

A publication of the International Society for Horticultural Science

Chronica Horticulturae



Horticultural highlights

How to make substrates' R&D greater? • Record giant pumpkin fruit weights: 1857 to 2017
• A national value: Turkish figs • An overview on fruit breeding in Turkey

Symposia and workshops

Cactus Pear and Cochineal • Pomegranate and Minor Mediterranean Fruits
• Walnut, Cashew and Pecan • Peach • Papaya • Seed, Transplant and Stand
Establishment of Horticultural Crops • Production and Establishment of
Micropropagated Plants • Growing Media, Soilless Cultivation, and Compost
Utilization in Horticulture • Postharvest Unlimited

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Chronica Horticulturae



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Cover photograph: 'Alata' seedless lemon cultivar. 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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> Time flies...

Yves Desjardins, ISHS Board Member
Responsible for Publications



> Yves Desjardins

I write these few lines with a bit of nostalgia since it is my last editorial as a Board member of ISHS. After eight years in this position, my mandate is coming to an end and I will be passing the flag to someone else. I may be getting older and my perception of time might be changing, but these years have passed in the blink of an eye. This happens when you are working on all kinds of challenging projects and living exhilarating moments. I am also nostalgic because my 20-year involvement in an active position within ISHS will come to an end in August at the next IHC in Turkey. Indeed, I will now go back to cultivate my own backyard, working on some new projects of my own. Actually, I will be quite busy in the coming years since I was recently appointed as the NSERC-Diana Food Research Chair on fruits and vegetables prebiotic effects. In this capacity I will thus continue some of the work I had initiated when I suggested the establishment of the ISHS Commission Fruits and Vegetables and Health in 2006.

A busy eight years!

The last few years have been turning points for the Society, which had to adapt to a very competitive and challenging scientific environment; it required swift reactions to the changing situation that could have jeopardized to some extent the future of ISHS. Indeed, the number of scientific journals and symposia is increasing every day and the role of scientific societies is being threatened by social media and electronic communications. The needs of our members and stakeholders are also changing fast. Horticultural science must therefore adapt at the same pace. In this context, many actions were undertaken by the two Boards I was involved in. Many of these pertained to the publication portfolio and three main measures were taken to meet membership requests.

Firstly, we needed to revamp *Acta Horticulturae*, fix some of the series pitfalls and bring it into the 21st century. Knowing that the Web of Science (now Clarivate Analytics) would not grant a journal statute to *Acta*, we decided to make it an excellent symposium proceedings series with a rapid turnaround time to reflect the outcome of symposia. Apart from the cosmetic rebranding of the publication, we have introduced deep, under-the-hood changes to hasten publication and improve the overall *Acta* product. The series

is now fully cross-referenced and fully edited electronically.

Secondly, to rapidly publish the *Acta*, ISHS needed to provide support to the conveners and assist them in the editing and reviewing process of the manuscripts. For this purpose, we have created and implemented a new online manuscript revision and follow-up system that we have named ROSA (Responsive Online System for *Acta Horticulturae* submission and review). This system has now been in use for the last two years and has received praise from conveners who are using it. Gone is the time when we would lose manuscripts, forget to track changes, and wait four years to publish an *Acta* volume.

Thirdly, to respond to membership requests, we have acquired two new refereed journals, both owned and controlled by the Society. The first of these was the acquisition, from the German Society for Horticultural Science, of the *European Journal of Horticulture Science*, *eJHS*, where the “e” could also stand for Electronic. This journal is beautifully and professionally crafted and is now gaining credence in the membership and the impact factor is increasing steadily. The second one is a newer acquisition, and also has great significance for the Society. Indeed, ISHS agreed with CIRAD to take over the journal *Fruits*, change the editorial policy and broaden the scope of the Journal to encompass all of tropical horticulture. Thus, its name has been changed to become the *International Journal of Tropical and Subtropical Horticulture*. These new ventures have not changed other publications’ core activities, and I am really indebted to Jill Stanley who took the helm of *Chronica Horticulturae* and continued to make it the best vehicle to liaise with the membership. In this sense, we continued the tradition set by Jules Janick who used *Chronica* as a stepping stone to promote horticulture worldwide. Finally, ISHS is becoming a book publisher, collaborating, in a first venture, on a new pomology book written by our Italian colleagues and edited by Dr. Silvano Sansavini. The book, entitled “Principles of modern fruit science”, will be essential to all those who want to have a very up-to-date overview of the latest trends in fruit tree culture, but at the same time to have a deep understanding of the physiological mechanism underlying productivity of fruit trees. The book should be available by the next IHC in Istanbul.

How ISHS remains pertinent!

ISHS continues to be pertinent and an incapable leader of the horticultural sector. The decision of the past Board to associate more closely with the private sector and the implementation by the current one of many successful collaborations (e.g. Bayer Crop Science) is starting to bear fruits. We are actively working with 4-5 corporate sponsors with whom the Society has established a lasting relationship of trust, which should bring many benefits to ISHS. This new approach, apart from confirming the pertinence of our horticulture science to the business trade, is enabling the Society to maintain the accessibility of a wide range of services, while keeping membership fees low. This pertinence is also assured by the complete rethinking and reorganization of the scientific structure of the Society, which will make it more efficient, flexible, responsive and focused. So, more than ever, despite the many projects and new ventures, ISHS remains profitable and is able to invest in the generation of new ideas and undertakings. The latest is the space made for young minds, and the emphasis placed on the rejuvenation of the membership. I have great faith that the measures taken by the Board to give access to young scientists will be fruitful and will perpetuate the tradition of excellence and networking that made ISHS so successful.

What’s ahead?

Yet, despite our recent successes, horticulture might face even greater challenges in the years to come and ISHS will have to react swiftly to offer innovative solutions to the many problems ahead. This is especially true in an era of fast-changing trends and rapid evolution of technology. In hindsight, one can say that horticultural science has been tremendously successful in providing quality fruits and vegetables for a large segment of the population. We have moved from a rural, commodity-based self-sustaining local production to a global, high technology-based horticultural production system. The advancements made in breeding, cultural management, postharvest technology and

marketing, have created a multibillion-dollar global industry. Now-a-days, consumers can enjoy the benefits of having fresh fruits and vegetables year-round, with the advent of de-seasonality of production and long-distance sea and air freight. We get tropical commodities like fresh pineapple, mango, papaya, and other tropical fruits as if they were picked in our own backyard. A huge industry has grown from the discoveries and advancements we have made over the last 50 years. While horticulture is not trendy anymore for many undergrads, no one can dispute the fact that it has had tremendous influence on our lives and livelihood.

In my mind, the future of horticulture bears in our capacity to carry multidisciplinary research in large research groups. I have learned, by participating in a few research projects with my horticultural science colleagues, medical doctors and clinicians, that we need to tackle research problems from many sides at once and have different points of view to solve complex issues. It is not surprising that when you read a scientific paper from the medical field, 20 authors are listed. Each brings their competence and contribution to a large construction with much scientific impact. In horticulture, I still see small teams and even individuals trying to survive in a very competitive arena. In this day and age, it is essential that we share our knowledge, competence and workforce to solve problems. We must unite and create large impact research groups and units, sharing multidisciplinary teams, to solve specific problems. In this sense, I see a great opportunity for ISHS to identify the needs (industry, consumers) and federate worldwide research capacities to provide innovative solutions.

ISHS must take an active role in promoting and enabling the discussion and dissemination of the development and use of emerging technologies. For instance, ISHS members will have to embrace and rapidly adopt the new CRISPR-9 technologies to control and precisely modify genes without resorting to transgenesis. This will enable us to modulate gene expression leading to specific phenotypes and biotic adaptations. We also need to rapidly jump on the bandwagon of cloud intelligence and big data management in horticulture. We have developed a hugely successful greenhouse industry worldwide,

based on engineering and science principles. We now need to move on and implement artificial intelligence and data intense management in our daily management operations. Our science needs to tackle and join forces with our software engineering colleagues to develop new management tools to assist horticulturists in growing better horticultural products. These new tools may be useful in providing traceability and ensuring safety of horticultural products. The recent *E. coli* outbreak in North America is just one example of how big data could prevent these dangerous outbreaks and/or enable fast tracking to the source.

We are entering into the era of microbiome research. The new OMICS tools, joined with capacity to analyze big data, are changing how we can study microbiomes. The capacity to characterize the phyllosphere and identifying new antagonist agents against pests is opening a whole new era for the control of diseases and pests. Extending this knowledge to organic production and soil should enable us to custom design new, more efficient fertilizers and biostimulants, respecting ecological cycles and reducing greenhouse gas.

Consumers are slowly changing their expectations of quality produce and are now willing to pay a premium for organic commodities. Organic production systems are now being developed and new production systems are being adopted alongside the more traditional ones. Deep knowledge of the system biology will therefore be needed to provide efficient and sustainable horticultural production systems. I thus see an important role of the ISHS scientific community to provide this information. Besides requesting organic commodities, consumers will also be demanding better tasting horticultural products. Breeding programs will thus have to introduce back into current cultivars those organoleptic quality traits that the consumer desires. At the same time, horticultural science will have to contribute to the increasing demand of urban consumers for locally grown food and zero miles commodities. ISHS should thus provide platforms to discuss and promote these new growing systems like vertical farms, community gardens, and proximity food production systems.

Horticulture will be a key player to prevent societal diseases and the outcome of many chronic disorders. ISHS needs to continue sharing with the medical profession, nutritionists and clinicians, to demonstrate the role of fruits and vegetables consumption in disease prevention. WHO and other nutrition organizations are recommending restricting the consumption of red meat and replacing much of the animal proteins with plant proteins. We will also have to reintroduce plant fibres into our diet to feed our gut microbiota. ISHS will have an important role to play in this new nutritional paradigm shift. And how about the large-scale production of cannabis, for which many countries, like my own, are now legalizing production? I can certainly see our Commission Fruits and Vegetables and Health making recommendations in the future for therapeutic use of cannabinoids. I can only await ISHS organizing the first international symposium on cannabis production and health effects.

Lastly, I see many initiatives worldwide for introducing research on gastronomy and what our Italian colleagues have coined "slow food". This movement is now gaining credence in many universities around the world and becoming a strong movement for the return of hedonistic approaches to healthy eating and sharing meals with friends. ISHS should follow this trend as it is a strong underlying current that will drive the demand for quality produce in a very near future.

Get involved!!!

In conclusion, and on a personal note, despite my retirement from ISHS, I still see many exciting opportunities in which to get involved. If I was young again, I would probably still choose a career in horticulture and get involved in a society like ISHS. I remain certain that our Society has the capacity and the resources to successfully meet the many challenges ahead. Yet, an organization like ours is only as useful and pertinent as the investment we are willing to put into it. Let's continue to work together to make the world a better place through horticulture.

Good luck to all and see you around at one of our great symposia or congresses! ●



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> Errol W. Hewett

Position or previous position

Professor of Horticultural Science (Emeritus); specialising in quality and postharvest horticulture

ISHS honour

ISHS Fellow since 2014

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

I recently retired and settled in Tauranga, Bay of Plenty, New Zealand, with Margaret, my wife of 56 years. Tauranga is located in the heart of the main New Zealand kiwi-fruit region. It is a region of equable climate conducive to growing fruit (including citrus, avocado, feijoas and tamarillos) along with vegetables, flowers and ornamental crops.

I am the son of a farmer who owned mixed farms in North Canterbury and then an apple/pear orchard in Nelson in the South Island of New Zealand.

I attended Nelson College where I met Margaret and we have been an item ever since. We have three sons, one of whom was an All Black and two of whom represented New Zealand universities at international competitions. We have eight grandchildren, the oldest of whom is now a qualified lawyer, the next is about to make us great-grandparents (we are too young for this!!).

I graduated with a Bachelor of Science (1st class Honours degree) from the University of Canterbury, Christchurch, majoring in Plant Physiology, before undertaking my first research with the Department of Industrial and Scientific Research (DSIR), investigating the use of overhead sprinkler irrigation to prevent frost damage to apricots in spring. At this time, frost protection was done by burning diesel in open pots – a foul smelling and air polluting technique. Overhead sprinkling was very successful. I wrote a technical bulletin for fruit growers. When the oil crisis occurred in 1973, nearly 75% of growers had enough information to use overhead sprinklers successfully when oil prices became prohibitory.

In 1969 I was awarded a Doctoral Fellowship and departed for the Department of Botany, University College of Wales, Aberystwyth,



> Errol Hewett inspecting ice load on apricot trees following overhead sprinkling in Earnsclough, Central Otago, 1968.

United Kingdom. I was fascinated by the internal regulatory systems that controlled onset of bud break in woody plants. Professor Phillip Wareing led an active group investigating the role of plant growth regulators (including auxins, gibberellins and abscisic acid) in regulating all aspects of plant growth. However, none of his students or staff (there were 23 graduate or postdoctoral students in his laboratory at that time from all continents) had worked with cytokinins so this was a niche waiting to be filled.

On completion of my PhD degree “Cytokinins in woody plants” and subsequent publication of nine refereed papers (including joint papers with colleagues from the laboratory on plants as diverse as broad beans, sycamore, willow and poplar), I returned to New Zealand and was based at Fruit Research Division, DSIR, at the Mt Albert campus in Auckland from 1973. I became involved in research activities at DSIR research orchards throughout New Zealand with a special responsibility for Earnsclough in Central Otago. In 1979 I was asked to head the Postharvest Section of the Division with a small but focussed group that concentrated on kiwifruit, apples and some minor crops such as feijoas and tamarillo. My main interest was attempting to control bitter pit in apples using preharvest calcium sprays, postharvest calcium dips or exposure to modified atmospheres. In 1982 I became Assistant Director of the Division.

In 1986 I was appointed Professor of Horticultural Science at Massey University, Palmerston North, where I commenced building up a postharvest laboratory. Initially this

occurred with the appointment of Nihal Rajapaske, a postdoctoral fellow, followed by the recruitment of Dr. Nigel Banks. This team, combined with those agricultural engineers who were interested in fruit handling and quality, and with refrigeration engineers to form The Centre for Postharvest and Refrigeration Research that investigated efficient management of storing, transporting and marketing perishable goods. It involved postharvest and refrigeration research, teaching and extension. It provided scientific outputs to sponsors, and exposed students to world-class research activity and philosophy.

In 2001 I retired for the first time and moved to Massey's Auckland campus where I was employed on a part time basis to provide mentorship to young staff, to give lectures on a range of topics related to food production, and to continue supervising graduate students. I became a permanent part time employee in 2005 through to 2015 when I finally retired for the second and final time.

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

As the son of an orchardist in Nelson, I worked on the family orchard during school vacations. It was here that I learnt about the vagaries that confront all fruit growers including pests and diseases, frost and hail, which were perennial challenges. It was heart breaking to see an entire crop ruined in five minutes of intense hail! I was involved in all orchard operations, including hand spraying chemicals, cultivating to minimise weed growth, and orchard management such as pruning, thinning, harvesting and packing



› Errol Hewett with jackfruit at the International Tropical Fruits Network (TFNET) meeting in Kuala Lumpur, 2003.



› Errol Hewett inspecting outdoor apple storage in Albania, 2008.

fruit. We also grew tomatoes and pumpkins for local markets.

I worked full time at a local orchard with the prospects of becoming an orchard manager. However, an opportunity arose to join the local Department of Scientific and Industrial Research (DSIR) research orchard as a technician. While enjoyable, I found the role frustrating as I did not understand the background to research projects that I was responsible for undertaking. I needed to know more. DSIR awarded me an undergraduate scholarship to go to university to obtain a science or agricultural degree on the condition that on completion I would move to Alexandra in Central Otago to tackle frost protection on apricots with water sprinklers. I studied for a science degree at university (naively, and wrongly, I thought that I knew all about horticulture because of my past practical experience). After graduating in 1963, I then moved to Earnscliffe, Alexandra for the next three years to work on frost protection. I also worked on irrigation on apple orchards in Nelson to fill in the production season after completion of the frost season work. In 1979 I took charge of the postharvest laboratory as I believed that I could be more useful to New Zealand undertaking research to maintain and improve quality of our fruit crops, the majority of which were exported to the other side of the globe over long periods of sea transport.

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

As a plant physiologist I believed that, to provide the best information for fruit growers to optimise yields of quality produce, it was

necessary to understand and then manipulate the natural development, ripening and senescence processes in horticultural crops. Even better, it was desirable to have solutions to production and postharvest problems in advance of them occurring in the field. So although my initial research task was frost protection, for my PhD I chose to study the changes of endogenous cytokinins in buds of trees in an attempt to learn if such changes could be used to predict or delay bud break in spring and thus reduce risks of frost damage. It has been a basic premise of my research career to attempt to understand the underlying physiological principles for development processes in fruit crops.

Apart from my research accomplishments (below), my career achievements include: obtaining my BSc (1st class) Honours degree with straight A+ grades; being a Foundation Member of the New Zealand Society for Horticultural Science (NZSHS) and eventually President; elected to Honorary Fellow of the NZSHS; elected as Chair of the ISHS Commissions Quality and Postharvest Horticulture and Education, Research Training and Consultancy; appointment to the ISHS Board for a 4-year term in 2010; elected to be international expert for the International Tropical Fruits Network (TFNET) for 12 years; consultancy projects in Albania (USAID), Saudi Arabia (IFAD), Thailand, Cambodia, and Nigeria (UDAID) as well as numerous tasks in New Zealand (e.g. for Zespri, NZ Apple and Pear industry, Plant & Food Research as well as private companies); published more than 150 refereed papers and delivered many keynote addresses at international conferences.

4. What do you consider were your greatest achievements?

- Proving that overhead water sprinkling could prevent frost damage to apricot buds in late winter/early spring when ambient temperatures sank as low as -8°C prior to, during and subsequent to full bloom. In addition, quantifying the degree of flower bud loss during winter because of low temperatures; even when bud loss was as high as 85%, there were enough viable buds remaining to produce a good crop.
- Quantifying production and economic benefits of trickle irrigation on apples growing in the Moutere Hills, Nelson, leading to widespread adoption of the technology by fruit growers.
- Demonstrating that endogenous cytokinin concentrations in sycamore sap and buds increased prior to, and concomitant with, bud burst in spring. Also showing that red light affected endogenous cytokinin concentrations.
- Discovering that benzyladenine (6-benzylaminopurine or BAP; also called topolin) was a naturally occurring cytokinin in sycamore trees in 1973. Although generating a degree of scepticism, this was validated in 1997. There is considerable medical interest in ortho-topolin in particular as it has been shown to have apoptotic effects on some human tumours. Such an effect was not the objective of the research, and was not anticipated, but does show the importance of serendipity.
- Demonstrating that the postharvest apple disorder, bitter pit, could be reduced/ameliorated by storing fruit in perforated polybags that generated a modified



› Errol Hewett with Dr. Fahd bin Abdulrahman Balghunaim, Minister of Agriculture, Saudi Arabia, in 2014.



› Errol Hewett and Jozef Van Assche, Executive Director of ISHS, at the launching of the European Journal of Horticultural Science in Freising, Germany, 2015.

atmosphere, reduced water loss, and maintained firmness and eating quality.

- Together with Nigel Banks, establishing a world class postharvest research laboratory at Massey University during the years 1986-2000. Main topics included physical damage to fruit, including quantifying the temporal development of bruising during long term storage, respiratory behaviour and control of fruit during storage, the importance of ethylene in fruit maturation, the role of ethylene in ripening and fungal disease in kiwifruit, the importance of hypoxia in influencing flavour of apples during storage, and the postharvest development of fruit softening.

Many significant research findings were also achieved in collaboration with PhD students working in my laboratory.

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

I disagree with the user pays philosophy of funding research. If research is applied in nature, and most horticultural science is, then beneficiaries are the industry as a whole and consumers of their products. Unless industries are united, well governed with carefully established mechanisms for determining priorities, research tends to be ad hoc, with little if any strategic adherence. Industry consultation may be satisfactory for identifying immediate short term problems (although not necessarily the underlying causes), but it can be detrimental to longer term solutions (although I doubt that

in many cases), where long term vision and understanding is short circuited by the need for immediate results.

My work on frost protection and irrigation was looked at askance by some industry personnel who queried the necessity for a youthful inexperienced lad straight from university to change traditional management techniques. I overheard a long time grower say "I have been growing fruit on these hills for 35 years without irrigation. I don't need a young inexperienced person from university telling me how to grow my apples". Yet both these projects were outstandingly successful. Oil prices increased so overhead sprinkling for frost protection was a new, viable technology with higher initial capital costs but significantly lower operational costs than burning diesel oil. And reliable water was required to reduce production risks, optimise yield and quality of apple trees in Nelson. It was serendipitous that five of the seven years of the irrigation experiment were among the driest on record. After these events, growers admitted that scientists sometimes did have the ability to undertake long term research that would benefit industry.

The lack of credit by the ISI publication system for applied horticultural scientists is lamentable. There are a plethora of horticultural journals internationally and their ISI ratings are relatively low. As such they are not rated very highly by personnel assessment committees in universities or research organisations. This means that it is very challenging for such applied scientists to gain promotions and salary increases. This has been, and still is, a very frustrating aspect

of career paths for horticultural scientists and technologists. The acknowledgement by Scopus for inclusion of *Acta Horticulturae* papers in their data base is a positive step forward.

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

From a 55-year research career, many memorable episodes occurred. It was always gratifying for me to have orchardists in Central Otago visit me at the DSIR Earnscleugh Research Orchard during the nights before, during and after frost events. They learnt that I was awake all night (just like them), monitoring my experiments, available for discussions and for providing a welcome tea or coffee, and then up all the next day evaluating experimental outcomes. I became 'one of them' and my recommendations were soon trusted, fully adopted and adapted. I prepared a DSIR Bulletin that became the growers bible for frost protection. Many years later (35 years), an orchardist who had been a young teenager when I worked at Earnscleugh, asked me to update the bulletin. I declined reminding him that I had not done any research, nor had I read about frost research, for more than 30 years.

Another memory was a grower member of the Kiwifruit Industry Research Committee castigating DSIR plant breeders for doing breeding trials for kiwifruit using a unique collection of germplasm available at that time. He berated scientists for wasting time and money on work that the industry did not need. If a new cultivar was developed then he would have to 'waste money' regrant-

ing his whole orchard! Current growers would not agree with that sentiment: the efforts of plant breeders, working closely with industry, enabled the release of a new yellow-fleshed cultivar of kiwifruit promptly when the crop was ravaged by the bacteria *Pseudomonas syringae* pv. *actinidiae* (Psa) in 2010-11. Scientists are paid to look into the future!

The Postharvest Gordon Conference provided another very significant memory for me. This was the first time that I knowingly and deliberately sampled food produced using genetically modified organisms (GMOs). Approval had been obtained for Calgene to produce and market GMO tomatoes and several trays of this fruit were donated to this conference. Don Grierson from the University of Nottingham, a scientist involved in elucidation and blocking the ethylene biosynthetic pathway, was given the honour of cutting and serving GMO tomatoes to an interested and somewhat apprehensive audience. A great time was had by all, and no one suffered as a result of this unique event.

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?

I have attended every ISHS International Horticultural Congress (IHC) since Sydney

1978. I was a Foundation member of the New Zealand Society for Horticultural Science (NZSHS). Naturally we were affiliated to ISHS so I became a member as soon as it was practicable. I became President of NZSHS and in this role I was one of our country's ISHS Council members. Here I learnt about the widespread nature and positive international activities of ISHS. I gained access and information to experiences and training that were invaluable when I decided to stand for a position of the ISHS Executive Committee. I believed that my knowledge and experience could be of value to developing countries, where food losses were high. ISHS has a global reach and an extensive symposium programme than can benefit all young scientists.

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

Get a degree in plant sciences or horticultural science, and achieve good grades in the basic sciences of chemistry, physics and mathematics and botany. Get practical experience in the field so as to obtain a perspective and knowledge of industry structures and issues. Broaden personal perspectives with international travel and work in research laboratories or in horticultural farms or industries. Join and actively participate in your local and

national horticultural science societies. Be passionate about the importance of plants and horticulture to bring pleasure and sustenance to human beings.

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

Adaption and application of new technologies provide significant opportunities to enhance and optimise food production, enhance nutritional value, reduce food waste, reduce malnutrition, minimise impact of pests and diseases and enhance human well being. Information technology, including artificial intelligence, will provide opportunities for increased use of automation in production and postharvest operations, robots in the entire chain, from producer to consumer, and plant engineers will continuously seek to improve plant production and quality through plant breeding. The discovery of CRISPR with its gene editing capacity holds great promise for future cultivar improvement. Increasingly the customer will become more important when considering outcomes from research, so the 'soft sciences' of psychology, sociology and human behaviour will be critical to all young scientists in their future career options. ●



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➤ How to make substrates' R&D greater? The results of the 2017 ISHS Working Group Growing Media survey

Jean-Charles Michel

Foreword from Professor Michael Raviv, Chair of ISHS Commission Plant Substrates and Soilless Culture, and Dr. Gerald Schmilewski, President of the International Peatland Society (IPS).

Cooperation between the Commission Plant Substrates and Soilless Culture of ISHS and the Peatlands and Economy (including horticulture) Commission of IPS has existed for over 30 years, and was formally recognised in an Agreement, initially signed at an ISHS symposium in Angers in 2005 and continued thereafter. Formal and informal contact between members of both societies has proved fruitful in terms of research, technical issues and indeed commercial developments, particularly in growing media. Links have also involved reciprocal visits of staff between laboratories and university/research institutes worldwide, and participation in international initiatives including the European Committee for Standardization (CEN) and the European Peat and Growing Media Association (EPAGMA). As Commission Chair and President of IPS respectively, we were delighted to support the proposal of Professor Jean-Charles Michel, from Agrocampus Ouest at Angers, France, and Chair of ISHS Working Group Growing Media, to develop a cross-society participative consultation via a questionnaire, with the aim of improving and developing contacts, as well as priming initiatives between members of both societies.

A questionnaire was drafted by the ISHS Working Group Growing Media and sent out to all members of the ISHS Commission Plant Substrates and Soilless Culture as well as members of the International Peatland Society (IPS) directly concerned with horticulture. The aim of the questionnaire was to propose and define some priority areas of work of the ISHS Working Group Growing Media in terms of improving and sharing knowledge and developing projects focused on growing media.

Four topics were covered by the survey: teaching and e-learning programs, publishing a book, a platform for sharing information, and international R&D projects.

Eighty-seven responses were obtained, highlighting the lack, but also the willingness, of respondents to develop and share common international activities on our topics. From these, definitive actions were proposed and potential avenues were suggested for future development.

Introduction

As defined by ISHS, the role of ISHS Sections, Commissions and Working Groups is to achieve a range of activities that are relevant to horticultural science, with the main objectives of further improving scientific publications, developing means of communication for dissemination of information (electronic newsletters, websites, etc.), and increasing attendance at symposia.

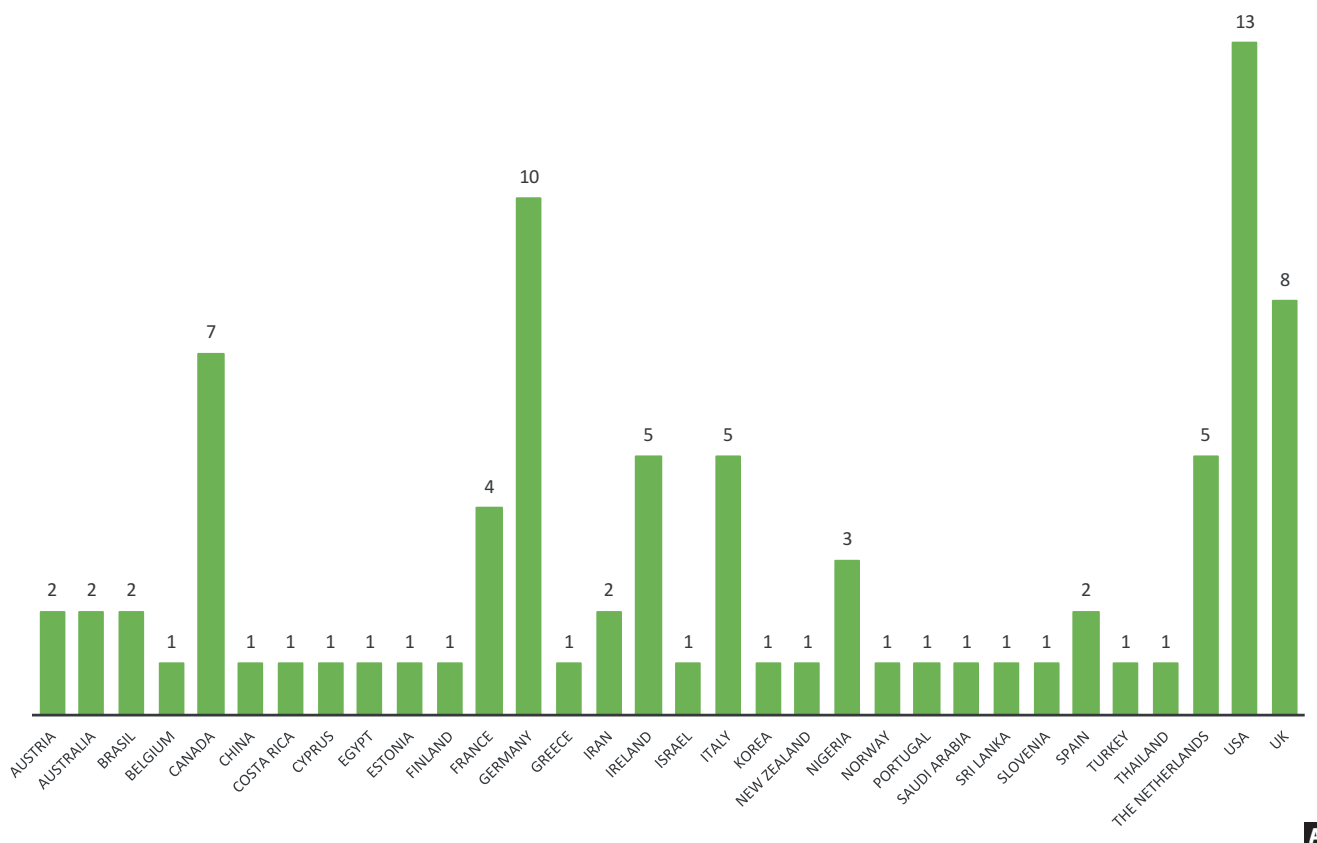
Some actions have already been conducted by the ISHS Commission Plant Substrates and Soilless Culture to meet some of these expectations, including: (1) reviewing each paper proposed for publication in *Acta Horticulturae*, (2) signing an Agreement between ISHS and IPS to jointly organize symposia every two years (since 2005 at the symposium in Angers), and (3) more recently in Portland in August 2017, promoting and honouring scientific activities developed by students during the symposium.

In addition to these actions, which have been mainly focused on the biennial symposium and managed by relatively few people (Organizing Committee, Chairs of the Commission and Working Groups), the Working Group Growing Media recently suggested a participative consultation, with the aim of allowing the development of some common activities within the Working Group by the involvement of its members. The first step of this initiative was to build and disseminate a questionnaire to all people potentially involved in substrates' R&D, in order to propose and define priorities of the Working Group in terms of improving and sharing knowledge and developing projects.

The objective of this article is to present the results of this questionnaire, to outline positive actions already implemented and to suggest potential avenues of work for future actions.

Questionnaire

The questionnaire can be found (including a completed version) at the following link: https://docs.google.com/forms/d/e/1FAIpQLSeJLT34FPE0yUMLKQonALkm_FeB-BH8AfzVr9TW-vvYvodWmRA/viewform#responses. It consisted of 35 items grouped in four main categories which are: teaching and e-learning programs, writing of a collective book, a platform for sharing information, and formulation of proposals for international R&D projects. Each category was similarly approached, questioning the state of knowledge of respondents, their interest and potential contribution in further development of activities, and the audiences targeted for these actions. Finally, from the respondents' point of view, the importance rating of suggested activities was requested. The questionnaire was sent out in March 2017 to all 912 effective members of the four Working Groups of ISHS Commission Plant



Substrates and Soilless Culture (Growing Media, Composting for Horticultural Applications, Substrate Analysis, Hydroponics and Aquaponics) as well as members of IPS directly concerned with horticultural purposes by the way of Gerald Schmilewski, President of IPS.

Results

Who responded?

Eighty-seven responses (from 31 countries) were recorded by August 20, 2017 (when the ISHS symposium in Portland started) (Figure 1A). They included those working in the public (56%) and the private sector (44%), mainly as scientists (78%) (Figure 1B). Most respondents were ISHS members (91%), with only 16% being IPS members.

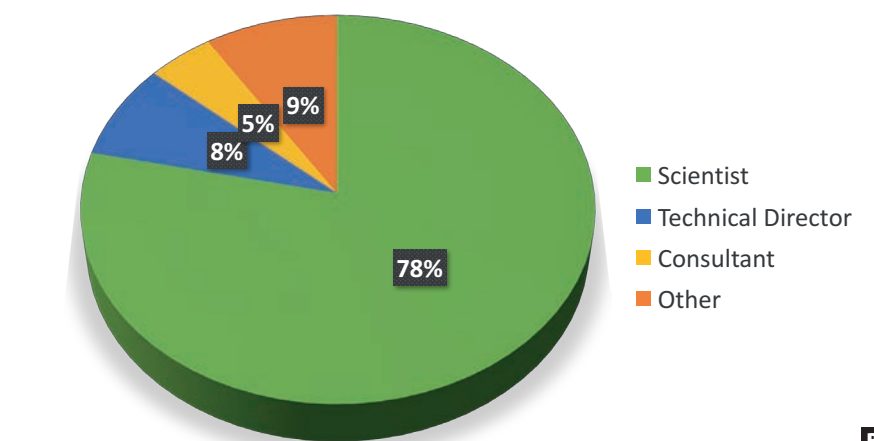


Figure 1. A) Country of residence and B) job positions of the 87 respondents of the questionnaire.

Teaching and e-learning programs

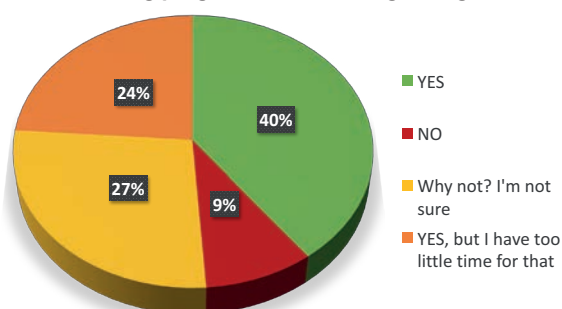
Sixty-nine percent of respondents indicated that they have participated in specific training courses about growing media; 23 and 28% of them have regularly taught more than 20 h and between 4 and 20 h per year, respectively; whereas the other 49% have occasionally participated in such teachings. The targeted audiences were very diversified with 68% of respondents indicating audiences had included growers, 65% had taught technicians and/or engineers of private companies and/or universities, 67% had taught Bachelor or Licence students (or equivalent level) and 52% had taught Master and PhD students. Until now, e-learning programs, considering all aspects of growing media and soilless

culture, have not been developed to any great extent, except for a few (and mainly unknown by 87% of respondents) webinars proposed in North America or in Europe. However, 86% of respondents would be interested by such e-learning programs and 40% would be willing to actively participate in the creation of an e-learning program (Figure 2A). The main identified audience would be growers for 79% of all respondents, but the other targeted audiences were also considered important: close to 55% of respondents identified students (whatever the levels), and a similar percentage identified technicians or engineers working in private companies, universities, research institutes, etc.

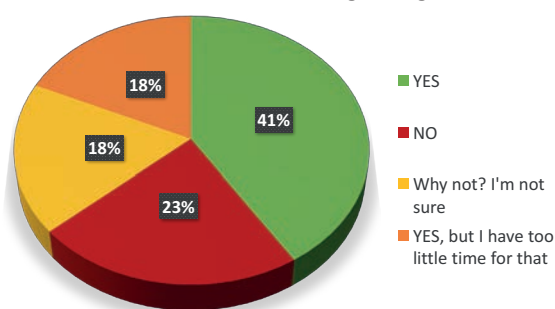
Writing of a collective book

Sixty-four percent of respondents were aware of many books about growing media. Regarding the number of respondents naming specific books, two of them could be considered as main reference books, with 16 and 10 citations for *Soilless Culture: Theory and Practice* (Raviv and Lieth, 2007) and *Media and Mixes for Container-Grown Plants* (Bunt, 1988), respectively. With a large interest in having a reference book, 41% of respondents indicated that they would also be willing to actively participate in the writing of a collective book focused on growing media (Figure 2B), again mainly targeted towards growers for 81% of

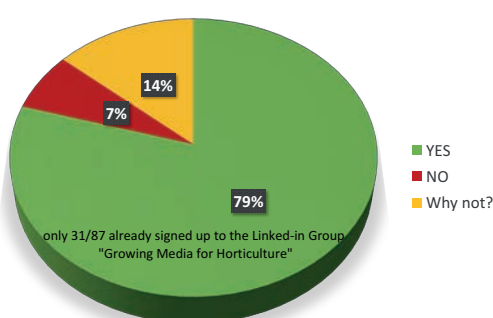
Would you be willing to participate in the creation of e-learning programs focused on growing media?



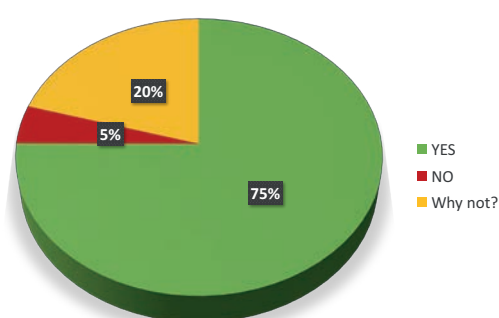
Would you be willing to participate in the writing of a collective book focused on growing media?



Would you be interested in a platform for exchange of information, focused on growing media and soilless culture?



Would you be willing to work on international R&D projects about growing media and soilless culture?



■ Figure 2. Interest of questionnaire respondents in proposed activities (87 responses for each question).

respondents, then technicians and/or engineers for 71% of them, and students for 56% of them.

Platform for sharing information and publications

The questions about sharing of information were subdivided into two parts; the first one strictly focused on a publication-sharing platform, and the second one referred to a platform for exchange of information in general, the information needed and/or which could be potentially shared by the users (Figure 3).

Fifty-nine percent of respondents were aware of publication-sharing platforms. Among all respondents, 53% have already signed up to such platforms (Figure 3A). For the remaining 47%, 46% were willing to sign up to a publication-sharing platform and 39% might possibly do it (Figure 3B).

The large majority of respondents (79%) expressed their interest in having a platform for the exchange of information specially focused on growing media; whereas 14% were undecided (Figure 2C). This validated the creation of the LinkedIn group "Growing Media for Horticulture" on the web (since December 2016) and which is accessible for free at <https://www.linkedin.com/groups/8568066>. However, this newly-created platform remains until now relatively unknown by respondents, with only 36% of respondents already registered as members of the LinkedIn group. Even so, this group is increasing, with 180 members in September 2017.

Three main kinds of information are considered to be absolutely essential by respondents: knowledge of national and international scientific events and trade shows/exhibitions for 99 and 97% of them, respectively, as well as the opportunity to find partners for R&D projects for 89% of respondents.

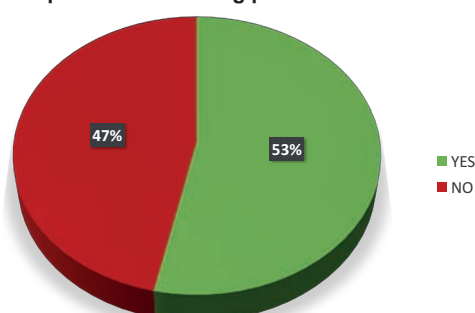
Other suggested topics considered important for dissemination included internship position (PhD, MSc, postdoctoral, etc.) offers, job position offers, and an updated list of publications about growing media, by 51, 57 and 53% of respondents, respectively.

Formulation of proposals for international R&D projects

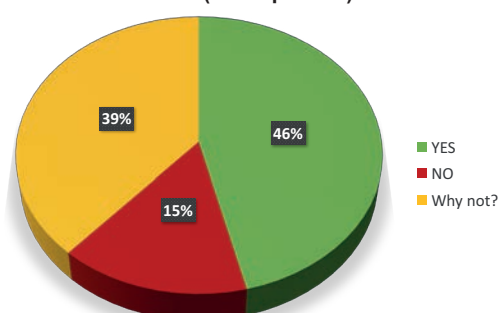
International projects were not usual for many respondents (75%), or were mainly only bilateral. However, 75% of respondents indicated that they would be interested in building and contributing to international and collaborative R&D projects (20% remained undecided).

Among proposals to respondents as for their own contribution, none were completely ignored, even if only 17% could contribute to socio-economic studies (current state, benefits of the projects), probably due to the scientific job sectors of respondents. For other

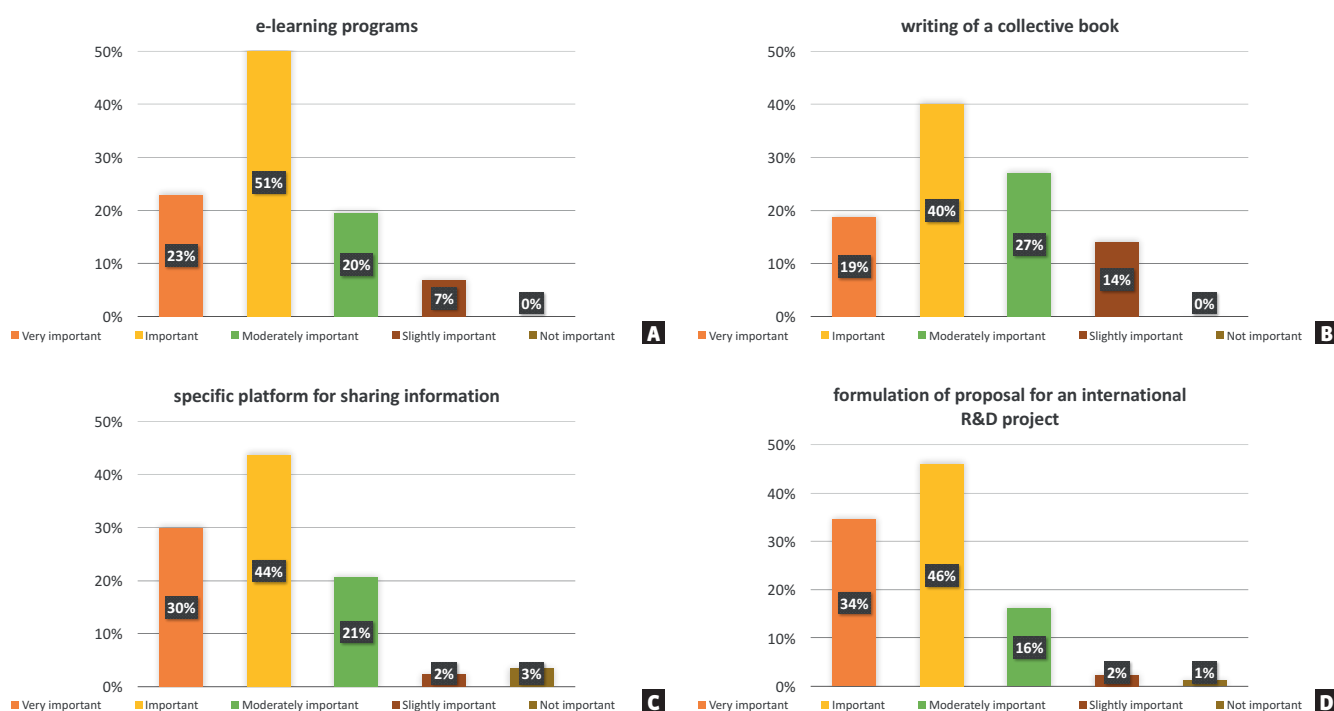
Did you already sign up to any publication-sharing platform?



If not, could you sign up to any publication-sharing platform? (40 responses)



■ Figure 3. A) Use and B) potential use of publication-sharing platforms by the 87 questionnaire respondents.



■ Figure 4. Importance rating of potential work focus for the Working Group Growing Media, as judged by the 87 questionnaire respondents.

actions, the rates reach 40% for supplying materials (growing media, additives, sensors, etc.), 49% for developing operational tools for end-users, 53% for developing scientific activities in laboratory and up to 72% for implementing growing tests in greenhouses and/or outside. Nutrient management (cited 9 times), peat alternatives (9), additives in growing media (8) and water-relations (7) were the main open proposals suggested by respondents, but other keywords were also mentioned, such as aqua/hydroponics (5), root growth and development (4), organic fertilizers (3), composts and their properties (3), and different materials potentially used as substrates (wood, biochars, wastes) (twice for each).

Importance level of topics mentioned

The answer to the last question, referring to the importance rating of topics mentioned, is presented in Figure 4. Regarding topics considered as “very important” by respondents, results clearly showed their main interest was in the formulation of international R&D projects (34%) then the use of a specific platform for exchange of information (30%), whereas the creation of an e-learning program and the writing of a collective book collected 23 and 19% of answers.

Discussion and conclusion

The results of the survey have shown the dynamism and high motivation of respondents to be actively involved in new activities

(Figure 2) that would assist them in their achievements. From the results of this survey and the discussions held at the last ISHS Commission Symposium in Portland, some proposals and suggestions were highlighted, in particular:

- The invitation to sign-up to the LinkedIn group “Growing Media for Horticulture” <https://www.linkedin.com/groups/8568066>, with the absolute necessity for members to share information and have open discussions;
- The opportunity to publish a handbook compiling methods of analysis (standardized or not); knowing also that a second version of the book by Raviv and Lieth is in progress;
- The identification of main issues and associated R&D questions that could be suitable for collaborative project proposals, potential partners and their level of involvement.

Working methods and tasks will soon be proposed to respondents. The progress in the achievement of tasks will be presented at the next symposium in 2019, <http://www.ishs.org/symposium/630>.

Acknowledgments

The author would like to thank all respondents for their contribution, as well as Michael Raviv (Chair of ISHS Commission Plant Substrates and Soilless Culture), Bill Carlile (Vice-Chair of the Commission), and Gerald Schmilewski (President of IPS), for their support of this survey. ●

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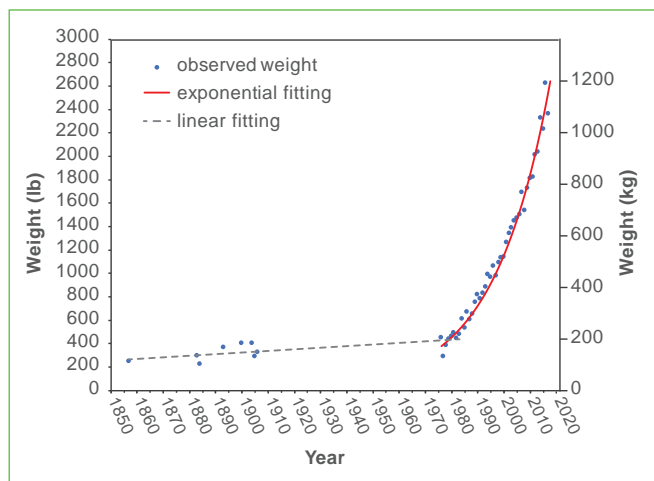
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Record giant pumpkin fruit weights: 1857 to 2017

Jules Janick, Don Langevin, Ying Li and Mathias Willemijns



■ Figure 1. Record pumpkin weight from 1857 to 2017. The data is linear from 1857 to 1983 ($R^2=0.51$) and exponential from 1976 to 2017 ($R^2=0.98$).

The increases in weight of giant pumpkins (*Cucurbita maxima*) in contests from 1857 to 2017 continue their remarkable upward trend. The world's record of 2624.6 lb (1190.5 kg) was achieved in Belgium in 2016, while the 2017 winner (2363 lb (1072 kg)) achieved in the State of Washington, USA, remains in second place. It was a shock to Americans and Canadian growers that the torch was passed to European growers in 2014 and 2016 (Table 1).

The trend line for increasing pumpkin fruit weight from 1983 to 2017 (Janick, 2008; Langevin and Janick, 2011) continues with no evidence of a maximum (Figure 1). In the 124-year interval from 1857 to 1981, record weight (245 to 493.5 lb) had an average annual increase of 2.0 lb, while in the 35-year interval from 1981 to 2016, weight increased from 493.5 to 2624.6 lb, an annual increase of 60.9 lb. Although the trend line from 1857 to 1983 was linear, the trend line from 1976 to 2017 was exponential. The increases in record fruit weights were due to new technologies – a combination of improved genetics due to selection and improved cultural practices. The driving force was undoubtedly giant pumpkin contests that were initiated in 1983 and appealed to growers and gardeners all over the world. Contest winners were located in northern latitudes from 37 to 51 degrees (Table 1), where a combination of long days and cool nights appears to be optimum.

The world record yield in 2016 was obtained by Mathias Willemijns, a 25-year-old grower in East Flanders, Belgium, who started growing pumpkins at the age of 17 (Figure 2). He is employed as a lead technician for growing vegetables in greenhouses at a research center, but giant pumpkin growing is a personal hobby carried out on his own farm. The world

lings transplanted to the tunnel 10 days later. Plants were stressed early by withholding water to force root growth. Each day the temperature was adjusted by rolling up the tunnel sides and on hot days fans brought in cooler outside air. Equal day-night temperatures were maintained in early growth, but after fruit set diurnal temperature differences were increased. Pistillate flowers were pollinated in the middle of June. A misting system was used to cool air temperatures on hot days and to raise relative humidity to avoid leaf burn. Plants were drip irrigated and received soluble fertilizer. Compost was applied to the soil and pesticides were used to control pests, but pyrethrum was avoided due to development of resistance by aphids. Strobilurins were used as sprays to control mildew as they increased leaf greening. Excess pesticide spray was avoided to reduce leaf aging. New plastic increased light transmission.

The doubling time for record pumpkin weight was 124, 13, and 18 years. If the trend continues, the fourth doubling to 3920 pounds (an increase in 1296 pounds or 49.4%) would be expected in 2023 (Table 2). An interesting question would be to determine if there is a maximum fruit size in pumpkin. Cultural practices that might be considered, besides



■ Figure 2. Mathias Willemijns and his 2016 world record giant pumpkin.

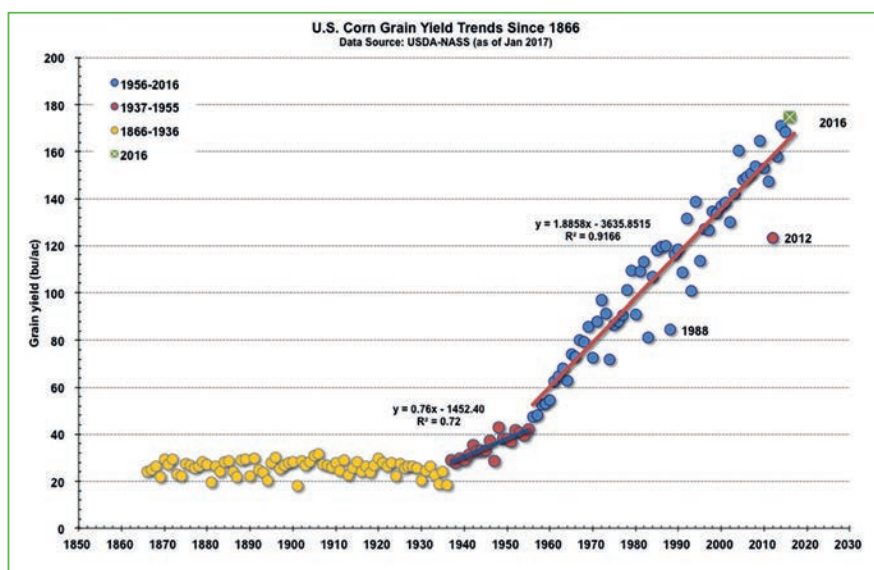
■ Table 1. Record weights of giant pumpkin 1857-2017. Source: http://www.sngpg.com/ag_history.aspx.

Year	Grower	Location	Latitude	Weight	
			°N	lb	kg
1857	Unknown	Sutcombe, Devonshire, UK	50.87	245	111
1883	Charles Hewitt	Halifax, Canada	44.65	292	132
1884	Joseph Dunn	Bryantsville, Kentucky, USA	37.72	226	103
1893	William Warnock	Goderich, Ontario, Canada	43.74	365	166
1900	William Warnock	Goderich, Ontario, Canada	43.74	400	181
1904	William Warnock	Goderich, Ontario, Canada	43.74	403	183
1905	A.W. Roel	Brattleboro, Vermont, USA	42.85	289	131
1906	A.W. Roel	Brattleboro, Vermont, USA	42.85	322.5	146
1976	Bob Ford	Pennsylvania, USA	41.20	451	205
1977	Howard Dill	Windsor, Nova Scotia, Canada	44.99	287	130
1978	Edgar Van Wick	Roland, Manitoba, Canada	49.37	382	173
1979	Howard Dill	Windsor, Nova Scotia, Canada	44.99	438.5	199
1980	Howard Dill	Windsor, Nova Scotia, Canada	44.99	459	208
1981	Howard Dill	Windsor, Nova Scotia, Canada	44.99	493.5	224
1982	Howard Dill	Windsor, Nova Scotia, Canada	44.99	445	202
1983	Owan Woodman	Falmouth, Nova Scotia, Canada	45.00	481	218
1984	Norm Gallagher	Chelan, Washington, USA	47.84	612	278
1985	Michael Hodgson	River Phillip, Nova Scotia, Canada	45.67	531	241
1986	Robert Gancarz	Wrightstown, New Jersey, USA	40.04	671	304
1987	Don Fleming	Morrisville, Vermont, USA	44.56	604.5	274
1988	Keith Chappel	Upper Granville, Nova Scotia, Canada	47.18	651	295
1989	Gordon Thompson	Hemmingford, Quebec, Canada	45.06	755	342
1990	Ed Gancarz	Wrightstown, New Jersey, USA	40.04	816.5	370
1991	Ray Waterman	Collins, New York, USA	44.83	780.5	354
1992	Joel Holland	Puyallup, Washington, USA	45.06	827	375
1993	Donald Black	Winthrop, New York, USA	44.81	884	401
1994	Herman Bax	Brockville, Ontario, USA	44.59	990	449
1995	Paula Zehr	Lowville, New York, USA	43.79	963	437
1996	Paula/Nathan Zehr	Lowville, New York, USA	43.79	1061	481
1997	Chris Anderson	Moraga, California, USA	37.83	977	443
1998	Gary Burke	Simcoe, Ontario, USA	42.84	1092	495
1999	Gerry Checkon	Spangler, Pennsylvania, USA	40.64	1131	513
2000	Dave Stelts	Leetonia, Ohio, USA	40.88	1140	517
2001	Geneva Emmons	Sammamish, Washington, USA	47.62	1262	572
2002	Charlie Houghton	Goffstown, New Hampshire, USA	43.02	1337.6	607
2003	Steve Daletas	Canby, Oregon, USA	45.26	1385	628
2004	Al Eaton	Ontario, Canada	51.25	1446	656
2005	Larry Checkon	Altoona, Pennsylvania, USA	40.52	1469	666
2006	Ron Wallace	Greene, Rhode Island, USA	41.69	1502	681
2007	Joe Jutras	North Smithfield, Rhode Island, USA	41.97	1689	766
2008	Jake VanKooten	Port Alberni, British Columbia, Canada	49.23	1536.5	697
2009	Christy Harp	Massillon, Ohio, USA	40.80	1725	782
2010	Chris Stevens	New Richmond, Wisconsin, USA	45.12	1810.5	821
2011	Jim Bryson	Ormstown, Quebec, Canada	45.09	1818.5	825
2012	Ron Wallace	Greene, Rhode Island, Canada	41.69	2009	911
2013	Tim Matheson	Napa, California, USA	38.30	2032	922
2014	Beni Meier	Pfungen, Switzerland	47.52	2323.7	1054
2015	R. Wallace	Greene, Rhode Island, USA	41.69	2230.5	914
2016	Mathias Willlemijns	East Flanders, Belgium	51.04	2624.6	1191
2017	Joel Holland	Sumner, Washington, USA	47.20	2363	1072

■ Table 2. Years to double record pumpkin weights.

Record pumpkin fruit weight	Year achieved or surpassed	Years to double
245	1857	
490	1981	124
980	1994	13
1960	2012	18
3290	2023 ¹	10 ¹

¹Based on extrapolation from curve $y = e^{(0.047 \cdot x - 86.456)}$, y represents the weight (lb), x represents the year.



■ Figure 3. United States corn grain yield trends since 1866 (Nielsen, 2017).

continued genetic selection, would be season extension maintained by growing plants continuously in heated greenhouses provided with illumination. Root and shoot grafting might be considered. An ancient Chinese system increased fruit size in bottle gourds by grafting to multiple roots (Mudge et al., 2009: 458). Senescent leaves might be replaced by shoot grafting.

The increase in fruit weights in pumpkins is similar to the increase in average maize yields in the United States from 1866 to 2016 (Figure 3). Corn grain yields were essentially constant from 1866 to 1936 and then increased linearly after that date due to genetic improvement (double cross and then single cross hybrids) and crop improvement technologies including increased plant density, the addition of nitrogen fertilizer, chemical weed control, and irrigation. ●

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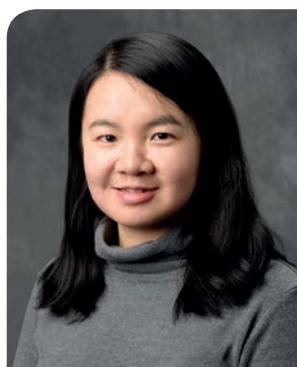
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> A national value: Turkish figs

Selim Arpacı, Ramazan Konak and Erdem Çiçek



■ Figure 1. Fig cultivation areas in Turkey (listed in white text).

Introduction

Figs are predominantly grown in countries that are dominated by a Mediterranean climate. Although fig plantations are widespread in Turkey, there are variations in soil and climate conditions among the growing regions. The ideal conditions for dried fig production are: temperate and rainy winters, 30-40°C summer temperatures especially in July-September, 45-50% relative humidity, alluvial, clayish-loam soil, and an average annual precipitation of around 650 mm (Ozen et al., 2007). When the famous Turkish fig cultivar, 'Sarılıp', is grown in the Büyük and Küçük Menderes basins of the Aegean region, where the climate and soil conditions meet these desired criteria, some of the best quality dried figs in the world are produced. Fig production is carried out mainly in Aydın, Bursa, İzmir, Mersin, Hatay, Balıkesir, Antalya and Gaziantep provinces in Turkey (Figure 1). In recent years, there has been an increase in fig production in both the Adana province and Çukurova basin. Aydın province accounts for 62 and 75% of fresh and dried fig production, respectively (Arpacı, 2017). Almost all of the dry fig cultivation in Turkey occurs in the Büyük and Küçük Menderes basin (Cobanoğlu, 2013). Fifty to sixty years ago, fig production was carried out mainly

on the lowlands (Figure 2), however, with the removal of fig trees from these flat areas for other purposes, the majority of fig production has shifted to slopes and mountainous terrain (Figure 3).

Poor soil structure and erosion are the most important problems in fig cultivation in the mountainous areas. In this regard, it has become necessary to develop soil and water preservation techniques. In lowland areas,

first olives and citrus, and then pomegranates, plums and corn, have been tried as alternatives to fig cultivation, but none of them have survived for long. At a conference held in 1955 on the theme of fig, it was recommended that the fig trees should not be removed, despite all the difficulties. The participants recognised that figs had been cultivated in these ecological locations for over 2500 years. Herodotos, who was an his-



■ Figure 2. A young fig orchard planted in lowland conditions in the Aydın province.



■ Figure 3. Fig production areas and drying tunnels in the Nazilli district.

torian living in the Bodrum county of Turkey in the fifth century BC was quoted as saying “fig culture is as old as human history”, and that “the reason Persians gave up their fighting in the battle was lack of fig in their foods” (Ureten, 2014).

Fig production and trade

Figs have been produced commercially in the Large and Small Menderes valleys for nearly 200 years. Turkey ranks first in the world in terms of fresh fig production, and is followed by Egypt, Algeria, Morocco and Iran (Table 1). Turkey produced 26% of the world production in 2014, whilst Egypt, Algeria and Morocco produced 16, 11 and 11%, respectively. Turkey is also the number one producer of dried figs (Table 2).

In recent years, domestic and international trade of fresh figs has been increasing (Sahin and Ucar, 2014). For the last 30 years there haven't been any large increases in the total area of figs, number of fig trees or total fig production in Turkey. In 1990, 300,000 t of figs were produced from 10,443 fig trees, and in 2013, 299,000 t were produced from

10,500 trees. However, export volumes have increased significantly, and this has resulted in greater incomes. Approximately 70% of fresh figs produced in Turkey are utilized for drying. According to the İzmir Commodity Exchange, dry fig production was estimated to be 80,000 t in 2017.

In terms of export quantities, in 1991, about 32,000 t of dried figs and 3,000 t of fresh figs were exported and approximately 66 and 4 million US\$ income was obtained, respectively (Sahin and Ucar, 2014). By 2014, dried fig exports had risen to 76,000 t, worth 253 million US\$ (Anonymous, 2017; Figure 4). While Turkey has exported most of its figs to EU countries, in recent years Russia, the Far East and the Arab countries have become significant export destinations. Whereas 10 years ago China imported very small amounts of figs, in the 2013-2014 season, it purchased more than 4,000 t (Anonymous, 2017). Given China's large population, it could become a very important export market for Turkish figs. In terms of dried figs, Turkey has almost no competitor in the world markets. However, in terms of fresh fig production, countries

such as Israel, Italy and Spain are becoming important competitors.

Fresh fig exports have increased in the last 10 years, particularly from Bursa. In 2005, 9,500 t of fresh figs were exported at a value of 12.5M US\$, whereas, in 2016, 18,000 t of product were exported at a value of 45M US\$ (Figure 5).

Fig cultivars

The Turkish traditional figs are still considered to be some of the highest quality figs available. The cultivar ‘Sarılop’ accounts for 90% of dried fig production grown in Turkey (Figures 6 and 7).

‘Sarı Zeybek’ (Figure 8) in the Nazilli region, ‘Bardacık’ in the İzmir region and ‘Akça’ in the Germencik area, are grown as local cultivars. Other cultivars used include ‘Keten Köyneği’ in the Şanlıurfa region for both dried and fresh figs, ‘Halebi’ and ‘Sultani’ in the Gaziantep region for dried figs, ‘Melli’ in the Burdur Bucak region for both dried and fresh figs, and ‘Mut’ in the Mersin Mut region. The dried figs (‘Sarılop’ and ‘Sarı Zeybek’ cultivars) produced in Turkey have unique qual-

■ Table 1. Fresh fig production in the world (t) (FAO, 2014).

Country	2011	2012	2013	2014
Turkey	260,508	274,535	298,914	300,282
Egypt	165,483	171,062	153,089	176,105
Algeria	120,187	110,058	117,100	128,620
Morocco	114,770	102,694	101,989	126,554
Iran	75,927	78,000	78,392	72,672
Syria	42,944	41,224	46,443	35,301
Spain	28,993	24,900	30,400	28,896
USA	35,072	35,072	26,212	30,300
Tunisia	26,000	25,000	23,500	27,000
Portugal	17,812	18,000	17,581	14,728
Others	225,001	212,644	223,832	197,272
World total	1,112,697	1,093,189	1,117,452	1,137,730

■ Table 2. Dried fig production in the world (t) (INC, 2018).

Country	2016/2017	2017/2018
Turkey	72,000	78,200
Iran	22,000	18,000
USA	9,000	9,500
Afghanistan	7,000	9,000
Greece	7,500	7,500
Spain	5,500	6,000
Italy	3,500	4,000
Others	5,000	3,500
World total	131,500	135,700

ities, including a soft texture, natural color, honey flavor and pleasant smell. Figs from Iran have a harder texture, and from Greece are smaller and whiter colored, than those from Turkey. For these reasons, Turkish figs have maintained their leading position in the world markets.

Among the fresh cultivars of Turkey, the cultivar ‘Bursa Siyahı’ (Figure 9) is at the forefront, with its high yield, big size and long shelf life, and this has become one of the major sources of income for the producers. ‘Bursa Siyahı’ figs make up the vast majority of Turkey’s fresh fig exports.

The properties of fig cultivars produced in Turkey are presented in Table 3. The local cultivars, ‘Sarı Zeybek’ and ‘Divrek Kara’, were submitted for cultivar registration in 2017, because of their good drying properties. Among these cultivars, ‘Divrek Kara’ is especially in demand by consumers because of its dark-color, low sugar content and antioxidant activity, which is about 2.5 times higher than yellow cultivars. ‘Sarı Zeybek’ is preferred as dried fruit for its lighter color and small ostiol width.

Orchard establishment

Fig orchard establishment in Turkey begins with the planting of single leader trees, which have been propagated from cuttings, have 10-15 mm diameter and are 70-90 cm in length (Figure 10). In preparation for planting, land is usually tilled 20-30 days after autumn rains. On flat land, trees are planted at 7×7 or 8×8 m spacings for dried fig plantations, or at 6×4 m spacings for fresh fig plantations. On slopes and highland regions, trees are usually planted at 6×6 m spacings because the trees develop smaller canopies. New orchards in Aydın district are usually planted from the second half of November to the first half of December after autumn defoliation has occurred. In cold regions, delaying planting of new orchards until February can be beneficial. After planting, canopy development is encouraged by heading the trees at 70-80 cm.

Orchard management

Fertilization, irrigation and soil preparation

Production of dried figs in the Aydın region is generally carried out without inorganic fertilization. The majority of Turkish figs are cultivated in soils with low nutrient content, and can be grown without the need for chemical control of pests and diseases. However, in some production areas the soils are sandy and contain lime. In such areas, soil analysis needs to be carried out, and where required, nutrient supplementation undertaken. In the years when the annual

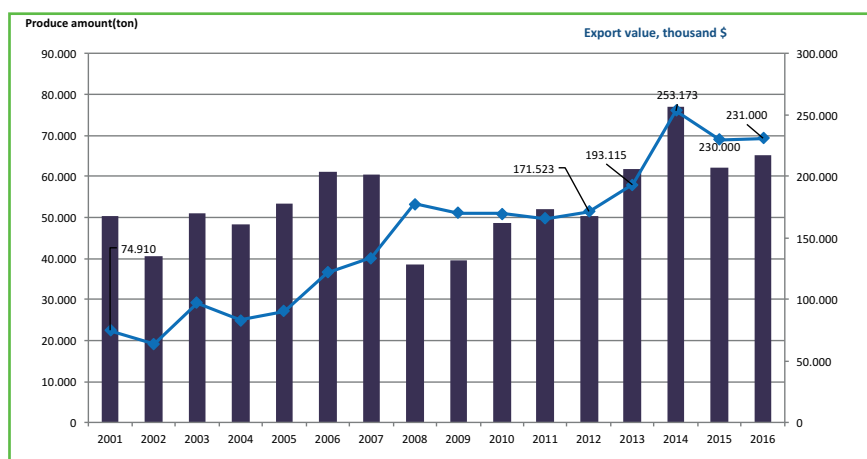


Figure 4. Dried fig export quantity (purple bars) and value (blue line) from Turkey (Anonymous, 2017).

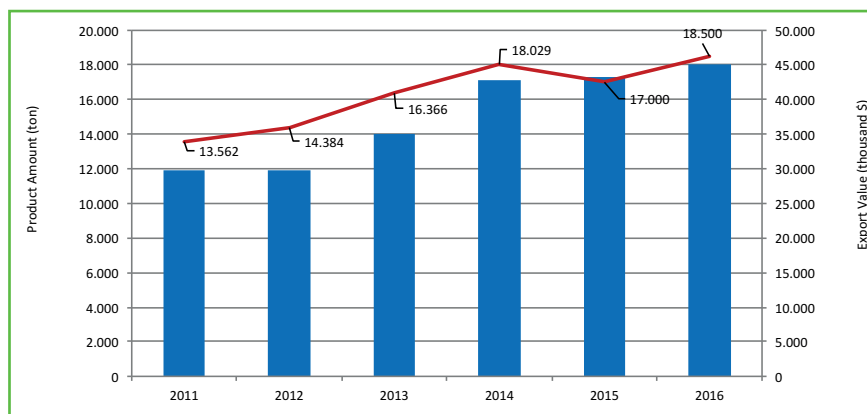


Figure 5. Fresh fig export quantity (red line) and value (blue bars) from Turkey (Anonymous, 2017).



Figure 6. Fresh fruit of ‘Sarılop’.



Figure 7. ‘Sarılop’ fruits at the fresh fig festival in Buharkent, Aydın district.



■ Figure 8. Ripe fruit of 'Sarı Zeybek'.



■ Figure 9. Ripe fruit of 'Bursa Siyahı'.



■ Figure 10. Fig saplings ready for planting.

precipitation is less than 600 mm, or in very permeable sandy soils, irrigation is required. Using underground irrigation systems is very important for reducing evaporation for dried fig cultivars. Winter irrigation is recommended if the rainfall is less than needed. Tillage is recommended 3-4 times per year in the cultivation of dried figs, for weed control, soil ventilation and rainwater storage, preferably in November, March and June. For the prevention of erosion on sloping terrain, tillage should be carried out as little as possible, but if it becomes necessary, in non-precipitation periods and following the contours of the slope (Aksoy, 2016).

Pruning

Generally, training of young trees follows "modified leader" or "goblet" systems. Trees are shaped as 3 or 4 main leaders and the canopy is created around these leaders. Dried fig cultivation areas are generally warm and dry in the summer, thus development of the main branches in the juvenile period of the tree will prevent sun burn. In sloping or mountainous areas, where the altitude is 500 m or above, multi-leader training is recommended. Because each cut has the potential to change the growth of the tree, no branch should be removed without a rea-

son. Removing branches more than needed can cause fruit quality losses in dried fig cultivation. On the contrary, leaving too many shoots and branches during annual pruning also causes fruit to be small and of poor quality because of excessive crop loads. Fig rootstocks tend to produce suckers, so these should be removed at the beginning of the growth period. Rejuvenation pruning of old trees can be applied by removing main branches as needed.

Pollination and fruit formation

The fig fruit is actually a syconium, a fleshy hollow receptacle with multiple ovaries. There are two types of fig trees; male trees (or caprifig trees) and female trees. *Ficus carica* is a gynodioecious species, the male (hermaphrodite fruit) and the female (female fruit) trees are separate. Male fruit (caprifig) form on male trees, and produce 2-3 crops per year as profichi, mamma and mammoni. Profichi are used to pollinate the main crop. Male fruit provide the pollen source for flowers on the female trees and are also the raw material for jam and confectionery (collected before fig wasp enters). Female trees produce edible fruit, and have only female flowers. Important Turkish fig cultivars such as 'Sarılop', 'Bursa Siyahı', 'Yeşilgüz', 'Morgüz'

and 'Göklop' are female trees and require cross-pollination for fruit set, which is carried out by the caprifig wasp, named *Platophaga psenes*. *P. psenes* lives in the fruit of caprifig trees. Mature wasps carry pollen with their wings and feet from the male flowers in the caprifig to female fruit through the ostiole hole. The ostiole is the opening of the involuted fig inflorescence through which the fig wasps enter to pollinate. In male trees (caprifig), three different fruit types are formed in three periods that contribute to the life cycle of the wasp. The first fruit are formed in September-November, the second occur in February-April and are called 'caprifig', and third and the last fruit in a season are formed in May-June. A ripe caprifig fruit (last half of May-first half of June) is sized like a large hazelnut, matt green colored, and consists of 170-1300 gal flowers (female flower) and 40-220 male flowers.

The main fig crop forms on current year's shoots, which emerge in May. In contrast, breba fruit develop on one-year-old shoots in March-April, and these fruits mature in the second half of June in Aydın province conditions, as observed in cultivars such as 'Siyah Orak', 'Beyaz Orak', 'Horasan' and 'Yediveren'. These cultivars also form fruit in summer. In some cultivars like 'Beyaz Orak' pollination

■ Table 3. Some characteristics of important fig cultivars produced in Turkey.

Cultivars	Fruit weight (g)	TSS (%)	Skin color	Inner color	Form of consumption
Sarılop	59-70	23.2	Yellow	Light pink	Dry-fresh
Morgüz	60-70	22.6	Greenish purple	Red	Fresh
208	47-55	22.2	Purple	Red	Fresh
Yeşilgüz	47-55	21.8	Green	Red	Fresh-dry
Sultan Selim	41-50	22.5	Greenish yellow	Red	Fresh
Bursa Siyahı	66-75	22.6	Black	Red	Fresh
Beyaz Orak	78-100	23.6	Yellowish green	Light pink	Fresh
Siyah Orak	29-40	23.1	Black	Light pink	Fresh-dry
Divrek Kara	43-50	23.9	Black	Red	Dry



■ Figure 11. Fruit of 'Siyah Orak'.



■ Figure 12. Caprifig fruits for sale.



■ Figure 13. Traditional fig drying in wooden trays.

by the caprifig wasp is not needed for fruit set in June, whereas in August insect pollination is obligatory. On the other hand, 'Siyah Orak' (Figure 11) does not need pollination for fruit set in either June or August. These cultivars are considered as parthenocarpic because their fruit develop without pollination and they have no seeds.

In Turkey, pollination of fig (caprification) is usually carried out in the first half of June. Caprifigs are harvested in the early hours of the morning (Figure 12) and put into a net bag containing 3-4 fruit. Three of these bags are hung on each female fig tree so the caprifig wasps can transfer the pollen to the female figs. This process is repeated at least twice at an interval of approximately one week. Chemical pest and weed control, hanging pheromone traps and tillage should not be carried out during the caprification period. Some caprifigs may carry diseases, thus, usage of healthy caprifig fruit for pollination are effective on the quality of summer fruit. Selection of healthy fruits for caprification is an effective method to prevent diseases in the fruit. After pollination male figs are collected and destroyed outside the orchard.

Harvesting and drying of figs

Harvesting of figs for drying takes about 8 weeks. In the 'Sarilop' cultivar, the fruit

ripen (semi dry, with 40-50% moisture content) on the tree and drop spontaneously to the ground. Fallen fruit are collected 2-3 times a week and brought to a suitable area for drying. Harvesting should be performed at frequent intervals. The drying process is carried out on plastic drying trays called ker-evet (Figure 13) for 2-3 days, until the water content drops to 22-24%.

In order to make the drying process faster and healthier, it is beneficial to dry the fruit under a plastic tunnel in which two sides are covered by a net (Figure 14). Once dried, the fruit are transported to wholesaler or growers' warehouses immediately. The warehouses are normally built in cool locations without sun, and have dry air flow and odorless environments. Windows and other open areas are covered with nets. The dried figs must be kept out of contact with the ground. Fig cultivation in Turkey is practiced almost without use of chemicals for pests and diseases. Especially in the lowland conditions, dried-fruit beetle (*Carpophilus hemipterus*) and fruit flies (*Drosophila* spp.) have been widespread for some years, but they are controlled using natural traps rather than chemicals. *C. hemipterus* and *Drosophila* spp. cause unwanted spoilage in mature fruit. The fungus *Fusarium moniliforme* can affect the inside of the fruit and this can also

occur when a diseased caprifig is used for pollination.

Processing and value-added products

Considering the historical importance and consumption trends, figs, especially dried figs, are a very important traditional food in Turkey (Figure 15). Fresh and dried figs can be processed into many different products. These products are mainly jam, marmalade, syrup, fig paste, candy and Turkish delight (Konak, 2010).

Fig fruit are one of the superior sources of minerals, especially potassium and calcium, polyphenols and crude fibers. The process steps employed in the fig enterprises are fumigation, sizing, selecting and removing aflatoxinous figs under UV light, washing, drying, packaging, storage and delivery (Figures 16-18). Fumigation is carried out to eliminate pests that arrived on the fruit prior to harvest. The dried fruit industry in Turkey generally uses approved chemicals or physical methods, such as shock treatment at -40°C, for fumigation. Aflatoxins are mycotoxins produced by two species of *Aspergillus* (*A. parasiticus* and *A. flavus*) and vary from 0.7 to 1.3% in figs produced in Turkey (Konak et al., 2017). In the aflatoxin screening process, the figs are examined under dark room conditions under a 365 nm UV lamp and bright greenish-yellow fluorescence fruit are removed. Then the figs are washed with 5-6% saline at 50-60°C to remove physical impurities. After washing, 60°C air is used in tunnel or cabinet type dryers at a flow rate higher than 2 m s⁻¹ to dry them and to reduce the moisture content of figs below 26%. Then the hand-shaped figs are packaged and stored. Optimum dry fig storage conditions are +4°C and 55-60% relative humidity in cold storage rooms (Ozen et al., 2007).

Targets and R&D studies

Although Turkey seems to be unrivaled in the world in both dried and fresh fig production, Turkish growers and marketers would like to increase fresh fig export quantity and price.



■ Figure 14. Drying figs under tunnels.



■ Figure 15. Natural dried figs of 'Sarilop'.



■ Figure 16. Separating possible aflatoxin-containing figs under UV light.



■ Figure 17. Selecting and sorting in fig enterprises.



■ Figure 18. Washing stage of dried fig processing.

Using existing cultivars, there is potential to triple exports of fresh figs by improving the packaging, promotion and cold chain conditions.

To achieve this goal, and to improve the whole value chain in general, R&D studies are needed, particularly to develop alternative cultivars that extend the market window. Fig harvesting can be undertaken between June and November because of the diverse fig germplasm and the range of climatic conditions within Turkey. With greenhouse cultivation, it is possible to provide fresh figs to the markets 30-40 days earlier or 20-30 days later than from outdoor production. There are many countries in the fresh fig market during August that ship their products to Europe and Far East countries in competition with Turkey. Also, many demands come from foreign and domestic markets for dried black figs and seedless cultivars, both fresh and dried. In particular, R&D studies on black-dried, seedless-dried and table fig cultivars should be initiated as soon as possible. The characteristics of the cultivar 'Sarilop', such as taste and flavor, thin skin and honey content, could be matched with the taste, large fruit size and high yield of the cultivar 'Bursa Siyahr', by crossing or implementing new breeding techniques for development of superior new cultivars.

Although Turkey produces some of the world's best quality dried figs, this sub-sector is faced with some threats as well:

- Climate change and geothermal energy; with global climate change, untimely rainfall in the growing period, extreme temperatures, and high humid weather conditions adversely affect the production of dried figs. High humidity (55-67%) and rainfall (9.6 mm), which occurred in the first week of August in 2017 and in the second week of the harvest period, negatively affected the dry fig production in Germencik, Incirliova and Efeler regions, resulting in a 20% yield reduction.
- During the fig harvest period, air relative humidity of 45-55% is required for proper drying. This is the most important limiting factor in the production of dried figs. In recent years, many dams have been built around the fig production areas and the irrigated fields near Büyük Menderes have been increased, and these have raised the humidity.

The lack of uptake of agriculture by the younger generation and the labor problem because of the limited use of mechanization are also important problems in fig production.

The Fig Research Institute is one of Turkey's outstanding national R&D facilities established in 1938, and located at the heart of fig industry in Aydın province. Mainly this institute, but also the other horticultural research centers of the Ministry of Food, Agriculture and Livestock and the relevant

universities, are undertaking research to deal with above mentioned challenges.

Conclusion

As the wealth of communities rises, the demand for natural and dry food increases. Turkish fig production entails almost no use of pesticides and inorganic fertilizers except in a few minor cases, thus, fig is considered as one of the leading natural foods. Figs are rated as a natural functional food owing to their significant dietary fiber content, high antioxidant capacity and the macro/micro nutrients present in the fruit. In addition, the Far East countries, which have large populations, have relatively recently been introduced to Turkish dried figs, and they are seen as a very big market for export. The price of dried figs has increased consistently over the last five years. The producer's wholesale price for 2013 was 1 US\$ kg⁻¹, whereas in 2017 it was 3 US\$ kg⁻¹ for dried figs. Demand for Turkish dried figs, both in the domestic and foreign markets, is very positive. In particular, when the demand for fresh and high quality dried figs started to increase in the domestic market, the export unit price increased accordingly. There is great potential to improve current fig production in Turkey, but this needs to occur without reducing the quality. This will increase the income level of fig producers, thus, it will continue to contribute much more to the national economy. ■

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> An overview on fruit breeding in Turkey

Emel Kaçal, Fatma Akıncı Yıldırım, Gökhan Öztürk and Melih Aydınli



Introduction

Anatolia has a rich biodiversity and it is home to many ancient civilizations. Breeding and culture of fruit species in Anatolia is based on a rich experience of many years. According to archaeological excavations, an advanced fruit culture in Anatolia already existed 4-5 thousand years ago, in Sumer and Hittites times. Central Asian Turks, who have deep-rooted fruit growing traditions, also made a significant contribution to this culture.

The great variability of climate and soil properties throughout the region has led to the emergence of many different types and varieties of fruit (Soylu, 1993). Some of them are presented in Table 1.

During migration from Central Asia, many fruit species were transported and cultured in Turkey (Soylu, 1993). Although there are some very good local cultivars in fruit production, for example for sweet cherry ('0900 Ziraat'), quince ('Eşme', 'Limon', 'Ekmek'), pear ('Deveci', 'Akça', 'Mustafabey') and apricot ('Kabaası', 'Hacı Haliloğlu'), foreign cultivars constitute a large proportion of commercial fruit production.

In scientific terms, fruit breeding studies began after the establishment of the Republic and gained momentum over time. Generally, these studies have been carried out by identification of genetic resources and selection of superior fruit types from the biodiversity. In this context, studies have been made in many species. New breeding programs have been established with different objectives and have used advanced techniques such as tissue culture and molecular methods for the last 15-20 years, mainly in apple, pear, lemon,

almond, orange, cherry, peach, apricot and pistachio. Although the primary objective of breeding programs is to develop new scion cultivars, rootstock breeding programs have also recently begun to gain speed in apple, pear, plum and sour cherry. Breeding studies in Turkey are carried out mainly by universities and research institutes. Since the early 2000s, scion and rootstock studies by the private sector have begun to emerge. Thus, an increase of medium and long-term breeding programs is foreseen.

Selection breeding

In the same way that individual growers have selected new fruit types in the past, modern fruit breeding programs in Turkey have also started by selecting fruit types that have desirable properties, using the available biodiversity. Selection studies have been carried out on economically important native species, including walnut (Ölez, 1971; Şen, 1983; Sütyemez and Eti, 2001), almond (Şimşek et al., 2010; Yıldırım et al., 2007), cornelian cherry (Eriş et al., 1992), apple (Kaya and Balta, 2009), hazelnut (Demir and Beyhan, 2000), black mulberry (Koyuncu et al., 2004), apricot (Akça, 1999) and raspberry (Onur et al., 1999). Some of these studies were limited to the determination of the pomological and morphological characteristics of local cultivars.

Selections were mostly made after the 1980s. '0900 Ziraat' is an outstanding commercial cultivar representing the Turkish sweet cherry, obtained by selection. Selection breeding has been widely used in Turkey to develop suitable cultivars for walnut and almond. Walnut selections started to be identified in 1971 by Ölez and have continued. Despite

numerous studies, the number of registered commercial cultivars in walnuts is still quite low. A total of 14 walnut cultivars were submitted for registration by Atatürk Horticultural Central Research Institute in 1990 and 1993. Some of those cultivars did not get enough evaluation, as they still present adaptation problems. New walnut cultivars were registered in 2009, 2010 and 2013 by Atatürk Horticultural Central Research Institute, Gaziosmanpaşa University and Kahramanmaraş Sütçü İmam University. Despite these advancements, current commercial walnut production is essentially done using foreign cultivars. In quince, the first studies were carried out by the Aegean Agricultural Research Institute in the 1960s and some promising genotypes were registered (Şahin and Mısırlı, 2016). As a result of the selection studies in the early 2000s, a number of promising genotypes were obtained in mulberry, but most of them have not been registered yet.

Besides selections for new scion cultivars, much work has also been carried out on rootstock selection. However, the number of registered rootstock cultivars is still very low, so foreign rootstocks are currently used in the fruit tree industry. In addition to the quince rootstock, S.Ö ('Sabahattin ÖZBEK'), rootstock breeding is continuing in species such as sweet and sour cherry, plum, and quince.

Crossing and mutation breeding

There has been a rapid increase in wide-scale hybridization studies since the beginning of 2000. In the last 15 years, numerous breeding programs have been carried out for cher-

■ Table 1. Some fruit species originating from Anatolia (Özbek, 1996).

Species	Latin name	Species	Latin name	Species	Latin name
Quince	<i>Cydonia vulgaris</i> Pres	Apple	<i>Malus × domestica</i>	Strawberry tree	<i>Arbutus andrachna</i> L.
Pear	<i>Pyrus communis</i> L.	Plum	<i>Prunus domestica</i> L.	Cherry laurel	<i>Prunus lauricerasus</i> L.
Wild pear	<i>Pyrus elaeagnifolia</i> Pall.	Hazelnut	<i>Corylus avellana</i> L.	Carob tree	<i>Ceretonia siliqua</i> L.
Hawthorn	<i>Crataegus azarolus</i> L.	Oleaster	<i>Elaeagnus orientalis</i> L.	Medlar	<i>Mespilus germanica</i> L.
Pistachio	<i>Pistacia vera</i> L.	Fig	<i>Ficus carica</i> L.	Terebinth	<i>Pistacia terebinthus</i> L.
Almond	<i>Amygdalus communis</i> L.	Mahlep	<i>Prunus mahaleb</i> L.	Pomegranate	<i>Punica granatum</i> L.
Walnut	<i>Juglans regia</i> L.	Sweet cherry	<i>Prunus avium</i> L.	Olive	<i>Olea europea</i> L.
Blackthorn	<i>Prunus spinosa</i> L.	Cornelian cherry	<i>Cornus mas</i> L.	Jujube	<i>Ziziphus vulgaris</i> L.
Service tree	<i>Sorbus aucuparia</i> L.	Chestnut	<i>Castanea sativa</i> Mill	Sour cherry	<i>Prunus cerasus</i> L.

ries, pears, apples, apricots, almonds, pistachios, plums, peaches, walnuts, mandarin, lemon, orange, pomegranate, strawberries and kiwi. Fruit breeding programs are focusing on fruit quality, productivity, earliness and disease resistance or tolerance. There have been about 20 breeding programs for temperate fruit species established in Turkey since 2000. Most of these have used conventional controlled hybridizations. Furthermore, cultivar development by mutation of some fruit species (e.g. *Citrus* genus, apple, sweet cherry) is still being used. Recently, promising genotypes of sweet cherry ('Burak' and 'Aldamla'), Minneola tangelo, mandarin, lemon and orange derived by mutation have been registered (Table 2).

The majority of breeding projects are funded by the Ministry of Food, Agriculture and Livestock. The Fruit Research Institute (MAREM) is preparing to present some promising pear

genotypes that are resistant to fire blight disease and have high fruit quality (Figure 1). Compared with conventional scion breeding, rootstock breeding has yet to yield results. Nowadays, rootstock breeding programs are underway for peaches, nectarines, apples, pears, almonds and pistachios, all using selection or conventional hybridization approaches.

DNA markers have been found as useful and reliable tools in breeding programs, to shorten the time to commercialization. In resistance breeding studies, early detection of susceptible plants, identification of genes that provide resistance, and genetic mapping have been possible using molecular markers. In particular, molecular methods are used in order to reveal genetic relationships between genotypes after natural collection of plant material. For example, genetic similarity studies have been carried out for sweet

cherry (Demirtaş et al., 2009; Ercişli et al., 2011) walnut (Doğan et al., 2014), hazelnut (Gökırmak et al., 2005), quince (Yüksel et al., 2013) and persimmon genotypes (Güneri, 2005). Marker assisted selection (MAS) and QTL studies have also increased with the development of technology, technical knowledge, and laboratory facilities, for example, SCAR markers have been used to select scab resistant plants (Kaymak et al., 2013) in apple breeding programs.

Short descriptions of some recently released fruit cultivars

'Davraz'

This sweet cherry cultivar was released in 2011 by the Eğirdir Fruit Research Institute. Flowering and harvest times are 3-5 days before the cultivar '0900 Ziraat'. Trees grow upright, and are semi-spreading. Fruit are

■ Table 2. Registered cultivars between 2000 and 2016 (TARİM, 2014).

	Cultivar name
Pistachio	Barak Yıldızı, Tekin, Uygur, Öztürk, Kaşka, Atlı
Almond	Payam 35, Özkarakas 35, Bademli 35, Nurlu 35, Halitbey, Bozkurt
Walnut	Maraş 18, Sütyemez 1, Kaman 1, Diriliş, 15Temmuz, Maraş 12, Oğuzlar 77, Niksar 1, Akça
Hazelnut	Okay 28, Giresun Melezi, Allahverdi
Chestnut	Eryayla, Ünal, Erfelek, Ersinop, Serdar
Japanese plum	Cemre, Algüz, Nazen, Nev, Alyaz, Güney, Emiş
Apricot	Dr. Kaşka, Çağataybey, Çağrıbey, Şahinbey, Alata Yıldızı, Mihralibey, Alkaya, Dilbay
Peach	Emir, Tan
Nectarine	Derin, Naz, Seyhan, Ateş
Cornelian cherry	Yalçınkaya 77, Erolbey 77
Cherry	Davraz, Aldamla, Burak
Rose hip	Yıldız, Gerçekcioğlu
Olive	Yamalak Sarısı, Hayat, Gemlik 21, Gemlik 27
Pear	Akçay 77
Quince	Altın 35, Zeybek 35
Apple	Egem
Loquat	Aykut, Tepe, Demir
Persimmon	Akbulut, Ayder, İrem, Kaplan, Onur, Yeşilırmak, Çoruh 1, Türkay, MKÜ Harbiye, Paşa
Lemon	Eylül, Alata, Gülşen, Uzun, Enter, Erdemli 33, Lamas, Yediveren, BATEM Sarısı, BATEM Pınarı
Tangerine	BATEM Göral, BATEM İncisi, BATEM Yıldızı, Sarıca, Toros Kırmızısı, Seferihisar 35, Ulubelde 35
Orange	BATEM Şekeri, BATEM Fatihi, BATEM Baharı
Medlar	Akçakoca 77
Pomegranate	BATEM Esinnar, BATEM Hicrannar, BATEM Yılmaznar, BATEM Onurnar, Dr Ercan 35, Efenar 35, Kamilbey 35, Tezeren 35
Grape	Özer karası, Tekirdağ sultanı, Güz gülü, Tekirdağ misketi, Bozbey, Altın sultanı, Sultan 1, Manisa sultanı, Sultan 7, Saruhanbey, Özer Beyazı, Cengizbey, Süleymanpaşa Beyazı, Gürnil, Gönülçelen, Emirali, Kebeli, İsmetbey, Pembe 77, Atak 77, Yalova Beyazı, Samancı Çekirdeksizi, Arifbey, Spil karası, Manisa pembesi, Lidya, Ece, Mesir, Rizessi, Rizpem, Ülkemiz, Rizellim, Çeliksi
Strawberry	Ebru, Kaşka, Sevgi, Seyhun, Ceyhun, Orhun, Eren 77, Ata 77, Erenoğlu 77, Hilal 77, Dorukhan 77, Doruk 77, Bolverim 77



■ Figure 1. Promising pear genotypes resistant to fire blight (photos by Gökhan Öztürk).

heart-shaped, large (fruit weight 9.2 g; fruit diameter 26.8 mm), dark in color and have long fruit stems (Figure 2).

‘Tekin’

This pistachio cultivar was selected by the Pistachio Research Institute. It has higher fruit quality and productivity (4.42 kg tree⁻¹) than standard cultivars. Alternate bearing tendency is low. Shell dehiscence is very high (96%). Harvest time is middle of September (Aktuğ Tahtacı and Gözel, 2011) (Figure 3).

‘Altın 35’

This quince cultivar was developed by the Aegean Agricultural Research Institute. Aroma, flesh juiciness, flesh quality, and taste are very good. Fruit color is yellow. Average fruit weight is 350 g and yields are approximately 70 kg tree⁻¹. Trees have low vigor. Harvest season is around 15-20 October (Figure 4).

‘Efenar 35’

This pomegranate cultivar was released by the Aegean Agricultural Research Institute. Trees are moderately vigorous. Fruit ripen in mid-season. Some fruit characteristics are:

fruit skin and seed color are dark red, fruit weight is around 350 g, seeds are fairly soft, fruit juice rate is around 36%, Brix is around 15.3 and yield is approximately 350 kg ha⁻¹ (Figure 5).

‘Batem Fatihi’

This seedless orange cultivar was developed by the Batı Akdeniz Agricultural Research Institute and was registered in 2011. The fruit size is between 299 and 340 g. The skin is quite thin, smooth and easily peelable. Fruit are of excellent eating quality and the cultivar has a high yield. It is a seedless table type cultivar, is very juicy and has good aroma. Fruit are harvested between mid-October and late November (Figure 6).

‘Sarica’

This mandarin was released from the Alata Horticultural Research Institute. Trees are 30% more productive than standard ‘Satsuma’ cultivars. It has regular yield characteristics. The pulp is divided into 11-12 segments with very few seeds. Some fruit characteristics of the cultivar are: fruit weight about 113 g, fruit diameter 66 mm, fruit length 53 mm, skin thickness 3.6 mm, Brix 10.3 and



■ Figure 2. ‘Davraz’ sweet cherry cultivar.

acidity 1.27%. It can generally be harvested in the first week of October (Kafa et al., 2017) (Figure 7).

‘Enter’

This lemon cultivar was obtained by selection from the ‘Interdonato’ cultivar at the Alata Horticultural Research Institute. It is 20% more productive than the standard ‘Interdonato’. It has regular yield. Some fruit characteristics of the cultivar are: weight 152 g, fruit diameter 62 mm, fruit length 88 mm, number of segments 8.8 fruit⁻¹, skin thickness 4.1 mm, number of seeds 9 fruit⁻¹ and acidity 6.47%. It can generally be harvested in the first week of October (Kafa et al., 2017) (Figure 8).



■ Figure 3. ‘Tekin’ pistachio cultivar.



■ Figure 4. ‘Altın 35’ quince cultivar.



■ Figure 5. 'Efenar 35' pomegranate cultivar.



■ Figure 6. 'Batem Fatihi' seedless orange cultivar.



■ Figure 7. 'Sarica' mandarin cultivar.

'Alata Seedless'

This seedless lemon cultivar was obtained by mutation at the Alata Horticultural Research Institute. Fruit are seedless and juicy. Some fruit characteristics are: fruit weight 149 g, fruit diameter 60 mm, fruit length 85 mm, skin thickness: 6.2 mm, number of segments 9.4 and sugar/acidity ratio 0.88 (Kafa and Uysal, 2017) (Figure 9).

Conclusion

Plant breeding requires a large investment in terms of technology and equipment. Research and development may take years, and success is not guaranteed. Research infrastructure and knowledgeable researchers, as well as species richness, make it possible to obtain new improved scion and rootstock cultivars. In the last 15-20 years, advanced techniques in hybridization breeding methods (tissue culture and molecular



■ Figure 8. 'Enter' lemon cultivar.



■ Figure 9. 'Alata' seedless lemon cultivar.

methods) and different breeding objectives have been successfully used. Nowadays, more than 20 fruit species are being actively bred in formal breeding programs in Turkey. Although the primary objective of these programs is to develop new scion cultivars, rootstock breeding programs in apple, pear, plum and sour cherry are gaining speed. Rootstock and scion breeding objectives are evolving

with changing consumer demands, but their goals also continue to be shaped by agricultural and environmental policies.

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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



De Pascale, S., Inglese, P., and Tagliavini, M., eds. (2018). *Harvesting the Sun Italy* (Firenze, Italy: Società di Ortoflorofrutticoltura Italiana), pp.87. ISBN 978-88-940276-5-5. €25. http://www.soihs.it/pubblicazioni/harvesting_the_sun.aspx

“Harvesting the Sun Italy”, a title that reminds us of the ISHS book “Harvesting the Sun – A Profile of World Horticulture” published as *Scripta Horticulturae* 14 in 2012 (<https://www.ishs.org/scripta-horticulturae/harvesting-sun-profile-world-horticulture/>), draws a profile of Italian horticulture for an international audience: from the field production to the huge agrobiodiversity that derives from its long tradition and from the variety of different cultural environments, to its role in shaping the landscape of the Italian Peninsula, to the postharvest supply chain, to the people that make it possible, to its contribution for human wellbeing, to future scenarios that have their roots in the past. The book ends with a chapter that summarizes the history and the main activities of the Italian Society for Horticultural Science (SOI), that since its foundation in 1953 has been one of the most active national horticultural societies worldwide. The book wishes to honour this tradition as well as underline the role of the innovation in making Italian horticulture an important asset for the national agricultural sector. Italy holds a treasure in

terms of biodiversity, tradition, and historical landscapes, which cohabit with technological innovations. There is no single village in the country that doesn't have a peculiar agricultural or food tradition, and horticultural products are at the heart of the renowned Italian gastronomy. The book is the result of a cooperative effort of a team of scientists and members of SOI, who have provided their voluntary contributions. *Harvesting the Sun Italy* is a publication of the Italian Society for Horticultural Science. The book, edited by S. De Pascale, P. Inglese and M. Tagliavini, was written under the aegis of ISHS and includes a Foreword by ISHS. The volume (approx. 100 pages) is freely available online at http://www.soihs.it/pubblicazioni/harvesting_the_sun.aspx. A printed copy (25 Euro) can be ordered by writing to segreteria@soihs.org.

*Reviewed by Massimo Tagliavini,
President of SOI*

> 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

Postharvest Technology course, 9-12 October 2018, Wageningen, The Netherlands. Info: Monique Tulp MSc, Wageningen Academy, The Netherlands, phone: +31 317 48 22 98, e-mail: monique.tulp@wur.nl, web: <http://bit.ly/21zQXrK>

1st Workshop on Metrology for Agriculture and Forestry, 1-2 October 2018, Ancona, Italy. Info: Janet L. Dubbini, A.IVE.LA., c/o DIISM, Polytechnic University of Marche, via Breccie Bianche, 60131 Ancona, Italy, e-mail: secretariat@metroagrifor.org, web: www.metroagrifor.org



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Symposia and
Workshops

> IX International Congress on Cactus Pear and Cochineal

Section Nuts and Mediterranean Climate Fruits

#ishs_senu

The Faculty for Agricultural Sciences, University of Chile, organized the IX International Congress on Cactus Pear and Cochineal (26th-30th March 2017, Coquimbo, Chile) of Section Nuts and Mediterranean Climate Fruits and Working Group Cactus Pear and Cochineal of the International Society for Horticultural Science (ISHS) and hosted the General Meeting of the FAO-ICARDA International Cooperation Network on Cactus Pear and Cochineal (FAO-ICARDA CACTUSNET). The scope of the congress was “CAM crops for a hotter and drier world” (<http://www.cactus-congress2017.uchile.cl/>).

Ninety-four researchers and producers from 29 countries attended the congress and 111 abstracts were selected to be presented orally or as posters.

Sponsors and funding agents were Aguas Río Cristal; Fundación Facultad de Ciencias Agronómicas de la Universidad de Chile; Vicerrectoría de Investigación y Desarrollo, Universidad de Chile; Food and Agriculture Organization of the United Nations (FAO); International Society for Horticultural Science (ISHS); International Center for Agricultural Research in the Dry Areas (ICARDA); and Foundation for Agricultural Innovation (FIA) of the Chilean Ministry for Agriculture.

The invited speakers were Dr. P. Nobel (University of California, Los Angeles, USA), C. Mondragón (Universidad Autónoma de Queré-
taro, Mexico), A. Nefzaoui (ICARDA, Tunisia), R. Stewart (Brigham Young University, USA), N. Tel-Zur (Ben-Gurion University of the Negev, Israel), P. Inglese (Università degli Studi di Palermo, Italy), P. Robert (Universidad de Chile, Chile), M. Nazareno (Universidad Nacional de Santiago del Estero, Argentina), and H. Ben Salem (ICARDA, Tunisia). The topics covered by the invited speakers were: CAM metabolism: advantages for a hotter and drier world (Prof. Nobel); Functional properties: actu-



> Participants of the congress.

al frontier of native and improved cactus pear germplasm (Dr. Mondragón); Cacti as an adaptation option for livestock feeding under changing climate in the dry areas (Dr. Nefzaoui); Exploring the possibility of photosynthetic plasticity in agave *sensu lato* (Prof. Ryan); Pitahayas – exotic species thriving in extreme desert conditions: challenges in developing a new crop (Prof. Tel-Zur); Cactus fruit production: where are we and where are we going to? (Prof. Inglese); Cactus pear betalains as a source for coloring foods (Dr. Robert); Recent advances in medicinal and nutraceutical properties of cactus products (Prof. Nazareno); and Integration of cactus in livestock production systems and reduction of their water foot print – a climate-smart intervention (Dr. Ben-Salem).

In this congress we noted that in the last twenty years, the research on cactus crops and their utilization has significantly increased. Cacti can help climate change, can be part of the diet of many people in developed countries and poor areas, and can also be used as a forage crop. The important work done by FAO and ICARDA among other institutions needs to be increased as well as the cooperation between researchers and producers to help many people escape from poverty.



> Authors of the FAO technical paper “Agroecology, cultivation and uses of cactus pear (*Opuntia* sp. pl.)” during the congress.



► Makiko Taguchi (FAO) presenting the ISHS young minds awards to A) Albie Du Toit for the best oral presentation, and B) Meriam Nefzaoui for the best poster.

Launching of FAO book and tribute to Prof. Enza Chessa

The 2nd edition of the FAO technical paper “Agroecology, cultivation and uses of cactus pear (*Opuntia* sp. pl.)” was launched (<http://www.fao.org/3/a-i7012e.pdf>). Authors from different countries contributed to the book with their experience and research: Argentina, Italy, Germany, Chile, Mexico, South Africa, United States, Tunisia, and Jordan. The book was dedicated to Prof. Enza Chessa from the University of Sassari, who passed away in 2015. Prof. Chessa was a great researcher on cactus pear and active member of Cactusnet. Prof. Paolo Inglese, General Coordinator of Cactusnet, and Dr. Judith Ochoa, Fruit Production Coordinator, both very good friends of Prof. Chessa,

spoke from the heart, and gave a bibliographical sketch of her and her contribution to Cactusnet.

Other activities developed during the event

- A workshop on geographic distribution of *Opuntia*, chaired by Makiko Taguchi (AGPM, FAO, Rome, Italy), was carried out. Miss Taguchi gave a presentation entitled “Use of GIS for zoning of *Opuntia ficus-indica* production areas”, which set the scene for the subsequent discussions.
- An open discussion took place about the status of genetic resources and their conservation and about the current status of cochineal in several countries, with special focus on the African region.

- Participants visited a commercial orchard for fruit production in Pan de Azúcar, Elqui Valley; the germplasm bank of Copao (*Eulychnia acida* Phil.) at the Experimental Station of the Institute of Agricultural Research (INIA) belonging to the Ministry of Agriculture in Vicuña; and pilot plots of different genotypes of cactus pear, pitaya, figs and pomegranate. The participants were able to compare the agricultural situation with that of their own countries.

Cactusnet General Meeting

The FAO-ICARDA CactusNet General Meeting took place, where Prof. Carmen Sáenz from the University of Chile was elected as the new General Coordinator of CactusNet. Other members of the International Steering Committee (ISC) of CactusNet elected were Dr. Maryna de Wit (University of Bloemfontein, South Africa) as Coordinator of the Agroindustries; Dr. José Dubeux (North Florida Research and Education Center, USA) as Forage Protection Coordinator; and Dr. Hichem Ben Salem (Institution of Agricultural Research & Higher Education (IRESA), Tunisia) as Mediterranean Coordinator. Dr. Nicolás Franck was elected as Chair of ISHS Working Group Cactus Pear and Cochineal. We regret to report that Dr. Franck passed away suddenly in October 2017. Dr. Prat Loreto has since been nominated as interim Chair of the Working Group.

After analyzing several proposals for the next congress, the General Meeting selected Tunisia for holding the X International Congress on Cactus Pear and Cochineal in 2020. Dr. Hichem Ben Salem, Director General, IRESA, Tunisia, will coordinate the logistics for the next congress.

Awards

Miss Makiko Taguchi from FAO presented ISHS young minds awards to Albie Du Toit from the University of the Free State, South Africa, for the best oral presentation entitled “Cactus pear mucilage: functional properties” and to Meriam Nefzaoui from the Federal Rural University of Pernambuco, Brazil, for the best poster entitled “Morphological characterization of cactus pear (*Opuntia ficus-indica*) accessions from the collection held at Agadir, Morocco”.

Carmen Saenz and Loreto Prat



► Copao plants at INIA.

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➤ IV International Symposium on Pomegranate and Minor Mediterranean Fruits

Section Nuts and Mediterranean Climate Fruits

#ishs_senu

The IV International Symposium on Pomegranate and Minor Mediterranean Fruits was held in Elche (Alicante), Spain, from 18-22 September 2017, under the aegis of the International Society for Horticultural Science (ISHS). The Experimental Station of Elche along with the Instituto Valenciano de Investigaciones Agrarias (Valencian Institute of Agricultural Research) organized the symposium in collaboration with the Elche City Council and DOP Granada Mollar de Elche.

Pomegranate is becoming an emerging fruit in the international market sales. This fruit is reaching higher export quantities and increasing consumer demands. The recent production trend is confirmed by the increase of tons produced, currently more than 3 million, of which 90% is grown in three countries: Iran, India and China. Production of the crop is expanding, in Mediterranean countries like Italy, Greece and Croatia, and in countries from the southern hemisphere like Australia, Chile, Peru and South Africa. In Spain, the exports are increasing, based on a higher demand in Europe as the result of new uses and health benefits of the fruit, which have been described in recent years. The success of the crop in Spain has been the combination of the introduction of new cultivars along with the continuation of

traditional cultivars, in which fruit quality has been the main feature, e.g. 'Mollar de Elche'. As the crop has expanded around the world, so has the progress in research. One hundred and five experts from India, China, United States, Israel, Italy, Greece, Croatia, Portugal, Albania, Russia, Algeria, Morocco, Pakistan, Turkey, Iran, Australia, South Africa, Peru, Cyprus and Spain participated in this international symposium, reviewing and providing the most recent results obtained on pomegranate. Topics covered were: genetic resources, breeding, orchard management for adaptability to different environmental conditions, pest and disease management in a sustainable context, techniques for improvement of fruit quality, postharvest techniques to improve quality and shelf life and new uses of pomegranate based on its health properties.

Dr. Doron Holland from the Agriculture Research Organization (ARO) of Israel gave a keynote lecture in which he reviewed the latest results on biotechnology applied to the improvement of pomegranate. He stressed the role of new cultivars in the improvement of the crop and presented the new plant material obtained by the ARO. The keynote lecture was followed by oral and poster sessions showing the main results from the

breeding programs carried out in Turkey, Spain and India. The use of molecular markers for diversity studies, and development of markers as SNPs associated to traits of interest, are the new contributions of biotechnology to breeding. Prof. Zhaohe Yuan (Nanjing Forestry University, China) presented the main characteristics of Chinese accessions. More results on cultivar trials were presented by participants from Italy, Croatia, Algeria and Turkey.

The session on Physiology and Biology comprised results from research on fruit components linked to quality, aimed at establishing the correct harvest time. Different orchard practices to increase fruit quality and yield were presented. Water and nutrition management was also discussed in a session aimed at unraveling the effects on yield and fruit quality including chemical components and nutritious attributes of pomegranate. Nutrient content and water management related to physiological disorders was revised, confirming the importance of management of fertigation, which should take into account the cultivar, phenology, and results of foliar analysis. Orchard practices for avoiding fruit cracking were also addressed in this session.



➤ Participants of the symposium.



› Keynote in the breeding session by Dr. Holland from ARO, Israel.



› Technical visit to 'Mollar de Elche' orchard.

In the pests and diseases session, Dr. Lluís Palou from IVIA gave a keynote lecture about pre- and postharvest diseases caused by fungi. Many communications about the disease caused by *Alternaria alternata*, currently one of the most important diseases in pomegranate, were presented. The control of the disease remains unsolved. Effects of different pesticides combined with biological control should be a strategy to be explored in the near future. The postharvest technology session was initiated by Dr. Selma (CEBAS/CSIC), who pointed out the health benefits of pomegranate. More than 20 communications included in this session presented results on the chemical components of pomegranate and their health benefits, in conjunction with techniques to improve the postharvest storage life of this fruit.

Besides pomegranate, some communications related to other minor fruits such as jujube (*Ziziphus jujube* Mill.), pistachio (*Pistacea vera* L.), quince (*Cydonia oblonga* Mill.), myrtle (*Myrtus communis* L.), caper (*Capparis spinosa* L.) and prickly pear (*Opuntia ficus-indica* Mill.) were presented.

At the ISHS business meeting, ISHS young minds awards were presented to M. Emma García Pastor from Universidad Miguel Hernández, Spain, for the best oral presentation entitled "Melatonin: a new tool to increase yield and quality at harvest and to extend postharvest shelf-life of pomegranate" and to Iva Prgomet from the Centre for the Research and Technology of Agro-Environmental and Biological Sciences, Universidade de Trás-os-Montes e Alto Douro, Portugal, for the best poster entitled "Effects of cold stratification on seed germination of wild grown pomegranate population". It was decided that the V International Symposium on Pomegranate and Minor Mediterranean Fruits will be held in Australia in 2021.

The technical tour included a visit to fields of the main pomegranate cultivars in Spain: 'Mollar' and 'Valenciana'. Participants learnt about the orchard management techniques including some interesting facts on soil, water practices and plant material. The visit allowed participants to learn about the harvesting methods of pomegranate in the region. The participants visited a packing

house belonging to the Cambayas Coop. V., the first exporter in Spain. The visit finished in a factory of juices and the museum of Vitalgrana in Catral.

A technical workshop was organized in which prominent technicians from the pomegranate industry met to discuss the main challenges. Dr. Erik Wilkings explained the pomegranate practices in California. Dr. David Ezra explained the identification and strategies for control of *Alternaria* carried out in Israel. Dr. Ashen I. Ozguven from Turkey pointed out causes and potential solutions for fruit cracking. Finally, Dr. Julian Bartual reviewed the variables to be taken into account in order to achieve optimum harvesting of pomegranate. The workshop had an audience of 300 people including growers, researchers and experts on the crop. Finally, a round table, participated by Dan Rymon (Israel), Robert Salazar (Peru), Angel del Pino (ANECOOP), Dr. Angel Carbonell (UMH) and Francisco Oliva (DOP Granada Mollar de Elche), led discussion on the trends and main facts of the pomegranate industry. During the meeting, in the poster room the participants were able to enjoy juices and products made from pomegranate. Companies from the pomegranate industry presented and promoted their products.

Maria L. Badenes and Julian Bartual

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› Francisco Oliva (right), President of the Mollar de Elche D.O.P. (Protected Designation of Origin), presenting the ISHS young minds award for the best oral presentation to M. Emma García Pastor (left).



› Daniel Soler (right), President of the grower association Cambayas Coop. V., presenting the ISHS young minds award for the best poster to Iva Prgomet (left).

➤ VIII International Symposium on Walnut, Cashew and Pecan

Section Nuts and Mediterranean Climate Fruits

#ishs_senu

The latest global gathering of the walnut, cashew and pecan industry took place in Santiago, the capital of Chile, under the aegis of the International Society for Horticultural Science (ISHS). For three days (from November 29th until December 1st, 2017), the world-class event congregated nearly 200 scientists, technical experts and other representatives to participate in the VIII International Symposium on Walnut, Cashew and Pecan. In total, delegates from 15 countries attended (Germany, Argentina, Belgium, Chile, China, Spain, the United States, France, Italy, Japan, Portugal, Turkey, Australia, Mexico and Iran). Everything began three days earlier with field trips, which in the opinion of the organizers were highly beneficial, both from a scientific/productive and a social point of view, as they generated high-level debates filled with knowledge that were livened up by fun conversation and typical Chilean gastronomy. Forty foreign delegates signed up to tour Chilean farms. A number of different production areas were visited, covering different climate and soil conditions, cultivars, plantation spacings, production management options such as irrigation, nutrition, training and pruning, and different plantation

ages, to show the development of the walnut trees. Activities in the Bío-Bío region included the following farming companies: Mackenna, Carper, Huertos del Valle and Rucalhue. The Maule region involved Retiro and Alto Los Olmos. In the region of O'Higgins, a visit took place to the Vista El Volcán farming company, while, finally, in the Metropolitan region, Fiume farming company hosted our delegation.

During the symposium, there were 33 oral and more than 30 poster presentations on genetics and propagation, plant health, production management, pecan/cashew, and the global market of walnut. The following keynote and invited presentations were given:

- “The past, present and future of genetic improvements and propagation in walnut” by Kourosh Vahdati (Iran);



➤ Participants of the symposium.

- “Chilean walnut industry evolution” by Gamalier Lemus (Chile);
- “Root and crown rot diseases of walnut in California: progress and remaining challenges” by Greg Browne (USA);
- “Walnut round table: overview of the global market” by Rafael Bianchini (Chile);
- “A vision of the production and international market of cashew nut in the world” by Fabio de Assis (Brazil);
- “The pecan tree in Brazil” by Edson Ortiz (Brazil);
- “Vision of pecan in America (United States, Mexico, Peru and Argentina)” by Enrique Frusso (Argentina).

ISHS young minds awards were presented to Hijiri Yamagata from the University of Tokyo, Japan, for the best oral presentation entitled “Consecutive monitoring method for pecan orchards with UAV” and to Javiera Morales from Pontificia Universidad Católica de Valparaíso, Chile, for the best poster entitled “Nitrogen source and dose interact with in vitro growth of *Phytophthora cinnamom* and *Phytophthora citrophthora*”.

Chilenut, the organization in charge of representing the host nation, granted a special recognition – the golden walnut – to Gamalier Lemus for his long-standing career as a researcher. His work has made a significant contribution to the development of walnut farming in Chile.

While the multinational event left the participants with only the finest of impressions, including the organization, the quality of the presentations, adherence to the schedule, the choice of locations and poster presentations, it was disappointing to see such a low turnout when it came to cashew posters; there was only one single presentation. Per-



➤ From left to right: Dr. Vittorio Bianchini, Symposium Convener; Dr. Gamalier Lemus, Editor of *Acta Horticulturae* Proceedings of the VIII International Symposium on Walnut, Cashew and Pecan; Dr. Jennifer J. Randall, ISHS representative; Dr. Alvaro Jimenez, Symposium Convener; Dr. Pia Barros, representative of ProChile.



➤ Dr. Alvaro Jimenez, Dr. Gamalier Lemus and Dr. Jennifer J. Randall presenting the ISHS young minds awards to A) Hijiri Yamagata for the best oral presentation, and B) Javiera Morales for the best poster.

haps it would be beneficial to analyze the relevance of the species represented in this activity.

The next symposium will be organized by Spain and France, who presented a joint project to receive the industry specialists in 2021.

Gamalier Lemus

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➤ Visit to a walnut orchard in Rucalhue.

➤ IX International Peach Symposium

Section Pome and Stone Fruits

#ishs_sefr



➤ Participants of the symposium.

The IX International Peach Symposium, held at the Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Romania, between 2 and 6 July 2017, was organized under the auspices of the Romanian Academy, the International Society for Horticultural Science (ISHS) and the Romanian Society of Horticulturists (SRH).

More than 100 top specialists from 19 countries worldwide, from Brazil to Australia and from Poland to South Africa, participated and shared their knowledge and experience during this important event for global peach research and innovation.

Five oral sessions were held on Genetic resources and breeding, genomics; Biotechnology and physiology; Rootstocks and



➤ Prof. Ted DeJong (left), Chair ISHS Section Pome and Stone Fruits, and Prof. Greg Reighard (right), former Chair of ISHS Working Group Peach Culture, presenting the ISHS medal award to Prof. Florin Stănică (center), Convener.



➤ Fruit exhibition.



➤ Prof. Ted DeJong (left), Prof. Florin Stănică (second from left) and Prof. Greg Reighard (right) presenting the ISHS young minds awards to A) Jun Liu for the best oral presentation and B) Isabela Primiano for the best poster.

orchard management; Eco-physiology, pests and diseases; and Fruit quality, postharvest and marketing. There were 39 presentations, while the poster session displayed 49 posters on the same topics.

Even though most of the peach breeding programs are nowadays financed and controlled by private companies, the development and evaluation of the novel genotypes, scion cultivars and rootstocks are generally made by public institutes or research stations. Comprehensive reports on peach scion cultivars and rootstock trials on six continents were presented. A few participants from countries located in the northern peach cultivation areas, expressed concern regarding the recent tendency of releasing new cultivars with low chilling requirements and minimal disease resistance. The need for extending peach cultivation areas was underlined, as well as the introduction of disease and pest tolerant/resistant genotypes, adapted to sustainable and organic production systems.

An important number of papers focused on genome-based strategies for peach breeding and genotyping for resistance, adaptability to stress and fruit quality, including the bio-

synthesis of active compounds; underlining an increased interest in genomics compared with previous symposia.

An overview of the peach industry in the European Union was given, from production to consumption, presenting the current situation, challenges, and some solutions, as well as future tendencies and predicted evolution of the sector. Reports on recent rootstock trials, new orchard floor management technologies, carbon sequestration, water saving irrigation strategies, balanced fertilization, and light spectrum modification using photo-selective hail nets, were just some of the topics discussed during the third session.

A number of aspects related to peach physiology under climate change and extreme conditions, such as drought and high and low temperatures, were presented in correlation with rootstock, cultivar and orchard technologies. Studies on genetic and gene expression responses to several peach diseases, disorders and pests, including peach rust, peach skin bronzing, brown rot and root-knot nematodes, were presented.

The last session focused on non-destructive assessment of fruit harvest maturity and

internal quality using near infrared spectroscopy, detection of chilling related disorders in peach and nectarines along with their biological basis and control strategies, measuring variation of volatile compounds among different commercial cultivars, etc. An interesting innovative marketing approach for new peach cultivar promotion and the impact of policy changes on peach sales were presented.

Beside the poster session, a fruit exhibition was organized, including 136 cultivars and new selections. Peaches and nectarines, along with apricot, sweet cherry and blueberry cultivars were displayed and tasted.

A technical post symposium tour was organized in Dobrogea region with visits to the Constanta Fruit Research Station, several peach and stone fruit farms and the UNESCO Heritage – Danube Delta Biosphere Reserve. Another post symposium tour crossed the Carpathian Mountains and included visits to Peleş Castle, Bran Castle, Braşov, Sighişoara (UNESCO Heritage) and Făgăraş medieval cities.

During the ISHS business meeting, the Convener, Prof. Florin Stănică (University of



➤ **Prunus Breeders Working Group meeting at Pitesti Research Institute for Fruit Growing.**

Agronomic Sciences and Veterinary Medicine of Bucharest), was unanimously elected as the new Chairperson of ISHS Working Group Peach Culture. The next International Peach Symposium will be organized by Prof. George Manganaris (Cyprus) and Prof. Athanassios Molassiotis in Greece in June 2021. The Convener received from Prof. Ted DeJong, Chair of ISHS Section Pome and Stone Fruits, and Prof. Greg Reighard, former Chairperson of ISHS Working Group Peach Culture, the ISHS medal and certificate. Prof. Ted DeJong, Prof. Florin Stănică and Prof. Greg Reighard presented ISHS young minds awards to Jun Liu from the University of Georgia, USA, for the best oral presentation entitled "The effect of fertilization and irrigation treatment on cold hardiness of young peach plants" and to Isabela Primiano from the University of Sao Paulo, Brazil, for the best poster entitled "Effect of chloride-containing fertilizer application on kiwifruit yield, quality, and soil chloride concentration".

During the symposium, an informal meeting of the "Prunus breeders working group" was organized at Pitești-Mărăcineni Research Institute for Fruit Growing. Under the leadership of Ksenija Gasic, several aspects of the international cooperation among the *Prunus* breeders were discussed and the experience



➤ **Post symposium tour – Constanta Fruit Research Station.**

of the European Fruit Research Institutes Network (EUFRIN) Apricot and Peach Working Group initiative was shared. It was decided to create a knowledge platform on www.peach2017.com for common use.

Florin Stănică

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> V International Symposium on Papaya

Section Tropical and Subtropical Fruits

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> Participants of the symposium.

For the first time, the papaya community gathered on the American continent to participate in the V International Symposium on Papaya, which was held on October 24-27, 2017, in the colonial city of Mérida, Yucatán, Mexico, under the aegis of the International Society for Horticultural Science. It was particularly interesting for participants because Mexico and Central America are the center of origin of this species. The symposium was attended by at least 180 participants from at least 15 countries from four continents, including participants from Spain, Switzerland, India, China, Brazil, USA, Canada, Costa Rica, South Africa, and Mexico. Fifteen speakers presented the state of the art of the worldwide research progress in papaya, addressing important topics such as genomics, molecular breeding, disease resistance, tolerance to climatic factors, nutraceutical aspects, and of course some aspects of papaya production, postharvest and export markets. In addition, there were 15 oral presentations and 18 posters.

Keynote speaker Dr. Ray Ming from Illinois University, USA (they sequenced the full genome of papaya in 2008), talked about his recent work on sex chromosomes from papaya. After that, Dr. Dennis Gonsalves from Cornell University, USA (who contributed to saving the papaya industry in Hawaii) gave a fascinating lecture on using a biotechnologi-

cal approach towards combatting the devastating effects of *Papaya ring spot virus* (PRSV) in Hawaii. Then, Dr. Amit Dhingra from Washington State University, USA, reviewed the use of recent precision breeding techniques (such as CRISPR/CAS9) to further understand the response of papaya plants towards biological and climate stress factors. On behalf of Prof. Dr. Sisir Mitra, Chair of ISHS Section Tropical and Subtropical Fruits from India, Dr. Richard Manshardt from Hawaii gave a presentation on papaya breeding for PRSV resistance in India. Prof. Dr. Yves Desjardins, ISHS Board Member from the University of Laval, Canada, reviewed the potential of papaya as a functional food and as a nutraceutical fruit in the tropics. Participants also listened to a lecture by Dr. Patricia Esquivel from the University of Costa Rica, discussing the carotenoids pathway in papaya and its potential as a source of antioxidants. Dr. Patricia Bueno from the University of Espírito Santo, Brazil, discussed the situation of papaya production in Brazil and her latest research findings on another important virus disease of papaya, the *Meleira virus* (sticky disease). Similarly, Dr. Laura Silva from Cinvestav Mexico, gave a review of her recent findings on the response of papaya plants towards PRSV. Dr. Cuauhtemoc Navarro, from Agromod Mexico, gave an overview of the current state of micropropagation as an effi-

cient tool for massive propagation of papaya. Finally, Dr. Jorge Santamaría, Symposium Convener from Centro de Investigación Científica de Yucatán (CICY), Mexico, discussed the use of transcriptomics to identify candidate genes to cope with water deficit stress in papaya.

The community of papaya growers was invited and at least 40 growers attended the symposium. The symposium also had a round



> ISHS Board member Prof. Dr. Yves Desjardins (left) presenting the ISHS medal award to Symposium Convener Dr. Jorge Santamaría (right).



► Humberto Estrella (left), winner of the ISHS young minds award for the best oral presentation.



► Dr. Jorge Santamaría (left) presenting the ISHS young minds award for the best poster to Irene Salinas Romero (right).



► Keynote speakers: A. Dr. Ray Ming, B. Dr. Dennis Gonsalves.

table discussion, where all the actors from the production chain were invited: growers, researchers, exporters, government officers responsible for food safety, etc. The growers expressed what they considered to be the main issues that needed to be investigated in papaya production and fruit quality for export markets. The views from the round table discussion were published in a book entitled “Current situation of the papaya industry” by Jorge Santamaría, Luisa Lopez and Gabriela Herrera (ISBN: 978-607-782-37-7). During the closing ceremony, ISHS young minds awards were presented to Humberto Estrella from CICY, Mexico, for the best oral presentation entitled “Rhizogenesis in in vitro plantlets of *Carica papaya* L.: identification and expression profiling of transcription repressors of response to auxin (AUX/IAA) and auxin response factor (ARFs) genes”, and to Irene Salinas Romero from the University of Almería, Spain, for the best poster entitled “Fruit thinning in ‘BH-65’ and ‘Intenza’ papaya grown in greenhouse”. Finally, Prof. Dr. Yves Desjardins presented an ISHS medal award to Dr. Jorge Santamaría, Symposium Convener. During the symposium dinner, the participants enjoyed the performance of tra-

ditional Yucatecan dances by the Merida’s Folk Ballet.

On the last day of the symposium, all participants had the opportunity to visit a commercial papaya plantation located near the highway Merida-Cancun. At this plantation, “Pamasur”, participants had the opportunity to appreciate the plasticity that papaya plants have, as the soil conditions in that area include very shallow calcareous stony soils, but papaya plants perform very well. On the way back, the participants visited an amazing “Cenote” (underground river) and the world famous Chichen-Itza Mayan Archeological site.

We want to acknowledge the support from CONACYT, the Ministry of Research and Innovation, the Ministry of Rural Development and the Ministry of Economical Development from the Government of Yucatan, the Merida’s City Hall, CICY, Agromod and Pamasur. I would also like to thank the organizing committee and the administration office at CICY, for the detailed planning of the symposium. The VI International Symposium on Papaya will be held in Spain in 2020.

Jorge M. Santamaría

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► Field visit to a local papaya plantation.



➤ VII International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops (SEST2016)

Section Vegetables, Quality Production Systems, Leafy Green and Non-Root Vegetables
Commission Protected Cultivation

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The Tshwane University of Technology (TUT), in collaboration with the University of Pretoria (UP) and the Agricultural Research Council (ARC), hosted the VII International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops (SEST2016). The symposium was hosted under the aegis of the International Society for Horticultural Science (ISHS) for the first time in the African continent, thus it was dubbed the 'Seed Indaba Africa'. 'Indaba' is used amongst the people of southern Africa to refer to a meeting to discuss a serious topic. The Seed Indaba Africa aimed to promote research and other activities related to seed and growing media, biotic and abiotic aspects in seedling growth, transplanting, as well as other practices that could enhance the establishment of a healthy and vigorous crop from seed. The Convener of the symposium, Prof. Puffy Soundy, is the Head of the Department of Crop Sciences, and the Co-convener, Prof. Retha Slabbert, is the Head of the Department of Horticulture at TUT. The symposium was held in the new Plant Science Complex, UP, from 11 to 14 September 2016. The scientific programme started with a welcome by

Prof. Soundy, followed by an opening address by Dr. Edgar Nesamvuni (Deputy Vice-Chancellor Postgraduate Studies, Research & Innovation). Dr. Nesamvuni commended the host partners for working together to bring such a prestigious symposium to South Africa, and challenged them to bring the International Horticultural Congress (IHC), which attracts over 3000 delegates, to Pretoria since there are plans for an International Conference Centre for the city of Tshwane in the near future.

The scientific programme ran over three days with various scientific sessions, and had 50 oral and poster presentations from 12 countries, which covered a wide range of topics on seed and technology issues to encompass international priorities and aims. The sessions included talks by four keynote speakers. Dr. Guro Brodal, a Senior Researcher in Plant Pathology at the Norwegian Institute of Bioeconomy Research (NIBIO), Norway, gave a presentation on the Svalbard Global Seed Vault and 100 years seed storage experiment. Prof. Reyes Blanco, Professor at the University of Almeria, Spain, presented on *Fusarium* seed-borne pathogens in

agricultural crops. Prof. Ron Walcott, Professor in the Department of Plant Pathology at the University of Georgia, USA, presented on Advanced molecular tools for seed health testing: challenges and opportunities. Prof. Daniel Leskovar, Professor in Vegetable Physiology and Director at the Texas A&M AgriLife Research Center, Uvalde, Texas, USA, presented on Root/shoot growth modulation of vegetable transplants. The three days were followed by an excursion to Sakata Seed Company in Lanseria, and to the Sittigs Nursery in Hartbeespoort Dam.

The programme was concluded with a gala dinner at the Zoological Gardens. At the gala dinner, ISHS young minds awards were presented to Ms. Zelda Pieterse, PhD student from UP under the supervision of Prof. Terry Aveling, for the best oral presentation entitled "Fungi associated with *Aizoaceae* seed in the succulent karoo", and to Ms. Jennifer Koen, Doctor Technologiae student at TUT under the supervision of Prof. Retha Slabbert, for the best poster entitled "Exploring aspects of honeybush (*Cyclopia* spp.) seed germination". Prof. Daniel Leskovar, Chair of ISHS Section Vegetables, Quality Production



➤ Participants of the symposium.



➤ Convener and keynote speakers. From left to right: Prof. Ron Walcott, Dr. Guro Brodal, Prof. Puffy Soundy, Prof. Reyes Blanco and Prof. Daniel Leskovar.

Systems, Leafy Green and Non-Root Vegetables, presented Prof. Puffy Soundy with an ISHS Medal, in recognition of his meritorious service to the Society as Convener of SEST2016 in South Africa.

The VIII International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops (SEST2018) will be held at the XXX International Horticultural Congress in Istanbul, Turkey, on 12-16 August 2018.

Puffy Soundy

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➤ Prof. Leskovar and Prof. Soundy presenting the ISHS young minds awards to A) Zelda Pieterse for the best oral presentation and B) Jennifer Koen for the best poster.

➤ VII International Symposium on Production and Establishment of Micropropagated Plants

Commission Molecular Biology and In Vitro Culture
Commission Protected Cultivation
Section Ornamental Plants

#ishs_cmmv
#ishs_cmpe
#ishs_seop

The VII International Symposium on Production and Establishment of Micropropagated Plants (PEMP Brazil) was held under the aegis of the ISHS at the Federal University of Lavras (UFLA), Brazil, from 24 to 28 April, 2017. PEMP Brazil was partially financed by the Brazilian Council of Scientific and Technological Development (CNPq) and the Minas Gerais State Research Foundation (FAPEMIG). This was the first time that PEMP had taken place in the southern hemisphere, turning Brazil into the pioneer country in South America to host one of the most important world scientific events in the area of in vitro plant propagation. The symposium promoted an interaction between the scientific, academic and commercial sectors, gathering 96 participants from 24 countries around the world in order to share experiences and knowledge related to in vitro propagation techniques. At the opening ceremony, Dr. Renato Paiva (Convener) shared his happiness in hosting outstanding researchers from all continents to attend PEMP Brazil. The words of Dr. Maurizio Lambardi, Chair of ISHS Commission

Molecular Biology and In Vitro Culture, created a scientific atmosphere for the upcoming symposium activities. Starting the presentations, Dr. Luiz Roberto Guimarães Guilherme (UFLA) presented the challenges and opportunities for sustainable agriculture in Brazil, showing the contributions of plant tissue culture in its development. Past and present advances in micropropagation was brilliantly presented by Dr. Paul E. Read (University of Nebraska-Lincoln, USA), showing that the future is even more promising.

Scientific contributions consisted of invited lectures and oral and poster presentations. The contributions were grouped into four different sessions: "Micropropagation of tropical plants", chaired by Dr. Miguel Pedro Guerra (Federal University of Santa Catarina, Brazil) and Dr. Pablo Jourdan (The Ohio State University, USA); "Micropropagation techniques: new knowledge", chaired by Dr. Paul E. Read (University of Nebraska-Lincoln, USA), Dr. Maria Antonietta Germanà (University of Palermo, Italy) and Dr. Margareta Welander (Swedish University of Agricultural Scienc-

es, Sweden); "Technologies, innovations and applications", chaired by Dr. Jorge Manuel Pataca Leal Canhoto (University of Coimbra, Portugal); and "Challenges of large-scale production", chaired by Dr. Wagner Campos Otoni (Federal University of Viçosa, Brazil). The outstanding presentations created interesting discussions after each oral and poster contribution.

Passionate scientific discussions between young and senior researchers continued well beyond the time of the official symposium sessions, and were stimulated by the beautiful location, local food products and by the friendly and relaxing atmosphere created by the symposium.

The ISHS young minds award ceremony was coordinated by Dr. Maurizio Lambardi and Dr. Renato Paiva. The best oral presentation, entitled "Somatic embryogenesis from oil palm zygotic embryos: the impact of medium components and culture conditions", was awarded to Sylvie Weckx from Belgium, and the best poster, entitled "Somatic embryogenesis from mature zygotic embryos of *Pas-*

siflora ligularis Juss” was awarded to Débora de Oliveira Prudente from Brazil.

As a technical tour, the participants had the opportunity to attend a guided visit to Bioplanta Tecnologia Vegetal Ltda, the largest Brazilian biofactory of commercially micropropagated plants, and to Multiplanta, which specializes in the production of banana and strawberry plantlets and potato seed tubers.

The participants also had the opportunity to visit the Minas Gerais state countryside to see a traditional coffee farm and taste the high quality coffee produced at the Capetinga farm, known as Café Origem. Capetinga is also known as one of the pioneer Minas Gerais state coffee farms to produce wine.

Our expectations were far exceeded, much of which was due to the outstanding group of participants that came from all continents around the world. We are confident that PEMP Brazil has contributed to establishing and fostering trusting relationships among the participants, as well as helping to turn this ISHS symposium into one of the most important world scientific events in the area of in vitro plant propagation.

The 8th edition of the symposium will be organized by Dr. Jorge Manuel Pataca Leal Canhoto at the University of Coimbra, Portugal, in 2020. We look forward to meeting all of you in Coimbra.

Renato Paiva, Diogo Pedrosa Corrêa da Silva and Michele Valquíria dos Reis



➤ Keynote speaker Dr. Luiz Roberto Guimarães Guilherme.



➤ Local organizing team.



➤ Maurizio Lambardi (left) and Renato Paiva (right) presenting the ISHS young minds awards to A) Sylvie Weckx for the best oral presentation, and B) Débora de Oliveira Prudente for the best poster.



➤ Participants at Multiplanta biofactory.



➤ Participants of the symposium.

➤ Contact

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› International Symposium on Growing Media, Soilless Cultivation, and Compost Utilization in Horticulture

Commission Plant Substrates and Soilless Culture

Commission Organic Horticulture

Commission Protected Cultivation

Section Vegetables, Quality Production Systems,
Leafy Green and Non-Root Vegetables

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

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#ishs_cmor

#ishs_cmpc

#ishs_sevq

#ishs_sevr

The International Symposium on Growing Media, Soilless Cultivation, and Compost Utilization in Horticulture was convened in Portland, Oregon, USA from 20-25 August, 2017. Members of the ISHS Commissions Organic Horticulture, Plant Substrates and Soilless Culture, and Protected Cultivation were well represented. At this symposium, there were 150 attendees present from 21 countries representing the Growing Media, Substrate Analysis, Hydroponics and Aquaponics, and Composting for Horticultural Applications Working Groups within ISHS.

With the ever-increasing production of ornamental, edible, medicinal, and recreational crops in controlled environments, the need for specialized substrates will only increase in the years and decades ahead. Scientists and industry professionals from around the world joined in a unified agreement and belief that our industry must continue to evolve to meet the ever-growing needs of our ever-changing industry. Substrates are now being designed, engineered, constructed, and utilized like never before in the history of container substrate production. It is the goal, challenge, and livelihood of members

of the participating groups and industries to continue meeting the needs of the horticultural industry.

In addition to tours of botanical gardens, greenhouses, nurseries, and substrate producers in the Portland area, this symposium had over 60 oral and 40 posters presentations covering a broad range of topics related to substrate science. The North American and European growing media industries were well represented with numerous peat producers present, as well as growing media manufacturers, hydroponic product/system distributors, fertilizer companies, compost



› Participants of the symposium.



► Convener Brian E. Jackson (left) presenting the ISHS young minds awards to A) Paul Bartley for the best oral presentation and B) Joshua Henry for the best poster.

companies, plant/soil analytical companies, private consultants, coconut coir distributors, wood fiber manufacturers, and academic researchers. The support from the North American and European industries, both in sponsorships and participation, was outstanding and with their support, the symposium was considered by all to be a tremendous success.

One of the great successes of this symposium was the active participation of graduate students from around the world. Oral and poster presentations from graduate students filled the first day of the scientific session and later in the week during the symposium business meeting the first, second, and third place winners in each category were presented with plaques. ISHS young minds awards were presented to Paul Bartley from NC State University, USA, for the best oral presentation entitled “3-Dimensional characterization of substrates with X-ray microtomography” and to Joshua Henry from NC State University for

the best poster entitled “Redefining phosphorus nutrition and deficiency symptomology for ornamentals grown in soilless substrates”. The delegates present at the symposium were in great support of continued efforts to encourage graduate students and other young professionals to attend future symposia with ideas of scholarships or travel grants being a potential way of supporting this initiative.

In addition to a near total eclipse on 21 August in Portland, there were many topics of primary and frequent discussions, including: 1) the world-wide revolution of wood fiber usage in growing media, 2) the emerging *Cannabis* industry and its growing media needs and opportunities, 3) the debate of growing media regulations and standards, 4) the role of biological additives to growing media, 5) the future of composting and compost systems, 6) raw material sourcing and processing, 7) environmental and governmental regulations, 8) microbiology of organ-

ic substrates, 9) substrate induced nutrient relations and deficiencies, and 10) substrate hydrology and water capture for maximum crop efficiency. Also discussed during many sessions (formally and informally) was carbon footprint/sequestration of substrates and substrate materials, and end-of-life reuse and recycling of substrate materials.

Brian E. Jackson

►Contact

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► Visit to Phillips Soil Products, a state-of-the-art substrate manufacturer and distributor in the Pacific Northwest, USA.

➤ VI International Conference Postharvest Unlimited

Commission Quality and Postharvest Horticulture
Section Ornamental Plants
Section Tropical and Subtropical Fruits

#ishs_cmph
#ishs_seop
#ishs_sets



➤ Participants of the conference.

The VI International Conference Postharvest Unlimited was held in Madrid (Spain) from 17-20 October 2017 during Fruit Attraction, one of the most prestigious fresh produce exhibitions in Europe. The conference organization was a joint initiative of the Departments of Food Science of University Miguel Hernández (Alicante, Spain) and CEBAS-CSIC (Murcia, Spain) under the auspices of the International Society for Horticultural Science (ISHS). Previous conferences took place in Leuven (2001), Sydney (2004), Berlin (2008), Seattle (2011) and Cyprus (2014). The conference was attended by about 250 delegates and accompanying persons from 45 countries, making the meeting a truly international initiative. Delegates came from Spain

(78), United Kingdom (14), Italy (12), USA (11), The Netherlands (10), South Korea (10), Belgium (9), Brazil (8), Australia (8), Israel (6), Germany (5), Japan (5) and New Zealand (5). The conference website (<http://www.postharvest-unlimited2017.org>) received approx. 10,000 visits from over 32 countries. The conference aimed to facilitate communication and discussion related to all aspects of postharvest, from breeding, to production, postharvest handling, storage and distribution. The conference provided the opportunity for scientists, professionals and students to present their latest findings and promoted the exchange of ideas. There were many opportunities to establish new links of collaboration among participants

who addressed different disciplines with a common interest in postharvest science. The scientific program included 10 plenary lectures, 96 oral presentations and 140 e-poster displays, with the e-poster presenters giving a 5-min oral presentation that provided discussion and promoted scientific dialogues among participants on fundamental research and postharvest implications.

Session 1 “Postharvest research and industry implications” was chaired by Chris Watkins, Chair of ISHS Commission Quality and Postharvest Horticulture, and started with keynote speaker Maria Isabel Gil (CEBAS-CSIC, Spain), who presented some examples in which postharvest scientists and industry have collaborated in different topics from production to consumption.

In Session 2 “Flowers: senescence and preservative solutions” the group by Verdonk et al. from the Netherlands explained the effect of air humidity and postharvest treatments on vase life of *Bouvardia* and the group by Trivellini et al. from Italy presented the results on the effect that ethylene and ABA interplay in the regulation of petunia petal senescence.

In Session 3 “Postharvest physiology”, Bart Nicolaï, as a keynote speaker from the University of Leuven in Belgium, presented a talk on the systems biology approach that links genetic and environmental responses and identifies the underlying biological networks.

Session 4 “Physiological disorders” was chaired by Carmen Merodio from ICTAN-CSIC (Spain) and started with keynote speaker Lorenzo Zacarias from IATA-CSIC (Spain) on the physiological disorders of fruit as an important cause of increased postharvest losses.

During the first part of Session 5, entitled “Bioactives after harvest”, many aspects of postharvest changes in bioactive molecules were introduced. Keynote speaker Yves Desjardins, from Laval University (Canada), opened the session with a very well received talk about the popular perception of polyphenols as ‘dietary antioxidants’.

The first part of Session 6 “Fresh produce supply chain: innovations to reduce postharvest losses” was chaired by Mustafa Erkan



► Organizing Committee.

from Akdeniz University (Turkey) and Fabián Guillén from University Miguel Hernández (Alicante, Spain). In this session, John Golding from Gosford Horticultural Institute in Australia talked about several technologies and commercial practices and Leon Terry from Cranfield University (United Kingdom), focused on innovations to reduce postharvest losses.

Session 7 “Postharvest and plant microbiota: from safety to biocontrol” was chaired by Jim Monaghan from Harper Adams University (Newport, United Kingdom). The session opened with a keynote presentation by Trevor Suslow (UC Davis), who gave an overview of microbiome studies in horticultural research. There was a particular focus on postharvest studies of food safety and spoilage processes.

The first part of Session 8, “Pre-harvest condition, harvest maturity and postharvest performance”, was chaired by Marita Cantwell from UC Davis (USA). Peter Toivonen, from the Pacific Agri-Food Research Centre in Canada, presented the relation between pre-harvest conditions, harvest maturity and postharvest performance.

In Session 9, “Postharvest technologies: CA storage, MA packaging and ethylene management”, Giancarlo Colelli, from University of Foggia (Italy), chaired the first part in which the effect of low oxygen stress in apple fruits using fluxomics was presented by Maarten Hertog (Belgium). In the second part of this session, chaired by Allan Woolf (Plant & Food Research, New Zealand), Randy Beaudry (Michigan State University, USA) gave an interesting talk on CA storage, MA packaging, and ethylene management as postharvest technologies. He focused his presentation on the basic concept of why we use low O_2 , how it works to suppress ethylene action, when it fails, how the respiratory suppression is really valuable and what the modes of action are by which CO_2 inhibits degreening, ethylene action, and decay.

In Session 10, “Metabolomics for quality”, chaired by Francisco Tomás-Barberán (CEBAS-CSIC, Spain), keynote speaker Thomas Hofmann (Technische Universität München,

Germany) described the sensomics approach for the objectifying postharvest sensory quality of fruits and vegetables.

A large number of posters were presented in all the sessions. Overall, both oral and poster presentations were very stimulating with the speakers giving excellent presentations, addressing a wide range of topics. ISHS young minds awards were presented to PhD students Maria Emma Garcia Pastor (University Miguel Hernández, Spain) for the best oral presentation entitled “Melatonin: a new tool for preserving table grape quality and enhancing bioactive compounds during storage” and Hector Calvo Crespo (Universidad de Zaragoza, Spain) for the best poster entitled “Growth, lipopeptide production and biocontrol efficacy against *Botrytis cinerea* and *Monilinia fructicola* of *Bacillus amyloliquefaciens* BUZ-14 cultured in low cost media”. The Conveners would like to thank the sponsors (Citrosol, Bayer, AgroFresh and Rijk Zwaan) for partially supporting this event and the Conference Secretariat (congresos@verticesur.es) for the effort organizing the registration and the logistics of the conference. Thanks are also given to the Chair of ISHS Commission Quality and Postharvest Horticulture, Christopher Watkins, and the chairpersons of the conference, Carmen Merodio, Manuel Serradilla, Julian Heyes, Mustafa Erkan, Jim Monaghan, Fabián Guillén, Lluís Palou and Maria B. Pérez-Gago, for their contribution to this article, providing their summaries for their respective sessions.

Finally, the next edition of the International Conference Postharvest Unlimited will be organized in the Netherlands in by Wageningen University in 2021.

Maria Isabel Gil and Daniel Valero

► Contact

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► Keynote speakers. A) Lorenzo Zacarias from IATA-CSIC (Spain). B) Thomas Hofmann (Technische Universität München, Germany) and session Chair Francisco Tomás-Barberán (CEBAS-CSIC, Spain).



► A) Convener Prof. Daniel Valero (right) presenting the ISHS young minds award to Maria Emma Garcia Pastor (left) for the best oral presentation. B) Convener Dr. Maria Isabel Gil (left) presenting the ISHS young minds award to Hector Calvo Crespo (right) for the best poster.

> New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

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> In memoriam



Dov Pasternak (1940-2018)

Prof. Dov Pasternak, often called “father of the poor of West Africa”, passed away on 27 April 2018. His contribution to Israeli agriculture was immense during his professional career. However, in early 2000 his focus shifted to

West Africa. He started a program called “System and Crop Diversification for the Sahel” operating from the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) Sahelian Center, Sadore, Niamey, Niger. I had the privilege to join his team (early 2007-mid 2011) along with many other colleagues. He was a mentor, leader, friend and a respected elder. I thoroughly enjoyed my tenure working with him and his highly motivated team members from different organizations. He hated poverty, therefore, was dedicated to bringing any technology that had potential to generate income for smallholders and landless women in West African Sahel. Obviously, horticultural crops (high value fruits and vegetables) were his favorite. In addition to crop diversification, Prof. Pasternak was passionate about system diversification, and as a result, the team at ICRISAT, under his leadership, developed and promoted integrated fruit and vegetable production systems, such as the African Market Garden for small scale irrigated gardens, the Sahelian Eco-Farm (SEF) for rain-fed farming, and the Bio-reclamation of Degraded Lands (BDL) that used recuperated

degraded lands for vegetable and fruit production. Identification and promotion of vegetable cultivars adapted to the heat of the Sahel was an integral component of these horticultural production systems. Continuous training for the production of vegetable seeds was aimed to motivate some vegetable growers to start seed production businesses. He adopted the Sadore village women’s association and provided them with improved and locally adapted planting material (both rootstocks and scions) of a number of fruit cultivars (mango, tamarind, ziziphus – Pomme du Sahel, saba, many *Citrus*). The Sadore women’s association members were trained in grafting techniques and helped to develop market linkages for grafted fruit tree seedlings. As a result of his efforts, individual members are independent and earn income by selling thousands of improved grafted plants annually, which are spreading in West African countries. Recently, he extended his experiences to many projects in the Sahel including the promotion of moringa in Niger and Farmers of the Future (FOF). He would frequently share team results in *Chronica Horticulturae* with great passion. Towards the end of last year, Prof. Pasternak authored his last article entitled “Selection and dissemination of vegetable cultivars in the Sahel” (*Chronica Horticulturae* 57 (4), 23–30). We are deeply saddened by his demise, but feel thankful that his last days were spent with the loving family (three daughters and 12 grandchildren). We will miss him dearly, but his legacy and foundation of horticultural development in the Sahel will continue – a real tribute to a great human being dedicated to poverty eradication.

*Sanjeet Kumar, Scientist, Pepper Breeding,
World Vegetable Center, Taiwan*

> Calendar of ISHS events

For updates and extra information go to www.ishs.org and check out the calendar of events. Alternatively use the “science” option from the website navigation menu for a comprehensive list of meetings for each Section, Commission or Working Group.

To claim reduced registration for ISHS members your personal membership number is required when registering - ensure your ISHS membership is current **before** registering. When in doubt sign in to your membership account and check/renew your membership status first: www.actahort.org or www.ishs.org

Year 2018

■ 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): **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@email.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. Pasakavaklari Cad. P.O35, 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): **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): **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): **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 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: evelyne.costes@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): **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): **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): **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): **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): **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 Omer Halisdemir 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): **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): **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): **XI International Symposium on Postharvest Quality of Ornamental Plants.** Info: Prof. Dr. Fisun G. Celikel, 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): **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: kcaglayan@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): **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, Envirotron 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 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 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 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): **International Symposium on Fruit and Vegetables for Processing**. Info: Prof. Dr. Mehmet Ali Koyuncu, Süleyman Demirel University, Agriculture Faculty, Department of Horticulture, 32260 Isparta, Turkey. Phone: (90)246 2118529, Fax: (90)246 2118696, E-mail: koyuncu.ma@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S27.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 Grafschaft-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: vmoshea@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 Plant & Environmental Science, 161 Poole Agricultural Center, Box 340310, Clemson, SC 29634-0310, United States of America. 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 Prosdociimi 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 bolumu, 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 A&M University, 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: yetisir1@erciyes.edu.tr 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, Uludağ 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): **International Symposium on Applied Functional Molecular Biology**. Info: Prof. Dr. Rosario Muleo, Dept.. Crop Production, Università della Toscana, Via S.C. De Lellis snc, Viterbo 01100, Italy. Phone: (39)0761357532, Fax: (39)761357531, E-mail: muleo@unitus.it or Assoc. Prof. Birsan Cakir, Ege University Faculty of Agriculture, Department of Horticulture, Bornova, 35100 3042mir, 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, Fax: (90)2422274564, 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, Fax: (33)467615821, 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 Croylaan 42 bus 2455, 3001 Leuven, Belgium. Phone: (32)16377067, E-mail: i.vandenbergh@cgiar.org E-mail symposium: secretariat@ihc2018.org Web: <http://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, Fax: (1)2087226708, E-mail: efallahi@uidaho.edu or Prof. Dr. Dilek Anac, Kaz305mdirik mahalesi 156 sokak No. 132, Nur Apt. Bornova-3042mir, 35040 Bornova, Turkey. E-mail: dilek.anac@ege.edu.tr or Dr. Alon Ben-Gal, Environmental Physics and Irrigation, Gilat Research Center, Agricultural Research Organization, Mobile Post Negev 2 85280, Israel. Phone: (972)8 9928644, Fax: (972)8 9926485, 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>
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 - August 12-16, 2018, Istanbul (Turkey): **VII International Symposium on Human Health Effects of Fruits and Vegetables - FAVHEALTH2018**. Info: Prof. Dr. Julian Heyes, Inst of Food, Nutrition & Human Health, Massey University, Private Bag 11222, Palmerston North, New Zealand. Phone: (64)63505963, Fax: (64)63517050, E-mail: j.a.heyas@massey.ac.nz or Dr. Trevor George, King's College London, 150 Stamford Street, London, SE1 9NH, United Kingdom. Phone: (44)2078484433, E-mail: trevor.george@kcl.ac.uk or Prof. Dr. Uygün Aksoy, Ege University, Faculty of Agriculture, Department of Horticulture, 35100 Bornova - Izmir, Turkey. Phone: (90)2323884000x2742, Fax: (90) 2323881864, E-mail: uygunaksoy@gmail.com E-mail symposium: secretariat@ihc2018.org Web: <http://www.ihc2018.org/en/S22.html>
 - August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Jackfruit and Other Moraceae**. 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 Grafschaft-Gelsdorf, Germany. Phone: (49)2225-8389895, E-mail: hannah.jaenicke@t-online.de or Prof. Dr. Mustafa Akbulut, Recep Tayyip Erdogan Üniversitesi, 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/S07.html>
 - August 12-16, 2018, Istanbul (Turkey): **II International Symposium on Date Palm**. Info: Dr. Yuval Cohen, Volcani Research Center, Department of Fruit Tree Sciences, Institute of Plant Science, Bet Dagan 50250, Israel. Phone: (972) 3-9683407, Fax: (972) 3-9669583, E-mail: vhyualc@volcani.agri.gov.il 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/S34.html>
 - August 22-22, 2018, Bangkok (Thailand): **International Forum on Horticultural Product Quality (HortiAsia2018)**. Info: Prof. Dr. Errol W. Hewett, Professor of Horticultural Science Emeritus, Institute of Food, Nutrition & Human Health, Massey University - 212/141 Bethlehem Road, Tauranga 3110, New Zealand. Phone: (64)75622672, E-mail: ewmhewett@xtra.co.nz or Dr. Surawit Wannakraioj, Department of Horticulture, Kasetsart University, Bangkok, Thailand. E-mail: agrsuw@ku.ac.th Web: <http://www.horti-asia.com/ishs-forum/>
 - September 9-13, 2018, Heraklion, Crete (Greece): **IX International Symposium on Soil and Substrate Disinfestation**. Info: Eleftherios Tjamos, Agricultural University of Athens, Iera Odos 75, 118 55 Athens, Greece. E-mail: ect@aua.gr E-mail symposium: secretariat@sd2018crete.gr Web: <http://www.sd2018crete.com/>
 - September 19-22, 2018, Krakow (Poland): **II International Symposium on Carrot and Other Apiaceae**. Info: Prof. Dariusz Grzebelus, Institute of Plant Biology and Biotechnolog, Faculty of Biotechnology and Horticulture, University of Agriculture in Krakow, 31-425 Krakow, Poland. Phone: (48)12-6625399, E-mail: d.grzebelus@ogr.ur.krakow.pl E-mail symposium: Carrot-symposium2018@targi.krakow.pl Web: <http://carrot-symposium2018.pl/gb/>
 - October 1-5, 2018, Yalta (Russian Federation): **VIII International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects)**. Info: Prof. Dr. Irina Mitrofanova, Nikita Botanical Gardens, Nikita, 298648, Yalta, Russian Federation. E-mail: irimitrofanova@yandex.ru E-mail symposium: yaltabiotech2018@mail.ru Web: <https://biotech2018.yolasite.com/>
 - October 15-17, 2018, Plovdiv (Bulgaria): **III International Symposium on Horticultural Crop Wild Relatives**. Info: Prof. Stefan Gandev, Fruit Growing Institute, Ostromila 12, 4004 Plovdiv, Bulgaria. Phone: (359)32 69 23 49, E-mail: s.gandev@abv.bg E-mail symposium: symwildfruits2018@abv.bg Web: <http://symposium.fruitgrowinginstitute.com>
 - November 13-16, 2018, Taichung (Chinese Taipei): **International Symposium on Horticultural Therapies: Past, Present and Future**. Info: Dr. Hsueh-Shih Lin, Director, TDAIS, Council of Agriculture, No.370 Song-Hwai Road, 51544 Changhua Tatsuen Village, Chinese Taipei. Phone: (886)48522624, Fax: (886)48521148, E-mail: hshlin@tdais.gov.tw or Prof. Dr. Sheng Jung Ou, 168 Jifeng E. Rd., 41349 Taichung, Chinese Taipei. E-mail: sjou@cyut.edu.tw or Prof. Dr. Chun-Yen Chang, No. 138 Sec. 4, Keelung Road, National Taiwan University, Taipei, 10673, Chinese Taipei. Phone: (886)233664859, Fax: (886)223699085, E-mail: cychmail@ntu.edu.tw E-mail symposium: hortitherapy2018@gmail.com Web: <http://www.2018hortitherapy.com.tw/>
 - December 4-7, 2018, Montevideo (Uruguay): **XIII International Pear Symposium**. Info: Dr. Roberto Zoppolo, INIA, Km. 10 Ruta 48, Rincon del Colorado (Canelones), 90200 Las Piedras, Uruguay. Phone: (598)23677641, Fax: (598)23677609, E-mail: rzoppolo@inia.org.uy or Carlos Danilo Cabrera Bologna, Ruta 48 km 10, Rincón del Colorado, Canelones, Uruguay. Phone: (598) 23677641, E-mail: dcabrera@inia.org.uy E-mail symposium: info@pear2018.uy Web: <https://www.pear2018.uy/>

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