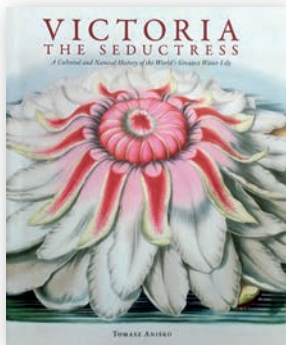


New Books
Websites

> New books, websites

Book reviews

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



Anisko, T. (2013). *Victoria The Seductress: A Cultural and Natural History of the World's Greatest Water Lily* (Kennett Square, PA, USA: Longwood Gardens), pp.468. ISBN 978-1-935442-22-6. \$69.99. www.longwoodgardens.org

No garden image is more astonishing than a floating Victoria water lily leaf supporting a person standing upright. The magnificent book, *Victoria the Seductress*, celebrates one of the world's most amazing flowering plants, and is replete with these images. The author, curator of plants at Longwood Gardens and renowned explorer, has created a glorious, beautifully illustrated work that chronicles the history, botany, and horticulture of *Victoria amazonica*, the world's largest water lily. This remarkable plant was encountered in 1801 along the Mamore River, a tributary of the Amazon, in Moxos, Bolivia, by the Bohemian botanist Thaddeus Haenke accompanied by a Franciscan missionary, Father Luis de La Cueva. In 1835, the French botanist Aime Bonpland (wonderful name for a plant explorer), collected and distributed the edible seeds of another large water lily known as Maiz de Agua. In 1828, another French botanist, Alcide d'Orbigny, found a large water lily in Paraguay that settlers called *yrupé* (water platter), which was pressed, preserved in alcohol, and

sent with a drawing to the National Museum of Natural History in Paris. However, these early European explorers did not publish, so the honor of choosing the scientific name was usurped by the indefatigable John Lindley, a stay-at-home English botanist who nevertheless named over 5000 plants. In 1837, based on specimens sent from Guiana by Robert Schomburgk, Lindley changed the generic name from *Nyphaea* to *Victoria* with the specific epithet *regia*, to honor England's new teenage sovereign. However, the epithet was changed in 1850 to *amazonica*, which was suppressed in England until the death of Queen Victoria in 1901. Maiz de Agua turned out to be a closely related species, *V. cruziana*.

Victoria amazonica is quite extraordinary. The floating, round, green leaves with upturned rims are very large, with record diameters from 2.3 m to an astonishing 2.9 m. They have a purplish-red underside with a network of fearsome, spiny ribs, presumably for protection. Their buoyancy is attributed to entrapped air and the leaf can support great weights without collapsing – up to 136 kilos of sand and 318 kilos of gravel have been reported! *V. cruziana* with smaller leaves but attractive upturned red rims is often chosen for cultivation.

The large flowers (30 to 46 cm across) are equally astonishing. They reach the water surface from very long peduncles that arise from leaf axles and open two days after the corresponding leaf has unfolded, but last only 48 hours. When first opened, white petals with their strong pineapple-like scent attract scarab beetles to enter a floral chamber made of 25 to 40 fused carpels around a strange conical projection called the floral apex. The chamber is heated as much as 6°C above air temperature from a thermochemical reaction. Flowers are hermaphroditic but are effectively pistillate on the first day of anthesis and sta-

mens dehisce on the second day. Upon initial opening, the white petals entrap scarab beetles, which forage in the floral chamber and copulate unseen. On the second day, an inner set of petals expand, turn pink, and release the beetles. The large spiny fruit develop underwater and can contain hundreds of seed.



The public was enchanted and the Victoria lily became the panda of the plant kingdom as botanical gardens vied to grow the plant in Europe's greenhouses, conservatories, and heated outdoor pools. Hybrids between *V. amazonica* ($2n=20$) and *V. cruziana* ($2n=24$) proved to be very vigorous. While plants can survive for a number of years in their native habitat, they are grown as an annual in culture. This is a sumptuous, gloriously illustrated book. I was particularly entranced by the fantastic pictures of conservatories, historical portraits, exquisite colored photographs of leaves and flowers, and meticulous historical accounts. My only complaint was that the index is confined to people and places and does not include subject matter. This book deserves to be in your collection.

Reviewed by Jules Janick,
Purdue University, USA

> Courses and meetings

The following are non-ISHS events. Be 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

III International On-line Course on Postharvest & Fresh-Cut Technologies, December 2017 to July 2018. Info: Dr. Francisco Artes-Hernandez, Postharvest & Refrigeration Group (GPR), Universidad Politecnica de Cartagena, Paseo Alfonso XIII, 48, 30203 Cartagena, Murcia, Spain, e-mail: postharvest@upct.es, web: <http://www.upct.es/gpostref/>

2nd iPLANTA Conference: the Future of Cross Talk Focus on RNAi Technology and Applications, 14-16 February 2018, Poznań, Poland. Info: Prof. Bruno Mezzetti, Dip. Sci. Agrarie, Alimentari ed Ambientali, Università Politecnica delle Marche, Via Brecce Bianche, Ancona 60100, Italy, e-mail: b.mezzetti@univpm.it, web: <http://iplanta2018.home.amu.edu.pl/>

XII Curso Internacional en Tecnología Postcosecha y Procesado Mínimo, 7-13 March 2018, Cartagena, Murcia, Spain. Info: Dr. Francisco Artes-Hernandez, Postharvest & Refrigeration Group (GPR), Universidad Politecnica de Cartagena, Paseo Alfonso XIII, 48, 30203 Cartagena, Murcia, Spain, e-mail: gpostref@upct.es, web: <http://www.upct.es/gpostref/>



> First International Conference & X National Horticultural Science Congress of Iran (IrHC2017)



> Participants of IrHC2017.

The First International Conference & X National Horticultural Science Congress of Iran (IrHC2017) was held in Tehran, Iran, at Tarbiat Modares University (TMU), from 4-7 September 2017. IrHC2017 was suggested and convened by Prof. Kazem Arzani, Head of Department of Horticultural Science at TMU, in recognition and commemoration of the 35th anniversary of the department, established in 1983. The IrHC2017 was organized by the Iranian Society for Horticultural Science (IrSHS), TMU and the Deputy Ministry of Agriculture of Iran in Horticulture. For the first time, TMU and IrSHS, with the collaboration of the other IrHC2017 organizers, decided to organize the “First International Horticultural Science Conference” at the same time as the X National Horticultural Science Congress of Iran, under the aegis of the International Society for Horticultural Science (ISHS).

IrHC2017 included two national and international parts with inter-related organization. More than 100 scientists from Iran and all over the world served on the two national and international scientific committees. They managed the scientific activities including oral presentations, posters, panel discussions, workshops, technical tours and exhibitions. In addition, the Executive Committee, which prepared by having more than 50 pro-

conference meetings, was well organized. Their efforts made the event enjoyable and successful. The official language of the First International Conference and X National Horticultural Science Congress of Iran (IrHC2017) was English in the international part, and Persian in the national part. The main theme of the IrHC2017 was “Productivity of horticultural crops in Iran: potential, production limitations, possible solutions and international collaborations”.

IrHC2017 covered all aspects of horticultural science, including pomology and fruit culture, floriculture, vegetable crops, medicinal plants, and landscape and urban horticulture. In addition to the X National Congress, this event was the “First International Horticultural Science Conference of Iran”, which created a suitable environment for Iranian and international delegates to exchange their knowledge and experience, and to discuss possible further collaboration. IrHC2017 created potential for international cooperation, especially to those participants who wanted to become member of ISHS: more than 160 Iranian postgraduate MSc and PhD students, scientists and private horticulturists joined ISHS prior to or during IrHC2017.

IrHC2017 was also a great opportunity for international scientists to visit and become familiar with Iran as a big, historic, and

beautiful country with friendly people through the emphasis of the horticultural industry. IrHC2017 gathered more than 600 participants from Iran and 20 other countries, including Russia, Iraq, Pakistan, Hungary, Italy, Romania, Thailand, Oman, France, Spain, Germany, Turkey, Czech Republic, USA, Greece, Mexico, The Netherlands, Croatia, Belgium, and Brazil. The event offered an opportunity to learn about new research results and to share experiences in seven different topics, including: horticultural engineering; molecular biology and plant genetic resources; environmental stress and plant protection; nutrition, irrigation and water relations; plant substrates and soilless culture; crop quality and postharvest; and landscape and urban horticulture. More than 265 abstracts and full text papers were submitted through the ISHS responsive online system for *Acta Horticulturae* submission and review (ROSA) for the First International Conference and more than 800 through the IrHC2017 website for the X National Horticultural Science Congress of Iran. Seventy five oral and 156 poster presentations were given in the First International Conference, and 56 oral and 546 poster presentations in the national part of IrHC2017. The program included three days of oral and poster sessions and a 1-day technical tour to the Alborz



> Prof. Kazem Arzani, IrHC2017 Convener, and Mr. Jozef Van Assche, Executive Director of ISHS, agreed for effective co-operation.



> A. On behalf of the IrHC2017 Students Award Committee, Prof. Silvana Nicola presented an ISHS student award to Marzieh Nasirzadeh for the best oral presentation. B. Hassan Hoseinabadi, ISHS student award winner for the best poster.



and Qazvin provinces. During the tour, participants visited the Sadaf commercial mushroom factory and Nazari pistachio orchards, as well as the historic places of Qazvin City. Nine keynote speakers in the First International Conference, and six in the X National Congress, presented the latest information on different aspects of horticultural science. In addition, three panel discussions were organized, including 'Greenhouse horticulture', 'Dust and climate change' and 'Challenges of local and global germplasm'. During IrHC2017, more than 20 national and international commercial companies actively exhibited their products and horticultural services. In addition, five workshops were carried out on nutrition of horticultural plants, bioinformatics, soilless culture and hydroponics, water relations and plant response to environmental stress, and medicinal plants processing.

In the opening ceremony, Prof. Silvana Nicola, ISHS Vice President, handed out the ISHS medal award to Prof. Kazem Arzani, Convener of IrHC2017. In the closing ceremony, IrSHS awards were presented and handed out to five Iranian distinguished professors, scientists and private horticulturists. On behalf of the IrHC2017 Students Award Committee, Prof. Silvana Nicola handed out ISHS student awards to Marzieh Nasirzadeh, PhD student at the Department of Horticultural Science, TMU, Iran, for the best oral presentation entitled "The use of ESTs-database for identification of *NIC* gene in trigonelline pathway in *Trigonella foenum-graecum* L.", and to Hassan Hoseinabadi, PhD student at the Institute of Grapes and Raisins, Malayer University, Iran, for the best poster entitled "Effect of irrigation and harvest time on grape buds tolerance in the face with frost". Prof. Dr. Yüksel Tüzel introduced IHC2018, which will be held in Istanbul,

Turkey, in August 2018. Urmieh University was introduced as the place for IrHC2019 as the XI National Horticultural Science Congress of Iran. It was also announced that TMU might host IrHC2021 as the II International Horticultural Science Congress of Iran. Finally, Prof. Kazem Arzani, Convener of IrHC2017 and Head of Department of Horticultural Science at TMU, acknowledged the Department of Horticultural Science, College of Agriculture and TMU authorities for providing excellent facilities, financial and administrative support. The support received from IrSHS, ISHS, Ministry of Agriculture of Iran, IrHC2017 National and International Scientific Committees, Executive Committee, Student Committee, as well as the IrSHS community and members, universities and research institutes and sponsors were also acknowledged.

Kazem Arzani



> From left, Dr. Ghazaleh Rouhani, Dr. Paul Arens, Prof. Yüksel Tüzel, Prof. Silvana Nicola, Prof. Kazem Arzani, Prof. Esmail Fallahi, Prof. Morteza Khoshkhui, Prof. Reza Fotouhi, Prof. Enayatolah Tafazoli, Prof. Kostas Chartzoulakis and Prof. Carol J. Lovatt at the IrHC2017 closing ceremony.



> Technical visit to Nazari Private pistachio orchards in Qazvin, Iran

> Contact

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› International Symposium on Horticulture: Priorities and Emerging Trends



› Symposium participants during inaugural session.

The International Symposium on Horticulture: Priorities and Emerging Trends was organized at J.N. Tata Auditorium, National Science Seminar Complex, Indian Institute of Science, Bengaluru by the Indian Council of Agricultural Research (ICAR)-Indian Institute of Horticultural Research (IIHR) at Bengaluru, India from 4-8 September 2017 to commemorate the golden jubilee year of the institute. His Excellency Shri Vajubhai Rudabhai Vala, Hon'ble Governor of Karnataka State of India, inaugurated the symposium. Shri Ananth Kumar, Hon'ble Union Minister for Chemicals & Fertilizers and Parliamentary Affairs, Govt. of India, graced the occasion as the Chief Guest. Dr. M.R. Dinesh, Director, ICAR-IIHR, extended a warm welcome to the dignitaries, delegates and invited guests. Dr. A.K. Singh, Deputy Director General (Horticultural Sciences), ICAR, New Delhi, highlighted the growth of horticulture in India and mentioned that horticultural production has reached 300 million tonnes from an area of 25 million ha during 2016-17. Shri. Ananth Kumar told the audience that the contribution of the institute, in supporting the horticulturists through development and dissemination of farmer-friendly technologies, was appreciated. His Excellency, Shri. Vajubhai Rudabhai Vala stated that agriculture supports the livelihoods of 65% of the country's population

and he called upon the scientists to help the farmers in doubling their income.

The symposium was jointly organized by ICAR, New Delhi, ICAR-IIHR, Bengaluru, and the Society for Promotion of Horticulture (SPH), Bengaluru, under the auspices of the International Society for Horticultural Science (ISHS). The symposium was attended by 600 delegates including 26 international delegates from 11 different countries. The symposium was comprised of eight keynote addresses, seven technical sessions and four workshops spread over four days. The keynote addresses were on research issues in horticulture, global perspective of research and development in horticulture, opportunities and challenges in value added products, precision horticulture, current trends in crop disease management, mitigating impact of climate change in horticultural crops, importance of social science research in technology dissemination and commercialization, and application of ICT in horticulture, and were delivered by renowned experts. Apart from these keynote addresses, 51 invited, 174 oral and 400 poster presentations were given during the symposium. There were seven thematic sessions: global scenario of production, trade, marketing, nutrition and health issues; genetic improvement – plant genetic resources, biotechnological approaches and

conventional breeding; production management – cropping systems, precision farming and input use efficiency; products and value addition – supply chain management, processing, by-products and waste utilization, mechanization in postharvest technology; biotic and abiotic stress management – insect pests, diseases and abiotic stresses; applications of ICT in horticulture; and participatory technology development, adoption and gender issues.

Technical sessions were spread over four days with four concurrent sessions on each day. Four hundred e-posters were presented on all seven thematic areas of the symposium. There were two exclusive sessions for students' oral presentations during which around 40 students presented their papers. ISHS student awards were presented to Narendra Singh Bhandari from the Division of Ornamental Crops, ICAR - IIHR, Bengaluru India, for the best oral presentation entitled "Study on pollen morphology and germination of 'Pavia' liliium (*Lilium longiflorum*)", and to Stanzin Angmo from the Defence Institute of High Altitude Research, DRDO, Leh, J&K, India, for the best poster entitled "Adoption of black plastic mulch technology in trans-Himalayan Ladakh".

The symposium concluded with an open session of feedback from various stakeholders



› His Excellency Shri Vajubhai Rudabhai Vala, Hon'ble Governor of Karnataka, India, and other dignitaries releasing the Souvenir of the symposium.

followed by a recommendations and awards ceremony.

The salient recommendations of the symposium are:

- There is need to harmonize international phyto-sanitary standards and regulations for fresh fruits and vegetables. Horticultural scientists around the world need to work together to make progress in the areas of pollinator research, rootstock breeding, marker assisted selection, pre-breeding lines, host plant resistance, vertical farming, robotics and mechanization in farming.
- Prospects of conservation of future fruits through custodianship in in situ areas must be explored. In situ conservation of identified commodities supported through communities and volunteer farmers in forest ecosystems must be explored. Use of geo-spatial technologies for efficient conservation of PGR needs to be done.
- Technologies, like tilling, eco-tilling, directed mutagenesis, doubled haploidy-based development of homozygous in-breeds, gene editing, gene chips and next generation sequencing, need to be incorporated into research programmes for increasing breeding efficiency.
- Building up of a global gene pool, which can be utilised across countries with appropriate material transfer agreements, is essential.
- Participatory breeding approaches can be efficiently applied in perennial crops in order to shorten the breeding cycle and to address the regionally-specific needs.
- Precision horticulture is dynamically changing, and has great potential for enhancing input use efficiency of all resources. Precision practices need to encourage large scale adoption. Use of new

technologies has to be taken up by more farmers.

- Although protected cultivation overcomes the biotic and abiotic stresses by avoiding extremes of weather, there is a need for regionally-specific designs, and identification of suitable cultivars and technologies for overcoming nematode problems. Water harvesting, use of solar energy, and development of skilled manpower are essential for making protected cultivation cost effective.
- The potential value of high density planting systems in perennial tropical fruit trees is not fully exploited commercially. Canopy management deserves greater attention by selection of proper rootstock-scion combinations, orchard designs, training and pruning systems, irrigation, and nutrition, for increasing productivity.
- To increase the profitability of horticultural farming, more attention should be given to development of cost effective, technically feasible and commercially viable postharvest handling, packaging and storage technologies. The time from field to market should be as short as possible, to increase the profitability for the farmer as well as affordability for the consumer.
- The farm level value addition has to be increased through technologies suitable for on farm processing. Few technologies have been developed by ICAR institutes for some of the commodities. However, there is a need to do more work on development of commodity specific machinery and tools for harvesting, grading and sorting that are suitable for small and medium holdings in more horticultural commodities.
- In-depth studies of host-pathogen interactions, taking into consideration biochemical and behaviour based host



› Dr. Jill Stanley, ISHS Board member, presenting ISHS student awards to A) Narendra Singh Bhandari for the best oral presentation, B) Stanzin Angmo for the best poster.

preferences, are essential to develop safe and sustainable IPM modules. There is an urgent need for developing production models.

- Identification of phenotypic traits using imaging techniques over multiple spectra should be strengthened for screening genotypes for abiotic stress tolerance. Metabolome imaging of the plant organs should be given more importance for trait identification.
- The importance of proteins belonging to SOS₃ pathway in imparting salinity tolerance was highlighted. Genes involved in this pathway may be used for development of markers or modifications.
- Multiple ICTs (mobile apps, SMS, video conference, DSS, etc.) should be extensively used for quickly monitoring and disseminating technologies at lower cost. Policies should be developed for large scale funding of ICT usage in horticultural crops.
- E-pest surveillance and monitoring should be standardised with latest GPS based, real time and robust tools for important horticultural crops.

- UAVs or drones should be used on a pilot basis in research and development activities in selected crops and aspects.
- Latest ICT tools should be used for germplasm database management programmes in all institutes for multiple crops.
- Explore the possibilities of using customised sensors that are functionally effective, use low power consumption, are low in cost, technically acceptable and environmentally friendly for research and development programmes in horticulture.
- Extension systems should be able to facilitate horticulturists to explore new

marketing options through well-equipped supply and value-chain systems in marketing of horticultural commodities.

- To augment technology adoption processes, situation-specific collaborations among partners of technology development, dissemination and utilization must be established.

Finally, the symposium ended with a vote of thanks to all delegates and the organizations who made it a great success.

*P.C. Tripathi, C. Aswath,
T.S. Aghora and M.R. Dinesh*

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› VII International Conference on Managing Quality in Chains (MQUIC) and II International Symposium on Ornamentals in association with XIII International Protea Research Symposium

Section Ornamental Plants

Commission Quality and Postharvest Horticulture

Commission Molecular Biology and In Vitro Culture

#ishs_seop

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› Conveners and keynote speakers. From left to right: Prof. Bart Nicolai, Prof. Leon Terry, Prof. Margrethe Serek, Dr. Lynn Hoffman, Stuart Symington, Prof. Umezuruike Linus Opara and Emily Rigby. Courtesy of Anton Jordaan, Stellenbosch University photographer.

A unique meeting uniting the VII International Conference on Managing Quality in Chains (MQUIC), II International Symposium on Ornamentals and XIII International Protea Research Symposium, was organised by the Department of Horticultural Sciences, Stellenbosch University, South Africa, under the auspices of the International Society for Horticultural Science (ISHS) on 4-7 September 2017. We thank our sponsors: National Research Foundation, National Department of Science and Technology, Western Cape Government Department of Agriculture, Department of Horticultural Science, SAR-ChI Postharvest Technology, Stellenbosch University, Star Roses and Plants, and Hortgro. A total of 121 participants attended the symposia representing MQUIC (54), Ornamentals (48) and Protea (19) from 20 countries: Australia, Belgium, Denmark, Germany, Indonesia, Iran, Italy, The Netherlands, New Zealand, Poland, Portugal, Russia, Spain, Sri



› Participants of the symposium. Courtesy of Anton Jordaan, Stellenbosch University photographer.



› ISHS student award winners: Tarl Berry (left) for the best oral presentation at MQUIC2017, Imke Kritzinger (center) for the best poster at MQUIC2017, and Anton Huysamer (right) for the best oral presentation at the II International Symposium on Ornamentals. Courtesy of Olaoluwa Olarewaju.



› Technical Fynbloem protea orchard tour. Courtesy of Zinash Belay.

Lanka, Switzerland, Thailand, the UK, the USA, Zimbabwe and South Africa. It is worth noting that almost half of all presentations were by students.

A total of six keynote speakers presented in plenary sessions throughout the symposium. Prof. Bart Nicolaï from KU Leuven (Belgium) concluded the introductory plenary session with his talk on the shape of things to come regarding online detection of internal disorders of horticultural products. Oral presentations followed the tea break and were delivered in parallel thematic sessions for each symposium. In the plenary session following lunch, Prof. Ernst Woltering from Wageningen University (The Netherlands) delivered a paper on the long-term storage of roses, for demand management and to facilitate long distance transport in reefer containers. Stuart Symington (Managing Director of CapeSpan, South Africa) concluded the day's presentations with his enticing talk on how to anticipate trends in the South African fruit industry entitled: The fruit tide is turning. The second day started with a plenary session where Prof. Leon Terry from Cranfield Univer-

sity (UK) delivered an address on mediating ethylene in non-climacteric systems. After lunch, Prof. Margarethe Serek from Leibniz University of Hannover (Germany) presented on the growth regulation in flowering potted plants *Kalanchoë blossfeldiana* and *Petunia* hybrid. Prof. Umezuruike Linus Opara from Stellenbosch University (South Africa) opened the final day's presentations with a review of the global status of pomegranate research and South Africa's contribution. The symposium included an excellent social program to allow for formal and informal discussions. The delegates were treated to a Cape winelands' experience of food and wine pairing at the gala dinner held at Clos Malverne. Conveners were thanked for their contribution and hard work organising the symposium, before dancing the night away. After the closing ceremony, participants were able to join an optional half-day "Explore Cape Town" excursion. Two post-symposium excursions were organised to showcase the Cape's rich flora biodiversity, deciduous fruit regions, Winelands' meander and Overberg region. The technical visit and scenic tour

headed to Oak Valley estate in Elgin where ornamentals such as *Alstroemeria*, *Chrysanthemum* as well as Oriental lilies are grown under cover. The scenic drive continued over Houwhoek Pass, into the Overberg area with its rolling hills of canola and grain fields, to Fynbloem, a prominent producer and exporter of indigenous Cape Flora bouquets. The Peninsula tour headed to Cape Point nature reserve with an on-route stop at Boulders beach, to enjoy the sight of waddling African penguins.

The VII International MQUIC Conference was convened by Prof. Umezuruike Linus Opara, who is also the Chair of the ISHS Working Group Quality in Chains. The oral presentations were grouped into three themes: non-destructive quality management, cold chain and packaging management, and post-harvest quality management. ISHS student awards were presented to Tarl Berry from Stellenbosch University for the best oral presentation entitled "Horticultural packaging systems of the future: improving reefer container usage" and to Imke Kritzinger from Stellenbosch University for the best



> [Technical Oakvalley packhouse tour.](#)
 Courtesy of Matia Mukama.

poster entitled “Evaluation of micro-perforated LDPE bags for reduction of post-harvest moisture loss and shrivelling in Japanese plums (*Prunus salicina* Lindl.)”. At the ISHS business meeting, it was unanimously agreed by participants that the ISHS should merge the International MQUIC Conference and Postharvest Unlimited, which have in recent times focused on similar research topics on quality and postharvest and attended by similar participants, into one International ISHS Conference.

The II International Symposium on Ornamentals was organised in collaboration with the XIII International Protea Research Symposium and XVIII International Protea Association

(IPA) Conference, and convened by Dr. Lynn Hoffman and Ms. Emily Rigby. Presentations relating to ISHS Working Group Protea were scheduled for the first day of the symposium and included topics such as controlled atmosphere storage and plant protection. The remaining ornamental topics were presented the following day and included ornamentals tissue culture, propagation and breeding. An ISHS student award was presented to Anton Huysamer from Stellenbosch University for the best oral presentation entitled “Novel technologies for the postharvest treatment of fynbos flowers to control phytosanitary insect pests”. During the ISHS business meeting, no convener for the III International Symposium on Ornamentals was decided.

IPA members enjoyed a pre-conference tour to production areas in Western Cape, followed by a growers’ day during the XVIII International Protea Association Conference (31 August - 4 September 2017), which was organised by IPA in collaboration with Cape Flora SA. During the business meeting of ISHS Working Group Protea, it was decided that the XIV International Protea Research Symposium will be held in Canary Islands (La Palma & Tenerife) in April 2020. Mr. Antonio López, the manager director of ASOCAN (Association of Growers and Exporters of

Cut Flowers and Plants from Canary Islands) offered to organize the symposium. Ms. Emily Rigby has been re-elected as Chair of ISHS Working Group Protea.

At the closing ceremony, Prof. Umezuruike Linus Opara (Chair of ISHS Working Group Quality in Chains) thanked all delegates for attending the symposium and Prof. Margrethe Serek (Chair ISHS Section Ornamental Plants) invited all participants to attend the XXX International Horticultural Congress in Turkey on 12-16 August, 2018.

*Lizanne de Kock, Retha Venter,
 Lynn Hoffman and Umezuruike Linus Opara*

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> XIII International Symposium on Plant Bioregulators in Fruit Production

Section Pome and Stone Fruits

Section Tropical and Subtropical Fruits

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The XIII International Symposium on Plant Bioregulators in Fruit Production was held in Chiba, Japan from 27 to 30 August 2017 under the auspices of the International Society for Horticultural Science (ISHS). To improve fruit quality and reduce labor in cultivation, the technique of plant growth regulation has been utilised in many kinds of fruits around the world. Therefore, ISHS Section Pome and Stone Fruits and ISHS Section Tropical and Subtropical Fruits supported the 2017 symposium. We discussed the physiological mechanism and cultivation advances made in the field of plant growth regulation. The symposium attracted 161 delegates from 16 countries, who presented 49 oral and 52 poster presentations. The scientific program of

the symposium was as follows: 1) thinning and alternate bearing, 2) flowering and fruiting, 3) tropical fruit, 4) vegetative growth, 5) ripening and postharvest physiology, 6) biochemical and molecular aspects, 7) dormancy and crop production.

A welcoming reception, including music, was held for the participants and their guests. On August 28, after the welcome speeches given by the convener (Prof. S. Kondo, Chiba University), the president of Chiba University (Prof. T. Tokuhisa), the representative of the Japanese Society for Horticultural Science (Prof. S. Kawabata, Tokyo University), and a member of the ISHS Board of Directors (Prof. R. Tao, Kyoto University), the plenary lecture was delivered by Prof. G. Costa (University

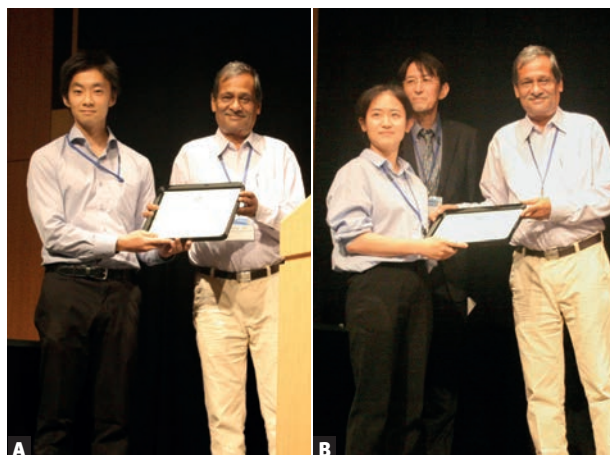
of Bologna, Italy), who presented “Dealing with plant bioregulators in Italy: from the introduction to now”. The symposium had six invited speakers. During the flowering and fruiting session on the first day, Prof. N. Kotoda (Japan) presented “The molecular basis of flowering in fruit trees”. In the tropical fruit session, Prof. S. Mitra (India) talked about “Paclobutrazol in flowering of some tropical and subtropical fruits”. During the vegetative growth session on the second day, Prof. H. Ramirez (Mexico) spoke about “Pomological characteristics and gibberellins identification on ‘Golden Delicious’ apple mutants”. The afternoon of the second day was dedicated to a symposium tour, which gave the participants the option of visiting



> Participants of the symposium.



> Prof. Satoru Kondo, Symposium Convener.



> Prof. Sisir Mitra presenting ISHS student awards to A) Humberto Mitio Horikoshi for the best oral presentation, and B) Wanichaya Chaiwimol for the best poster.



> Japanese pear orchard (Shiroi, Chiba prefecture).

either Chiba University's plant factory and orchard or the packing house and orchard of Japanese pear in Shiroi city. At the plant factory, the solar plant factories had shading nets and thermal screens on the roof and side wall for controlling light intensity and maintaining temperature. An insect-proof net was also attached to the solar plant factories. At the packing house, it was shown that Chiba prefecture produces the highest yield of Japanese pears in Japan, with Shiroi city being the prefecture's most productive area. The main cultivars of Japanese pear in Chiba are 'Kosui' and 'Hosui'. The visitors of the packing house were able to taste 'Hosui' Japanese pears. The third day comprised three main sessions. During the ripening and postharvest physiology session, Prof. Y. Hao talked about "Molecular mechanism by which phytohormone ABA promotes sugar accumulation in

apple". During the biochemical and molecular aspects session, Dr. M. Okamoto presented "Chemical regulation in ABA metabolism" and during the dormancy and crop production session, Prof. E. Or argued that "ABA is a modulator of endo-dormancy release in grapevine buds". In addition to these sessions, student sessions (10 oral and 16 poster presentations) were held on the first and second days. The best oral and the best poster student presentations were selected by 10 session chairpersons and ISHS student award certificates were presented by Prof. Sisir Mitra, Chair of ISHS Section Tropical and Subtropical Fruits, to Mr. Humberto Mitio Horikoshi from the University of Tsukuba, Japan, for the best oral presentation entitled "Metabolic profiling of 'Hosui' Japanese pear flower buds treated with hydrogen cyanamide" and to Miss Wanichaya Chaiwimol from Mahidol University, Thailand, for

the best poster entitled "Exogenous abscisic acid (ABA) and prohydrojasmon affect anthocyanin accumulation and endogenous ABA and jasmonic acid content in the fruit of red fleshed kiwifruit".

The XIV International Symposium on Plant Bioregulators in Fruit Production will be hosted by Dr. Fabrizio Costa of Fondazione Edmund Mach, Italy in 2021. Finally I'd like to extend my appreciation to the various members of the organizing committee without whom this symposium would not have been possible.

Satoru Kondo

> Contact

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› VII South-Eastern Europe Symposium on Vegetables and Potatoes

Section Vegetables, Roots, Tubers, Edible Bulbs,
Brassica, Asparagus
Commission Protected Cultivation

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The University of Maribor, Faculty of Agriculture and Life Science, had the honor of organizing the VII South-Eastern Europe (former Balkan) Symposium on Vegetables and Potatoes on June 20-23, 2017, in Maribor, Slovenia, under the auspices of the International Society for Horticulture Science (ISHS) and with the support of the Food and Agriculture Organization (FAO) and the Slovene Ministry of Agriculture, Food and Forestry (MAFF).

A long tradition of vegetable production for processing industry in the past, and for fresh market more recently, encouraged the Slovene Association to establish integrated vegetable production in the year 2000, to prepare all procedures for the first vegetable crop with the origin of denomination "Ptujski lük", which was approved at European level in 2011.

During the first day of the symposium, the scientific program covered the following topics: Production systems and quality of vegetables and potatoes (V&P), Organic V&P production, Short supply chains and other concepts of V&P marketing, Protected cul-

tivation and GAP of greenhouse production on small farms, Biodiversity, Irrigation and plant water relations, Genetic resources and breeding, Potato, Plant protection, General and other topics. Three additional events took place: an FAO workshop on GAP for greenhouse production on small farms in South-Eastern Europe (SEE), with the presentation of a new manual printed by FAO, a networking event for further project collaboration in SEE, and an ISHS business meeting. During the first event, twelve authors of the FAO technical document presented their chapters – some of them also as posters, which were also presented to all participants on the following day. There were 21 participants who attended the second event, networking for further project collaboration in SEE, which resulted in a decision for further collaboration with FAO on preparing a new technical document on "Organic vegetable production". During the ISHS business meeting it was decided that the VIII South-Eastern Europe Symposium on Vegetables and Potatoes will be convened by Dr. Gordana

Popsimonova from the University from Skopje, Macedonia, and Dr. Skender Kaciu from the University of Prishtina, Kosovo, in Ohrid, Macedonia, in September 2020. Prof. Nazim Gruda from Germany was elected as the new Chair of ISHS Working Group Balkan Vegetable and Potato Production.

During the next scientific day, a parallel event entitled "Some important facts for improving greenhouse vegetable production" took place. This event was intended for vegetable and potato growers, advisors, technical workers and other professional public people. Under the support of FAO and MAFF, ten distinguished professionals presented the most important topics for successful greenhouse vegetable production with the goal to also give the attendees insights in novel research findings and recommendations for improvements. We concluded the symposium with a field trip to grower properties, where different production methods (from biodynamic organic to integrated and soilless, Global GAP) and different marketing strategies (direct selling, community-supported agri-



› Participants of the symposium.



› ISHS Vice-President Prof. Silvana Nicola (left) handing out the ISHS medal award to Symposium Convener Prof. Martina Bavec.



› Prof. Silvana Nicola presenting ISHS student awards to A) Tanyat Tarinta for the best oral presentation, and B) Loriana Cardone for the best poster.

culture (CSA), protected origin products, establishing non-formal co-operations and supplying to big chains) were presented with the aim to exchange ideas and knowledge among participants and growers from the Podravje region.

Sixty-three participants (33 full registrations) from 28 countries participated in the symposium, who contributed 79 abstracts and 46 manuscripts, which are under review and will be prepared and edited for publishing in *Acta Horticulturae*.

In the scope of ISHS student awards, Tanyat Tarinta from Khon Kaen University, Thailand, received an award for the best oral presentation entitled “Accumulation of capsinoids and capsaicinoids in three *Capsicum* species during fruit growth” and Loriana Cardone from Università degli Studi della Basilicata, Italy, received an award for the best poster entitled “Effect of geographical origin and dimension of corms on saffron production in Basilicata Region (Southern Italy)”.

The VII South-Eastern Europe Symposium on Vegetables and Potatoes was supported by the municipality of Maribor having a vice major as well as state secretary of MAFF and president of Slovene association of integrated vegetable production, who gave speeches at the opening ceremony. In addition, MAFF supported the workshop for farmers and trainers by financing simultaneous translation and the congress hall and FAO by providing foreign lecturers presenting the most important topics for successful greenhouse vegetable production to Slovene advisors and growers.

Encouraged by the positive response from the participants, the University of Maribor decided to organize another ISHS symposium – IV International Symposium on Underutilized Plant Species (<http://www.ishs.org/symposium/625>) under the auspices of the ISHS in June 2019.

Tjaša Vukmanič

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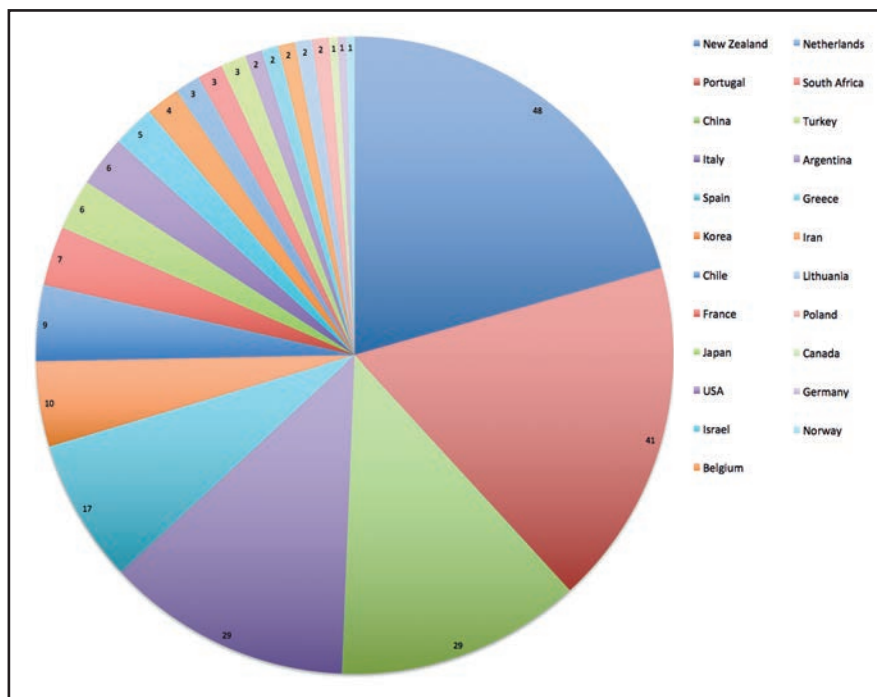


› Symposium excursion – a stop at the test field of the Faculty of Agriculture and Life Sciences.

> IX International Symposium on Kiwifruit

ISHS Section Vine and Berry Fruits
 ISHS Section Pome and Stone Fruits
 ISHS Commission Plant Protection

#ishs_sevi
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■ Figure 1. Number of participants from each country.

The IX International Symposium on Kiwifruit was held in Porto, Portugal, from September 6-9, 2017. The symposium was organized in cooperation with the Algarve (Portugal) and Vigo (Spain) Universities and the Portuguese Society of Horticulture Science (APH), under

the auspices of the ISHS Working Group Kiwifruit and Its Culture (Section Vine and Berry Fruits). The symposium brought together 234 participants from 23 countries from all around the world (Figure 1), who presented 71 oral presentations and 89 posters.

The opening ceremony was led by Eng. Miguel Freitas, State Secretary of Forestry and Rural Development, Prof. Bernadine Strik, Chair of ISHS Section Vine and Berry Fruits, Prof. Domingos Almeida, President of APH and the Conveners, Prof. Dulce Antunes (Algarve University) and Prof. Pedro Pablo Gallego (Vigo University). All welcomed the participants, extended their gratitude to the Organizing Committee and recognized the common organization of Portugal and Spain, where kiwifruit production has shown a great increase in the last decades and still represents a high growing potential.

The symposium was over three working days, and included seven sessions and a field trip. In session 1, Prof. Guglielmo Costa (Italy) gave a keynote presentation on “Main changes in the kiwifruit industry since its introduction: present situation and future”, co-authored by Dr. Ross Ferguson (New Zealand), Prof. Hongwen Huang (China) and Prof. Raffaele Testolin (Italy). This talk was followed by another seven oral presentations focused on the most updated techniques of production, economical aspects and marketing in several countries such as Portugal, Spain, Chile, Iran and China. In session 2, basic knowledge of the kiwifruit genome and its application in breeding programs were discussed. New techniques for exploratory QTL analysis, genome-wide



> Participants of the symposium.



> Opening ceremony.

identification and genomic prediction were presented orally (19) or as posters (11). Session 3 related with crop physiology and biochemistry, included 10 oral presentations and 11 posters, dealing with insights into carbohydrate metabolism, composition and manipulation, balancing vine growth and mineral composition with fruit production, isolation of allelopathic substances and assessment of drought tolerance under plant tissue culture. Session 4 was fully dedicated to the bacterial canker *Pseudomonas syringae* pv. *actinidiae* (Psa) and started with an invited lecture by Dr. Marco Scortichini (Italy) updating aspects still to solve in the management of Psa. More than 40 eminent experts exposed the latest research (20 oral and 20 poster presentations) including: characterization, virulence, plant defense mechanisms, new treatments and diversity of Psa. Session 5 was dedicated to cultural management, and 10 oral and 16 poster presentations were given. Pollination: natural, assisted with bumblebee and honeybee, or using entomovector technology, was recognized as a very important issue. New approaches in kiwifruit management and the effect of farming practices on soil fauna were also discussed widely. Session 6 focused on postharvest and fruit quality and started with the invited lecture “New cultivars: physiological challenges to commercial success” presented by Dr. Jeremy Burdon (New Zealand). Topics included: problems associated with storage disorders and softening and with postharvest pathogens, the use of non-destructive tools, such as near-infrared spectrophotometry, quality assessment, cold storage at 0°C in normal atmosphere compared with gaseous ozone,

and this session had 9 oral presentations and 43 posters.

A final session on kiwiberry was included, starting with an excellent overview on “The kiwiberry chronicles: a history of cold-hardy *Actinidia* in North America” by Dr. Bob Guthrie (USA). Three more oral talks and 19 posters gave an idea of the importance of *A. arguta* as new cultivar worldwide. Most presentations dealt with genomic studies (molecular marker, hybrid populations), mineral nutrition, bioactive compounds (phenolic and anti-oxidant activities), post-harvest and fruit quality and, finally, optimization of plant tissue culture media for *A. arguta* micropropagation.

At the business meeting, it was announced that the X International Symposium on Kiwifruit will be held in Yalova (Turkey) in October 2020, and Dr. Arif Atak, as convenor, was elected Chair of the ISHS Working Group Kiwifruit and Its Culture. Also, it was decided that the XI International Symposium on Kiwifruit will be held in New Zealand in 2023. ISHS student awards were given to Leo Lai from the Centre for Postharvest and Refrigeration, Massey University, New Zealand for his oral presentation entitled “Fruit development and skin changes of *Actinidia chinensis* ‘Sungold™’ kiwifruit” and to Marta Nunes da Silva from Faculty of Sciences, Porto University, Portugal, for her poster entitled “Chemical characterization and antimicrobial activity of six plant essential oils against *Pseudomonas syringae* pv. *actinidiae* and *Pseudomonas syringae* pv. *actinidifoliorum*”.

Dulce Maria Antunes and Pedro Pablo Gallego



> The conveners Prof. Pedro P. Gallego (left) and Prof. Dulce Antunes (right) receiving the ISHS medal award from ISHS representative Prof. Bernadine Strik (center).



> ISHS student awards presented to A) Mr. Leo Lai for the best student oral presentation, and B) Ms. Marta Nunes da Silva for the best student poster.



> Field trip to the main area of kiwifruit production in the Iberian Peninsula.

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› Greensys2017 - International Symposium on New Technologies for Environment Control, Energy-Saving and Crop Production in Greenhouse and Plant Factory

Commission Horticultural Engineering
Commission Protected Cultivation

#ishs_cmen
#ishs_cmpc

The International Symposium on New Technologies for Environment Control, Energy-Saving and Crop Production in Greenhouse and Plant Factory (GreenSys2017) was successfully held in Beijing (China National Convention Center), China from 20-24 August 2017, under the aegis of ISHS. It was the first worldwide international symposium on protected horticulture held in China. The symposium was sponsored by the Chinese Academy of Agricultural Sciences and the Chinese Association of Agricultural Science Societies, and organized by the Institute of Environment and Sustainable Development in Agriculture-CAAS, as well as the Chinese Society for Horticultural Science. It was also sponsored by 16 companies and associations, for which booths were provided to exhibit their products and technologies. In total, 511 participants from 27 countries exchanged the latest insights in the field of greenhouse systems engineering, latest technologies, different crop production aspects and plant physiological insights. More than 300 participants from China were present. Participants from Japan, Korea and the Netherlands formed the largest group of international experts. Three keynotes, 13 invited, 121 oral and 153 poster presentations were given. Topics included greenhouse system design, covering materials, climate control and modelling, plant factory technology, lighting technologies, crop production and management, crop modelling, product quality, fertigation, and growing medium management. The symposium received great support from the Ministry of Agriculture of P.R. China. Vice Minister, Dr. Taolin Zhang, attended the opening ceremony and gave a welcome speech. He briefly introduced the general situation of protected horticulture industry in China, and emphasized the necessity of global cooperation for food safety.



› Participants listening to a keynote presentation.

During the symposium, the following trends could be observed: a shift from simple protected cultivation towards more high-tech greenhouse production, development of production systems with more intelligent environmental control, use of more ICT, big data and machine learning technologies, and a shift towards plant factories for green leafy vegetables, especially in cities.

An ISHS student award was given to Rack-Woo Kim from Seoul National University, Korea for the best student poster entitled “A review of greenhouse design standard for wind load action on greenhouse”. Based on the topics discussed, we concluded that:

- 1) Optimization of the future protected horticulture production system should not only focus on crop yield and quality, but full attention should also be given to economic feasibility and resource use efficiency.
- 2) Plant factories with artificial light (PFAL) have been widely studied and applied

recently and get full attention worldwide. The advantages of PFAL are apparent, but disadvantages cannot be neglected, e.g. high operation skills, sophisticated technology, and high investment are needed, and sustainable production has not yet been achieved. Future challenges of PFAL are increasing light use efficiency, decreasing electricity use, and finding new produce types.

- 3) LED lighting opens up many possibilities to control photosynthesis, morphology, development and growth of plants as well as product quality for production of plants in greenhouses or vertical farms. Trends in LED should shift from single colour to white LEDs. Green and far-red light appears to be the focus of a lot of current research.
- 4) Urban agriculture has great potential, not only for providing food production, but also for environmental and social services with direct interaction with local urban

markets. New urban solutions, such as community gardens, green roofs, vertical farms and roof top greenhouses, should be explored.

- 5) In plant research, more attention is needed on the interaction between different growth conditions and plant processes, as well as for fluctuations in climatic conditions. Controlling the climate should focus more strongly on the microclimate near the plant organs than on the average greenhouse climate.
- 6) For climate control, use of cheaper and more powerful sensor & camera systems and artificial intelligence for data interpretation are future trends.

Tao Li, Silke Hemming and Ep Heuvelink



› Mini growth chamber with LEDs in the exhibition.

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- › Symposium Convener Prof. Dr. Qichang Yang presenting the ISHS student award to Rack-Woo Kim for the best poster.



› X International Workshop on Sap Flow

Commission Irrigation and Plant Water Relations

#ishs_cmir

Plants move approximately as much water to the atmosphere as all the world's rivers carry to the oceans. This flow has huge impacts on the global water cycle and climate. It is also of great concern in seasonally or permanently dry regions, where horticulture and agriculture require irrigation. Accurate measurements of plant water use and sap flow have become increasingly important for determining irrigation needs and conserving irrigation water. This calls for research on the physiology of plant water use, on improving

measurement technology, and on applying it in horticulture and agriculture.

To address this need, the ISHS Working Group on Sap Flow has organized International Workshops on Sap Flow for many years. While firmly rooted in horticultural science, over the years these workshops have also increasingly attracted scientists who study plant water use in agriculture, forestry, and natural ecosystems, using sap flow measurement technology and a wide variety of other approaches for measuring water status in living plants.

The X International Workshop on Sap Flow continued the trend of covering a broad range of topics related to plant water use. It was convened by H. Jochen Schenk (California State University Fullerton, USA) and took place from 22-26 May 2017 in the Fullerton Arboretum in Fullerton, California, USA, where outstanding meeting facilities and support were provided by the Arboretum, one of the main sponsors of the workshop. Other major sponsors included equipment manufacturers Dynamax Inc. (USA), ICT



› Former ISHS Working Group Chair J. Enrique Fernández (left) handing out the ISHS medal award to Convener and new Working Group Chair H. Jochen Schenk (right).



› ISHS student award winners: Jens Mincke (left) for the best oral presentation and Eleinis Ávila-Lovera (right) for the best poster.



› Field trip to San Dimas Experimental Forest. Alec Downey (ICT International, with laptop) presents the wireless network installed at the site.

International (Australia), UP and Ecomatik (both Germany), and the California Avocado Commission. The workshop included 82 participants from 19 countries and featured five keynote talks, 42 oral and 27 poster presentations.

Keynote speaker George Koch (Northern Arizona University) opened the scientific program with a talk about challenging work to measure water status in some of the world's tallest trees, such as redwoods in California and *Eucalyptus regnans* in Australia, using stem psychrometers. The following oral session featured presentations on plant hydraulics and the physiology of water transport in xylem and leaves, with several talks addressing drought impacts and embolism formation in plants. Chelcy Miniati (US Department of Agriculture) presented a keynote talk on the use of sap flow measurements as a tool for land use managers to assess landscape-scale water fluxes in forests. Her examples focused on forests that are experiencing a change in tree species composition, such as the loss and replacement of eastern hemlock from southern Appalachian forests. Other presentations on transpiration

and water use addressed these processes at scales ranging from leaves to plants to entire watersheds.

The next day, a talk on water conducting capacity and water storage in plants, presented by keynote speaker Andrew McElrone (US Department of Agriculture/University of California Davis), featured 3D images of water in living plant xylem created by micro-computed tomography at a stunning level of detail. Other presentations in this session also addressed relationships between structure and function in xylem and the implications for water movement and sap flow. The session on sap flow in horticulture and its relationships to irrigation was opened by keynote speaker Thibaut Scholasch (Fruition Sciences, France), who shared his experiences building a company that applies sap flow measurements in vineyards of France and California with the aim of developing irrigation strategies for increasing wine quality and conserving water. The final session addressed sap flow measurements and methodologies and was opened by keynote speaker Rafael Oliveira (Universidade Estadual de Campinas, Brazil),

who talked about the challenges of disentangling the effects of soil and atmospheric drought on the sap flow of tropical montane cloud forest trees.

A full-day field excursion introduced participants to a sap flow and irrigation experiment at an avocado orchard at Pine Tree Ranch maintained by the California Avocado Commission in the Santa Clara River valley, the Rancho Camulos museum, and the San Dimas Experimental Forest, where an experiment to measure whole plant hydraulic conductance was set up in large lysimeters. The Pine Tree Ranch site was instrumented with a wireless network of sap flow sensors with support from gold sponsor Dynamax Inc. The San Dimas site was instrumented with a wireless network of stem psychrometers, sap flow, and soil moisture sensors with support from gold sponsor ICT International.

The award for the best oral presentation by a student went to Jens Mincke from Ghent University, Belgium, for his presentation entitled "Visualization of dynamics in woody tissue photosynthesis via positron autoradiography of xylem-transported $^{14}\text{CO}_2$ " with co-authors Michiel Hubeau, Christian Vanhove, Stefaan Vandenberghe, and Kathy Steppe. The award for best poster presentation by a student went to Eleinis Ávila-Lovera from the University of California Riverside, USA, for her presentation entitled "Cost-benefit analysis of carbon gain and water use in green-stemmed desert species from southern California" with co-authors Roxana Ms. Haro and Louis S. Santiago.

H. Jochen Schenk



› Field trip to an avocado orchard at Pine Tree Ranch. Mike van Bavel (Dynamax, second from right) explains the sap flow technology installed at the site.

› Contact

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› International Symposium on Greener Cities for More Efficient Ecosystem Services in a Climate Changing World

Commission Landscape and Urban Horticulture #ishs_cmuh
 Commission Education, Research Training and Consultancy #ishs_cmet
 Commission Horticultural Engineering #ishs_cmen
 Commission Protected Cultivation #ishs_cmpc
 Section Vegetables, Roots, Tubers, Edible Bulbs, Brassica, Asparagus #ishs_sevr



› Conveners Giorgio Prosdocimi Gianquinto (left), Francesco Orsini (center) and Teodoro Georgiadis (right) during the closing ceremony.

Global concerns on climate change have intensified as a result of drastic policy changes and an increased recurrence of extreme weather events that challenge our society. In this context, climate change adaptation and mitigation has become central in urban design, where green infrastructures are being integrated, with the aim of boosting ecosystem services that had been undermined by intense urbanization, thereby making cities more resilient. The International Symposium on Greener Cities for More Efficient Ecosystem Services in a Climate Changing World (GreenCities2017) is the first ISHS event addressing such a complex issue, as an evolution from the past conferences of ISHS Commission Landscape and Urban Horticulture, thereby highlighting the role of smart agriculture and the

challenges of climate change in the urban environment. GreenCities2017 took place between September 12 and 15, 2017, at the University of Bologna, Italy, and was organized by the Research Centre in Urban Environment for Agriculture and Biodiversity (ResCUE-AB) of the Department of Agricultural Sciences (DIPSA) of the Alma Mater Studiorum – University of Bologna and the Institute of Biometeorology of the National Research Council of Italy (CNR) under the auspices of the ISHS. The three symposium conveners, Prof. Giorgio Prosdocimi Gianquinto, Chair of ISHS Commission Landscape and Urban Horticulture, with a large expertise in urban horticulture and small-scale farming in cooperation and development projects in developing countries, Dr. Francesco Orsini, Chair

of ISHS Working Group Urban Horticulture and specialist in urban horticulture, abiotic stress and smart horticulture, as well as in the promotion of urban agriculture in higher education, and Dr. Teodoro Georgiadis, referent in urban bioclimatology and thermal balances in cities, accomplished the goal of putting together a multidisciplinary discussion on the topic.

The four days of symposium resulted in a discussion space where horticulturists, urban planners, landscape designers, architects, environmental scientists as well as experts in bio-meteorology, sociology, economy and other disciplines, found a common ground for debate and action. A total of 171 contributions (combining plenary lectures, oral presentations, and short communications) were presented by scientists, professionals, practitioners and public bodies from 30 countries representing all the continents.

The opening ceremony started the three days of scientific sessions, which was followed by a final day of technical visits. The lectio magistralis was offered by the architect Mario Cucinella (Mario Cucinella Architects, Italy) with the ambitious title “Creative empathy”. The scientific program was structured in four sessions, each of them introduced by specific keynote lectures. “Cities and climate change” (Session 1) was introduced by Dr. Andrew Karvonen (KTH Royal Institute of Technology, Sweden), who highlighted the complexity and the need of up-scaling scientific findings towards bridging the gap between research and society, and by Prof. Andreas Matzarakis (University of Freiburg, Germany) with a talk that combined the importance of data gathering and the role that science can play in satisfying the demands of the society. “Smart horticulture for sustainable cities”

(Session 2) included keynotes on technological advances and societal aspects. While Prof. Cecilia Stanghellini (Wageningen University and Research Centre, The Netherlands) and Dr. Juan Ignacio Montero (IRTA, Spain) introduced recent advancements in rooftop greenhouses, Dr. Chiara Tornaghi (Coventry University, United Kingdom) focused on the challenge to empower society in the configuration of new urban food systems. Prof. Alessandra Bonoli (University of Bologna, Italy) outlined the role of urban green technologies in energy saving strategies to introduce Session 3 on “Green infrastructures for more efficient ecosystem services”. Finally, “Designing and engineering greener cities: bridging visions” (Session 4) brought together the opportunities of nature-based solutions within the circular economy exposed by Marco Marcatili (Nomisma, Italy) and the potential conflicts and societal impacts of urban greening through green gentrification processes, unveiled by Dr. Isabelle Anguelovski (Universitat Autònoma, Spain). The challenges of multidisciplinary approaches, i.e., integrating quantitative and qualitative visions, the need to reinforce the links between research and society, the advances provided by high-tech solutions and modelling, as well as the intrinsic contribution to resource efficiency of a green city vision, were central discussions of the different sessions. Indeed, the symposium was organized to set specific scenarios for multi-actor discussions by integrating two business actions, a policy action and a networking session in the program. Resulting from these interactions, Climate-KIC representatives (European Institute of Innovation and Technology) introduced their funding program that promotes innovation towards climate change adaptation and mitigation to SMEs. The recently launched cluster, UrbanAg on entrepreneurial urban agriculture, was the basis for the networking session on higher education, leading to a discussion on the role of different stakeholders in the development of urban agriculture. At the symposium closure, ISHS student awards were presented to Dr. Francesco Lisi from the University of Pisa, Italy, for the best oral presentation entitled “Green roofs: benefits analysis and development of a simplified dynamic energy model” and to Dr. Amy Heim from Saint Mary’s University, Canada, for the best poster entitled “The effect of soil depth heterogeneity on species diversity, biomass, and weedy species colonization on an extensive green roof”.

The social program included the welcome cocktail in the emblematic Archiginnasio, the first venue of the University of Bologna, after the UrbanAg networking session, and the social dinner at the Spazio Battirame of the



> **Winners of the ISHS student awards: A. Francesco Lisi for the best oral presentation. B. Amy Heim for the best poster.**



> **Participants visiting the Parco Villa Ghigi after the trekking from the city centre.**

Eta Beta social cooperative. The delegates were welcomed to the social dinner with a unique Landscape Theater performance that explored the organic circular garden as well as the emotions linked to the green resources in cities. Spazio Battirame delighted the participants with its very special identity, which combines urban regeneration, organic farming, social inclusion, arts and cooking. The scientific sessions were then closed by a tasty and surprising buffet made of local and organic food, pairing with exceptional Italian wines. Finally, technical visits were made, which included a bike tour from the centre of Bologna along the Reno channel to Urban blue infrastructures (Parco della Chiusa) or a walking tour to the Parco Villa Ghigi. These eco-friendly tours were the perfect way to end the four-day symposium that highlight-

ed interactions among different disciplines and stakeholders concerning the development of multidisciplinary and multi-actor approach towards developing green cities.

Esther Sanyé-Mengual

> Contact

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> New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Albania: Alban Ibraliu; **Argentina:** Assoc. Prof. Viviana Noemí, Dr. Carina Andrea Reyes Martínez, Lorena Sendin; **Australia:** Mr. Lafta Atshan, Dr. Ron Balsys, Mr. Zhong Xiang Cheah, Ms. Yun Si Grace Chua, Mr. John Coulombe, Mr. Christopher De Ieso, Dr. Jamel Fani, Dr. Mofakhar Hossain, Mr. Shane Kay, Mr. Steve Kneebone, Mr. Jordan Lawton-Heritage, Ms. Margie Milgate, Mr. William Nak, Dr. Narender Pathania, Ms. P. Upamali S. Peiris, Mr. Kenneth Rayner, Mr. John-Paul Slaven, Ms. Mahya Tavan, Mr. Rahul Thakur, Dr. Michael Treeby, Mr. Peter Underhill, Assoc. Prof. Simon White; **Belgium:** Ms. Silvia Bruznican, Dr. Karoline D'Haene, Mr. Jeroen Van der Veken; **Botswana:** Dr. Israel Legwaila; **Brazil:** Mr. Claudio Almeida, Dr. Adimara Bentivoglio Colturato, Bruna Ap. Bettini, Prof. Dr. Leila Trevizan Braz, Ms. Maiara Crutolo, Caio Cugler Siqueira, Dr. André Luiz Fadel, Prof. Dr. Jocleita Ferrareze, Mr. José Luís Trevizan Chiomento, Dr. Luana Maro, Dr. Edilson Paiva, Dr. Leandro Pena García, Dr. Janay Serejo; **Bulgaria:** Dr. Stanislava Dimitrova; **Canada:** Mr. Pierre-Marc de Champlain, Ms. Navina Janmeja, Mr. Deepak Kumar Jha, Mr. Kevin Kersten, Mr. Calum Malcolm, Mr. Lonnie Mesick, Dr. Aime Messiga, Ms. Sherryl Patton, Marc Sirois; **Chile:** Maximiliano Bustamante; **China:** Changwei Ao, Changbao Chen, Prof. Li Dong, Yuhui Dong, Dr. Wei Du, Prof. Zhihong Gao, Prof. Qingsheng Gu, Dr. Mingxin Guo, Prof. Dr. Hongju He, Prof. Dr. Xilin Hou, Conglin Huang, Dr. Dandan Huang, Jian Huang, Mr. Hafiz Javed, Fangling Jiang, Dr. Danlong Jing, Dr. Yiqian Ju, Prof. Dr. Jiang Li Lei, Dr. Jidong Li, Assoc. Prof. Qingming Li, Rongfei Li, Xiansong Li, Prof. Yan Liang, Dr. Gaoyuan Liu, Ms. Min Liu, Assoc. Prof. Niya Liu, Prof. Zhande Liu, Dr. zhiguo Liu, Prof. Qunfeng Lou, Dr. Wei Lu, Mr. Jianxiang Ma, Ms. Junbei Ni, Shenchun Q u, Prof. Dr. Yushan Qiao, Haiyan Ren, Ms. Haiyan Sun, Assoc. Prof. Haiping Wang, Assoc. Prof. Hongxia Wang, Dr. Jianhui Wang, Dr. Lan Wang, Assist. Prof. Lili Wang, Dr. Yinglin Wang, Assoc. Prof. Zhenlei Wang, Assoc. Prof. Gang Wangle, Prof. Jianhe Wei, Dr. Xiaohui Wen, Prof. Lin Wu, Prof. Zhen Wu, Suqiong Xiang, Jin Xu, Prof. Dr. Xuefeng Xu, Prof. Yong Xu, Xiaofang Xue, Dr. Ling Yin, Chengcheng Zeng, Dr. Ji-Yu Zhang, Lili Zhang, Dr. Lili Zhang, Dr. Tengxun Zhang, Assoc. Prof. Yang Zhang, Assoc. Prof. Yi Zhang, Prof. Zhihua Zhang, Prof. Dr. Deying Zhao, Assoc. Prof. Shugang Zhao, Prof. Dr. Xusheng Zhao, Mr. Tangchun Zheng, Prof. Guangfang Zhou, Dr. Rong Zhou, Assoc. Prof. Zhong-Yu Zhou, Prof.

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Year 2018

■ March 7-9, 2018, Seoul (Korea (Republic of)): **III International Orchid Symposium**. Info: Prof. Dr. Ki Sun Kim, Department of

Plant Science, CALS, Seoul National University, Seoul 151-921, Korea (Republic of). Phone: (82)2-880-4561, Fax: (82)2-873-2056, E-mail: kisun@snu.ac.kr E-mail symposium: info@ios2018.kr Web: <http://ios2018.kr>

■ March 26-28, 2018, Bangkok (Thailand): **III International Symposium on Plant Cryopreservation**. Info: Dr. Kanchit Thammasiri, Department of Plant Science, Faculty of Science, Mahidol University, Rama VI Road, Phyathai, Bangkok 10400, Thailand. Phone: (66)89-132-7015, Fax: (66)2-354-7172, E-mail: kanchitthammasiri@gmail.com E-mail symposium: cryosymp2018@gmail.com Web: <http://www.sc.mahidol.ac.th/scpl/cryosymp2018>

■ April 16-18, 2018, Canelones (Uruguay): **IV International Symposium on Citrus Biotechnology**. Info: Dr.

Fernando Rivas, Ruta 3, Camino al Terrible SN, Salto 50000, Uruguay. Phone: (598) 47332300, E-mail: cfrivas@inia.org.uy E-mailsymposium:info@citrusbiotechnology2018.org Web: <https://www.citrusbiotechnology2018.org/>

- May 29-31, 2018, Bordeaux-Arcachon (France): **XXI CIPA Congress on Agriculture, Plastics and Environment**. Info: Mr. Bernard Le Moine, CIPA-CPA-APE, Plasticulture in Agriculture, 125, rue Aristide Briand, 92300 Levallois Perret, France. Phone: (33)144011649, E-mail: b.lemoine@plastiques-agriculture.com Web: <http://cipa-congress.com/>
- June 11-15, 2018, Athens (Greece): **XV International Symposium on Processing Tomato - XIII World Processing Tomato Congress**. Info: Prof. Dr. Montaña Cámara, Dpto. Nutrición y Bromatología II, Facultad Farmacia. UCM, Plaza Ramón y Cajal sn, 28040 Madrid, Spain. Phone: (34) 913941808, Fax: (34) 913941799, E-mail: mcamara@farm.ucm.es or Dr. Luca Sandei, ssica, Tomato area, Viale f.Tanara 31/a, 43121 Parma PR, Italy. Phone: (39) 0521795257, Fax: (39) 0521771829, E-mail: luca.sandei@ssica.it or Dr. Panagiotis Kalaitzis, Dept Horticultural Genetics & Biotechnology, Mediterranean Agronomic Inst. Of Chania, Macedonia Str. 1, P.O. Box 85, 73100 Chania, Greece. Phone: (30)2821035030, Fax: (30)2821035001, E-mail: panagiot@maich.gr E-mail symposium: wptc2018@tomate.org Web: <http://www.worldtomatocongress.com>
- July 15-20, 2018, Bordeaux (France): **XII International Conference on Grapevine Breeding and Genetics**. Info: Prof. Serge Delrot, ISVV, 210 Chemin de Leysotte, 33882 Villenave d'Ornon, France. Phone: (33) 631122791, Fax: (33)557575903, E-mail: serge.delrot@inra.fr E-mail symposium: gbg2018@u-bordeaux.fr Web: <http://gbg2018.u-bordeaux.fr/en>

- August 12-16, 2018, Istanbul (Turkey): **XXX International Horticultural Congress: IHC2018**. Info: Prof. Dr. Yüksel Tüzel, Ege University, Agriculture Faculty, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323111398, Fax: (90)2323881865, E-mail: yuksel.tuzel@ege.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org>

Symposia at IHC2018:

- August 12-16, 2018, Istanbul (Turkey): **XIX International Symposium on Horticultural Economics and Management and VII International Symposium on Improving the Performance of Supply Chains in the Transitional Economies and II International Symposium on Horticulture Economics, Marketing and Consumer Research**. Info: Prof. Dr. Ismet Boz, OMU Faculty of Agriculture, Department of A, OMU Faculty of Agriculture, Department of A, OMU Faculty of Agriculture, 55139 Samsun, Turkey. Phone: 3623121919, E-mail: ismet.boz@omu.edu.tr 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 E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S24.html>
- August 12-16, 2018, Istanbul (Turkey): **III International Berry Fruit Symposium**. Info: Prof. Dr. Sezai Ercisli, Ataturk University Agricultural Faculty, Department of Horticulture, 25240 Erzurum, Turkey. Phone: (90) 442-2312599, Fax: (90) 442 2360958, E-mail: sercisli@atauni.edu.tr or Prof. Dr. Sedat Serçe, Nigde University, Faculty of Agricultural Sciences and Techn., Dept. Agricultural Genetic Engineering, Nigde, 51240, Turkey. Phone: (90) 388 2254463, Fax: (90) 388 2254440, E-mail: sedatserce@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S12.html>

- August 12-16, 2018, Istanbul (Turkey): **V International Symposium on Plant Genetic Resources: Sustainable Management and Utilization for Food, Nutrition and Environmental Security**. Info: Dr. Sandhya Gupta, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi, Delhi, 110 012, India. Phone: (91)9958499781, Fax: (91)11-25842495, E-mail: sandhya_gupta87@yahoo.com or Hülya İlbi, Ege University, Faculty of Agriculture, Dept. Of Horticulture, 35100 Bornova Izmir, Turkey. E-mail: hulya.ilbi@ege.edu.tr or Assoc. Prof. Birsen Cakir, Ege University Faculty of Agriculture, Department of Horticulture, Bornova, 35100 304zmir, Turkey. Phone: (90) 232 3112633, Fax: (90)2323881865, E-mail: birsencakir@hotmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S01.html>
- August 12-16, 2018, Istanbul (Turkey): **VIII International Symposium on Education, Research Training and Consultancy**. Info: Dr. Rémi Kahane, CIRAD, Dept Persyst TA B-DIR/09, Avenue Agropolis, 34398 Montpellier cedex 5, France. Phone: (33)467614938, E-mail: remi.kahane@cirad.fr or Prof. Dr. Ismet Boz, OMU Faculty of Agriculture, Department of A, OMU Faculty of Agriculture, Department of A, OMU Faculty of Agriculture, 55139 Samsun, Turkey. Phone: 3623121919, E-mail: ismet.boz@omu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S36.html>
- August 12-16, 2018, Istanbul (Turkey): **VI International Symposium on Saffron Biology and Technology**. Info: Prof. Dr. Saliha Kirici, Cukurova University, Agriculture Fac., Field Crops Dept., 01330 SARICAM, Turkey. Phone: (90)5324018575, E-mail: kirici@cu.edu.tr or Prof. Dr. Yesim Yalcin Mendi, Department of Horticulture, Faculty of Agriculture, University of Cukurova, Adana, Turkey. E-mail: ymendi@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S39.html>
- August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Micropropagation and In Vitro Techniques**. Info: Dr. Maurizio Lambardi, IVALSA/Trees and Timber Institute, National Research Council (CNR), Polo Scientifico, via Madonna del Piano 10, I-50019 Sesto Fiorentino, Firenze, Italy. Phone: (39) 055 5225685, Fax: (39) 055 5225656, E-mail: lambardi@ivalsa.cnr.it or Aylin Ozudogru, CNR-IVALSA, Via Madonna del Piano 10, 50019 Sesto Fiorentino, FI, Italy. E-mail: elifaylinozudogru@yahoo.it or Prof. Dr. Yesim Yalcin Mendi, Department of Horticulture, Faculty of Agriculture, University of Cukurova, Adana, Turkey. E-mail: ymendi@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S02.html>
- August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Plant Breeding in Horticulture**. Info: Prof. Dr. Nebahat Sari, Cukurova University, Agricultural Faculty, Dept. of Hort/Balcali, 01330 Adana, Turkey. Phone: (90)3223386497, Fax: (90)3223386388, E-mail: nesari@cu.edu.tr or Prof. Dr. Yildiz Aka Kacar, University of Cukurova, Faculty of Agriculture, Horticulture Dept. Lab for Plant Biotech., 01330 Adana, Turkey. Phone: (90)322-3386388, Fax: (90)322-3386388, E-mail: ykacar@cu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S20.html>
- August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Organic Horticulture for Wellbeing of the Environment and Population**. Info: Prof. Martine Dorais, Centre de recherche & d'innovation-végétaux, Laval University, Environtron Bldg, Room 2120, Quebec G1K 7P4, Canada. Phone: (1)418-6562131, Fax: (1)418-6563515, E-mail: martine.dorais.1@ulaval.ca or Prof. Dr. Uygun Aksoy, Ege University, Faculty of Agriculture, Department of Horticulture, 35100 Bornova - Izmir, Turkey. Phone: (90)2323884000x2742, Fax: (90) 2323881864, E-mail: uygunaksoy@gmail.com or Prof. Dr. Roberto Ugás, Universidad

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Nacional Agraria La Molina, Programa de Hortalizas, Apartado 12-056, Lima, Peru. Phone: (511)3485796, Fax: (511)3485796, E-mail: rugas@lamolina.edu.pe E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S23.html>

■ August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Innovative Plant Protection in Horticulture.**

Info: Dr. David Hunter, 13 Graves Crescent, St. Catharines, Ontario, L2S 3Y7, Canada. Phone: (1)9056853851, E-mail: davidmhunter13@gmail.com or Prof. Dr. Ana Paula Ramos, Instituto Superior de Agronomia - ULisboa, Tapada da Ajuda, 1349-017 Lisboa Lisboa, Portugal. E-mail: pramos@isa.ulisboa.pt or Prof. Dr. Kadriye Caglayan, Mustafa Kemal University, Agriculture Faculty, Plant Protection Department, 31034 Antakya-Hatay, Turkey. Phone: (90)326 2455836 Ext.1347, Fax: (90)326 2455832, E-mail: kcgaylano@yahoo.com or Assoc. Prof. Feza Can Cengiz, MKU. Agriculture Faculty Plant Protection D, Mustafa Kemal University, Hatay, 31000 Antakya, Turkey. Phone: (90)3262455845/1328, Fax: (90)3262455832, E-mail: cezafan_onurcan@hotmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S28.html>

■ August 12-16, 2018, Istanbul (Turkey): **XI International Symposium on Postharvest Quality of Ornamental Plants.**

Info: Prof. Dr. Fisun Çelikel, Ondokuz Mayıs University, Faculty of Agriculture, Dept. Horticulture, Kurupelit, Atakum, 55200 Samsun, Turkey. Phone: (90)362-3121919, Fax: (90)362-4576034, E-mail: fgcelikel@omu.edu.tr or Dr. Shimon Meir, Dept. Postharvest Sci.Fresh Pr., The Volcani Center, ARO, PO Box 6, Bet Dagan 50250, Israel. Phone: (972)39683667, Fax: (972)39683622, E-mail: shimonm@volcani.agri.gov.il E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S14.html>

■ August 12-16, 2018, Istanbul (Turkey): **VII International Symposium on Tropical and Subtropical Fruits.** Info: Prof.

Dr. Sisir Kumar Mitra, B-12/48, Kalyani, Nadia, West Bengal 741235, India. Phone: (91)9432174249, Fax: (91)3325828460, E-mail: sisirm55@gmail.com or Dr. Hannah Jaenicke, Burghof 26, Schloss Gelsdorf, 53501 Graftschaf-Gelsdorf, Germany. Phone: (49)2225-8389895, E-mail: hannah.jaenicke@t-online.de or Prof. Dr. Mustafa Akbulut, Recep Tayyip Erdogan Universitesi, Ziraat ve Doga Bil. Fak. Bahce Bit. Bol., Faculty of Agricultural and Nature Science, Depart. of Horticulture Pazar / Rize, 53300, Turkey. Phone: +90(464)6127317, Fax: +90(464)6127316, E-mail: makbuluttr@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S05.html>

■ August 12-16, 2018, Istanbul (Turkey): **I International Symposium on Avocado.** Info: Prof. Dr. Sisir Kumar Mitra,

B-12/48, Kalyani, Nadia, West Bengal 741235, India. Phone: (91)9432174249, Fax: (91)3325828460, E-mail: sisirm55@gmail.com or Assist. Prof. Hatice Ikten, Akdeniz University Agricultural Faculty, Department of Agricultural Biotechnology, 07070 Antalya, Turkey. Phone: (90)242 3106557, E-mail: hikten2@hotmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S06.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Nuts and Mediterranean Climate Fruits: Advances in Breeding and New Strategies of Horticultural Management for Sustainable Production.** Info: Prof.

Dr. Tiziano Caruso, Department of Agricultural & Forest Science, University of Palermo, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39) 09123861207, E-mail: tiziano.caruso@unipa.it or Dr. Moshe A. Flaishman, Department of Fruit Trees Sciences, ARO - The Volcani Center, PO Box 6, 50-250 Bet Dagan, Israel. Phone: (972)39683394, Fax: (972)39683793, E-mail: vhmosea@volcani.agri.gov.il or Dr.

Louise Ferguson, 2037 Wickson Hall, Plant Sciences Department Mail Stop II, UC Davis 1 Shields Ave. Davis CA 95616, United States of America. Phone: (1) 559 737 3061, Fax: (1) 530 752 8502, E-mail: lferguson@ucdavis.edu or Deniz Sanal, Alata Horticultural Research Station, Mersin, Erdemli, Turkey. E-mail: denizsanal06@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S11.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Evaluation of Cultivars, Rootstocks and Management Systems for Sustainable Production of Deciduous Fruit Crops.**

Info: Dr. Gregory L. Reighard, Department of Horticulture, 170 Poole Agricultural Center, Box 340319, Clemson, SC 29634-0319, United States of America. Phone: (1)8646564962, Fax: (1)8646564960, E-mail: grghrd@clemson.edu or Brunella Morandi, Università di Bologna, Viale Fanin 44, 40127 Bologna, Italy. E-mail: brunella.morandi@unibo.it or Prof. Dr. Ayzin B. Küden, University of Cukurova, Dean of the Faculty of Agriculture, Department of Horticulture, 01330 Adana, Turkey. Phone: (90)3386364/3386447, Fax: (90)3386364/3386447, E-mail: abkuden@cu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S09.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Viticulture: Primary Production and Processing.** Info:

Prof. Dr. Zeki Kara, Selcuk University Faculty of Agriculture, Department of Horticulture, 42003 Konya Selcuklu, Turkey. Phone: (90)332-2232899, Fax: (90)332-2410108, E-mail: zkara@selcuk.edu.tr or Prof. Dr. Gökhan Söylemezoglu, Ankara University, Faculty of Agriculture, Department of Horticulture, Ankara 06110, Turkey. Phone: (90)3125961304, Fax: (90)3123179119, E-mail: soylemez@agri.ankara.edu.tr or Prof. Dr. Ahmet Altindisli, Ege University Faculty of Agriculture, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323882622, Fax: (90)2323881865, E-mail: ahmet.altindisli@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S13.html>

■ August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Soilless Culture.** Info: Prof. Dr. Michael Raviv, Agric. Res.

Organization, Newe Ya'ar Research Center, PO Box 1021, Ramat Yishay 30095, Israel. Phone: (972)49836464, Fax: (972)49836936, E-mail: mraviv@volcani.agri.gov.il or Prof. Dr. Ayse Gül, Department of Horticulture, Faculty of Agriculture, Ege University, 35100 Bornova Izmir, Turkey. Phone: (90)2323884000, Fax: (90)2323881865, E-mail: ayse.gul@ege.edu.tr or Prof. Dr. H. Yildiz Dasgan, Cukurova University, Agricultural Faculty, Horticultural Department, 01330 Adana, Turkey. Phone: (90)3223386388, Fax: (90)3223386388, E-mail: dasgan@mail.cu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S18.html>

■ August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Root and Tuber Crops: Value Added Crops for the Next Generation.** Info: Dr. Ali Fuat Gokce, Nigde Ömer Halisdemir

University, Faculty of Agric. Sci. and Technologies, Department of Agri. Genetic Engineering, 51240 Nigde, Turkey. Phone: (90)05365434241, E-mail: gokce01@yahoo.com 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 E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S19.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Advances in Production and Processing of Medicinal and Aromatic Plants.** Info: Prof. Dr. Bhimanagouda Patil, VFIC, Texas

A&M University, Department of Horticulture, 1500 Research Parkway Ste A120, College Station, TX 77845, United States of America. Phone: (1)9794588090, Fax: (1)9798624522, E-mail:

b-patil@tamu.edu or Dr. Fatma Uysal Bayar, BATEM, Antalya, Turkey. E-mail: uysal.fatma@tarim.gov.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S29.html>

- August 12-16, 2018, Istanbul (Turkey): **International Symposium on Culinary Herbs and Edible Fungi**. Info: Prof. Dr. Lyle Craker, Dept. of Plant & Soil Science, University of Massachusetts, Stockbridge Hall, Amherst, MA 01003-7245, United States of America. Phone: (1)413-545-2347, Fax: (1)413-545-3958, E-mail: craker@pssci.umass.edu or Prof. Dr. Aysun Peksen, Ondokuz Mayıs University, Faculty of Agriculture, Department of Horticulture, Samsun 55139, Turkey. Phone: (90)3624576020/1137, Fax: (90)3624576034, E-mail: aysunp@omu.edu.tr or Mr. Mustafa Kemal Soylu, Atatürk Central Horticultural Research Inst, 77102 Yalova, Turkey. Phone: (90)2268142520, Fax: (90)2268141146, E-mail: mksoylu@hotmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S30.html>
- August 12-16, 2018, Istanbul (Turkey): **IV International Conference on Turfgrass Management and Science for Sports Fields: Bridging the Needs and Research on Turfgrass at the Age of Climate Change**. Info: Prof. Dr. Giorgio Prosdociami Gianquinto, Dip. Scienze Agrarie, DiPSA, Università degli Studi di Bologna, Viale Fanin, 44 - 40127 Bologna, Italy. Phone: (39) 0512096663, Fax: (39) 0512096245, E-mail: giorgio.gianquinto@unibo.it or Erik Ervin, Virginia Polytechnic Inst. & State University, Dept of Crop and Soil Environment Sciences, 335 SMY TH, Blacksburg 24061, VA, United States of America. Phone: (1)5402315208, Fax: (1)5402313431, E-mail: eervin@vt.edu or Assoc. Prof. Songul Sever Mutlu, Akdeniz University, Ziraat Fakültesi, Peyzaj Mimarlığı bölümü, Antalya, Turkey. Phone: (90)242-2455, E-mail: songulmutlu@akdeniz.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S26.html>
- August 12-16, 2018, Istanbul (Turkey): **VIII International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops**. Info: Prof. Dr. Daniel Leskovar, 1619 Garner Field Rd., Texas A&M AgriLife Research, Texas AM Univeristy, Uvalde Texas 78801, United States of America. Phone: (1)830-278-9151, Fax: (1)830-278-1570, E-mail: daniel.leskovar@agnet.tamu.edu or Prof. Dr. Ahmet Korkmaz, KSU, Faculty of Agriculture, Dept. of Horticulture, Kahramanmaraş, Turkey. Phone: 90-344-2802035, E-mail: akorkmaz@ksu.edu.tr or Prof. Dr. Halit Yetisir, Department of Horticulture, Faculty of Agriculture, University of Erciyes, 38039 Kayseri, Turkey. E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S35.html>
- August 12-16, 2018, Istanbul (Turkey): **International Symposium on Tropical and Subtropical Vegetable Production: Tackling Present and Future Global Biotic and Abiotic Stressors**. Info: Prof. Dr. Hakan Aktas, Suleyman Demirel University, Agriculture, Faculty, Horticulture Dept, 32260 Isparta, Turkey. Phone: (90)2462118533, Fax: (90)2462118533, E-mail: aktashakan33@gmail.com or Dr. Srinivasan Ramasamy, AVRDC-The World Vegetable Center, 60 Yi Minga Liao, Shanhua, 74151 Tainan Tainan, Chinese Taipei. Phone: (886)6-5852499, Fax: (886)6-5830009, E-mail: srini.ramasamy@worldveg.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 Assoc. Prof. Golgen Bahar Oztekin, Ege University, Faculty of Agriculture, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323112577, Fax: (90)2323881865, E-mail: golgen.oztekin@ege.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S16.html>
- August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Mechanization, Precision Horticulture, and Robotics**. Info: Prof. Reza Ehsani, Department of Mechanical

Engineering, University of California, Merced, 5200 N. Lake Road, Merced, CA 95343, United States of America. Phone: (1)2092283613, Fax: (1)2092284047, E-mail: rehsani@ucmerced.edu or Assoc. Prof. Selçuk Arslan, Uludag University Faculty of Agriculture, 16059 Bursa, Turkey. Phone: +90 224-2941606, E-mail: sarslan@uludag.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S31.html>

- August 12-16, 2018, Istanbul (Turkey): **IV International Jujube Symposium**. Info: Prof. Dr. Mengjun Liu, Research Center of Chinese Jujube, Agricultural University of Hebei, Baoding, Hebei, 71001, China. Phone: (86)312754342, Fax: (86)3127521251, E-mail: lmj1234567@aliyun.com or 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 or Assoc. Prof. Kazim Gunduz, Mustafa Kemal University, A287riculture Faculty, Department of Horticulture, 31034 Hatay Antakya, Turkey. Phone: +90 0326 245 5845, Fax: +90 0326 245 5832, E-mail: kgunduz44@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S08.html>
- August 12-16, 2018, Istanbul (Turkey): **International Symposium on Understanding Fruit Tree Behaviour in Dynamic Environments**. Info: Dr. Evelyne Costes, INRA UMR AGAP, 2, place Viala, 34060 Montpellier Cedex 1, France. Phone: (33)499612787, Fax: (33)499612616, E-mail: costes@supagro.inra.fr or Dr. Pasquale Losciale, Council for Agric. Research & Economics, Research Centre for Agric. & Environment, Via Celso Ulpiani 5, Bari, Italy. Phone: (39)0805475036, Fax: (39)0805475023, E-mail: pasquale.losciale@crea.gov.it or Prof. Dr. Ayzin B. Küden, University of Cukurova, Dean of the Faculty of Agriculture, Department of Horticulture, 01330 Adana, Turkey. Phone: (90)3386364/3386447, Fax: (90)3386364/3386447, E-mail: abkuden@cu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S10.html>
- August 12-16, 2018, Istanbul (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 E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S37.html>
- August 12-16, 2018, Istanbul (Turkey): **International Symposium on Ornamental Horticulture: Colour Your World**. Info: Prof. Dr. Rina Kamenetsky, Institute of Plant Sciences, Agricultural Research Organization, The Volcani Center, Rishon LeZion, 7528809, Israel. Phone: (972)39683511, Fax: (972)39660589, E-mail: vhrkamen@volcani.agri.gov.il 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 or Ass. Prof. Soner Kazaz, Ankara University, Faculty of Agriculture, Department of Horticulture, Diskapi - Ankara, Turkey. Phone: (90)312-596 12 87, Fax: (90)312-317 91 19, E-mail: skazaz@ankara.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S15.html>
- August 12-16, 2018, Istanbul (Turkey): **III International Symposium on Innovation and New Technologies in Protected Cultivation**. Info: Dr. Murat Kacira, Dept. of Agric. and Biosystems Engineering, 1177 East 4th Street, Room 403, Shantz Building, 38, Tucson, AZ 85721-0038, United States of America. Phone: (1) 520-626-4254, Fax: (1) 520-626-1700, E-mail: mkacira@cals.arizona.edu or Dr. Silke Hemming, Wageningen UR, Plant Research International, PO Box 16, 6700 AA Wageningen, Netherlands. Phone: (31)317 4 86921, Fax: (31)317 423110, E-mail: silke.hemming@wur.nl 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 or Dr. Hatice Filiz Boyaci, Demircikara Mah. Pasakavaklara Cad. P.035, Muratpasa, 07100 Antalya, Turkey. Fax: (90)242-3211512, E-mail: filiz_boyaci@yahoo.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S17.html>

■ August 12-16, 2018, Istanbul (Turkey): **VII International Conference on Landscape and Urban Horticulture**. Info: Federica Larcher, Largo P. Braccini 2, 10095 Grugliasco, Torino, Italy. E-mail: federica.larcher@unito.it or Jesus Ochoa, Universidad Politécnica de Cartagena, Paseo Alfonso XIII, 48, 30203 Cartagena, Murcia, Spain. E-mail: jesus.ochoa@upct.es E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S25.html>

■ August 12-16, 2018, Istanbul (Turkey): **X International Symposium on Temperate Fruits in the Tropics and Subtropics**. Info: Dr. Giuliano Finetto, Institute for Agricultural Sciences, Via A. Milani 19, 37124 Verona, Italy. Phone: (39)045942439, Fax: (39)045942439, E-mail: giulianofinetto@tin.it or 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 or Prof. Dr. Ali Kuden, Cukurova univ. Fac.of Agric., Dept. of Horticulture, 01330 Adana, Turkey. Phone: (90)322 3386748, E-mail: akuden@cu.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S38.html>

■ August 12-16, 2018, Istanbul (Turkey): **X International Symposium on Applied Functional Molecular Biology**. Info: Prof. Dr. Rosario Muleo, Dept.. Crop Production, Università della Tuscia, Via S.C. De Lellis snc, Viterbo 01100, Italy. Phone: (39)0761357532, Fax: (39)761357531, E-mail: muleo@unitus.it or Assoc. Prof. Birsen Cakir, Ege University Faculty of Agriculture, Department of Horticulture, Bornova, 35100 304zmir, Turkey. Phone: (90) 232 3112633, Fax: (90)2323881865, E-mail: birsencakir@hotmail.com or Prof. Dr. Ali Ergul, Ankara University Biotechnology Institute, Central Laboratory, 06100 Ankara, Turkey. Phone: +90-312-2225816, Fax: +90-312-2225872, E-mail: ergul@ankara.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S03.html>

■ August 12-16, 2018, Istanbul (Turkey): **XI International Symposium on Banana: ISHS-ProMusa Symposium on Growing and Marketing Banana under Subtropical Conditions**. Info: Prof. Dr. Hamide Gubbuk, Akdeniz University, Faculty of Agriculture, Department of Horticulture, 07058 Antalya, Turkey. Phone: (90)2423102422, E-mail: gubbuk@akdeniz.edu.tr or Dr. Thierry Lescot, CIRAD, RU GECCO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: (33)467615666, E-mail: thierry.lescot@cirad.fr or Dr. Víctor Galán Saucó, Isaac Albéniz 17, 38208 La Laguna, Tenerife, Canary islands, Spain. Phone: (34)922261647, E-mail: vgalan46@gmail.com or Dr. Inge Van den Bergh, Bioversity International, C/O KULeuven, W. De Croylaen 42 bus 2455, 3001 Leuven, Belgium. Phone: (32)16377067, E-mail: i.vandenbergh@cgiar.org E-mail symposium: secretariat@ihc2018.org Web: www.ihc2018.org/en/S04.html

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Strategies and Technologies to Maintain Quality and Reduce Postharvest Losses**. Info: Dr. Mustafa Erkan, Akdeniz University, Department of Horticulture, 07058 Antalya, Turkey. Phone: +90 242 3102428, Fax: +90 242 2274564, E-mail: erkan@akdeniz.edu.tr E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S32.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Water and Nutrient Relations and Management of Horticultural Crops**. Info: Prof. Dr. Esmaeil Fallahi, University of Idaho, Parma

Res. & Extension Center, 29603 University of Idaho Lane, Parma, ID 83660-6699, United States of America. Phone: (1)2087226701 ext225, E-mail: efallahi@uidaho.edu or Prof. Dr. Dilek Anaç, Kaz305mdirik mahallesi 156 sokak No. 132, Nur Apt. Bornova-304zmir, 35040 Bornova, Turkey. E-mail: dilek.anac@ege.edu.tr or Dr. Alon Bengal, Environmental Physics and Irrigation, Gilat Research Center, Agricultural Research Organization, Mobile Post Negev 2 85280, Israel. Phone: (972)8 9928644, E-mail: bengal@agri.gov.il or Mr. Janjo de Haan, Soesterweg 410, 3812BK Amersfoort, Netherlands. Phone: (31)320291211, E-mail: janjo.dehaan@wur.nl or Dr. Clive Rahn, 60 Ettington Close, Wellesbourne, Warwick, CV35 9RJ, United Kingdom. E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S33.html>

■ August 12-16, 2018, Istanbul (Turkey): **International Symposium on Quality and Safety of Horticultural Products**. Info: Prof. Dr. Güner Arkun, Istanbul Aydin University Engineering Facul, Besyol Mah Inonü cad no 38 Küçükçekmece, 34295 Istanbul, Turkey. Phone: (90) 4441428, E-mail: gunerozay@aydin.edu.tr or Dr. Kamer Betül Ozer, Ege University, Faculty of Agriculture, Department of Horticulture, Evka-3, 35100 Izmir Bornova, Turkey. Phone: (90)232-3112631, E-mail: betul.sintra@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S21.html>

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