A publication of the International Society for Horticultural Science

Chronica Horticulturae

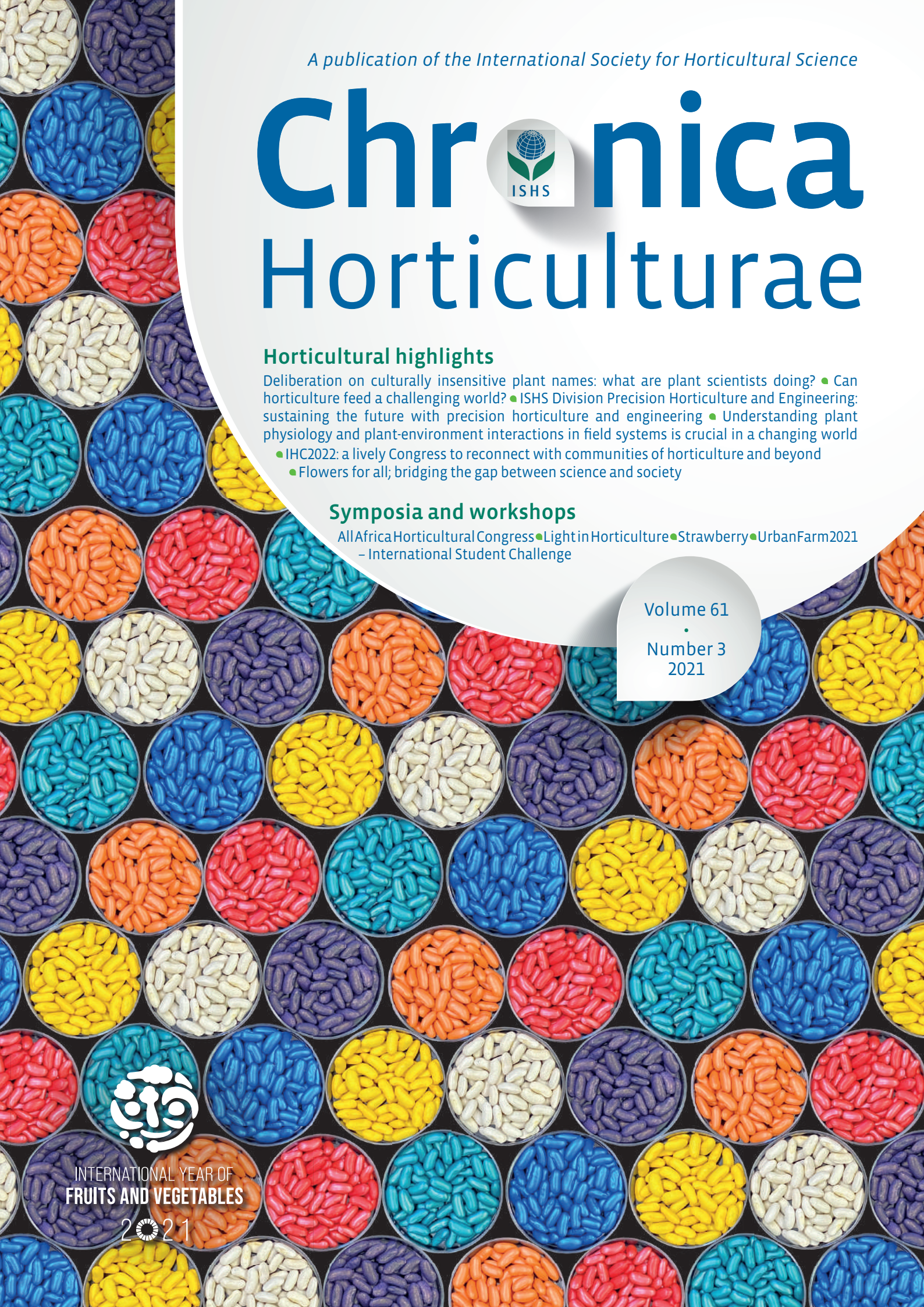
Horticultural highlights

Deliberation on culturally insensitive plant names: what are plant scientists doing? • Can horticulture feed a challenging world? • ISHS Division Precision Horticulture and Engineering: sustaining the future with precision horticulture and engineering • Understanding plant physiology and plant-environment interactions in field systems is crucial in a changing world • IHC2022: a lively Congress to reconnect with communities of horticulture and beyond • Flowers for all; bridging the gap between science and society

Symposia and workshops

All Africa Horticultural Congress • Light in Horticulture • Strawberry • UrbanFarm2021 – International Student Challenge

Volume 61 • Number 3 2021



Chronica Horticulturae

Chronica Horticulturae© Volume 61 – Number 3; September 2021;
ISSN: 0578-039X (print), 2506-9772 (electronic).

Published quarterly by the International Society for Horticultural Science, Leuven, Belgium. Lay-out and printing by Drukkerij Graphius, Gent, Belgium. All previous issues are also available online at www.ishs.org. Contact the ISHS Secretariat for details on full colour advertisements (1/1, 1/2, 1/4 page) and/or mailing list options

Editorial office and contact address:
ISHS Secretariat, PO Box 500, B-3001 Leuven 1, Belgium. Phone: (+32)16229427, Fax: (+32)16229450, E-mail: **info@ishs.org**, Web: **www.ishs.org** or **www.actahort.org**.

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

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

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Pubhort is a service of ISHS as part of its mission to promote and to encourage research in all branches of horticulture, and to efficiently transfer knowledge on a global scale. The PubHort platform aims to provide opportunities not only to ISHS publications but also to other important series of related societies and organizations. The ISHS and its partners welcome their members to use this valuable tool and invite others to share their commitment to our profession. The PubHort eLibrary portal contains over 78,000 downloadable full text scientific articles in pdf format, and includes The Horticulture Journal, Journal of the American Pomological Society, Journal of the International Society for Mushroom Science, Proceedings of the International Plant Propagators' Society, Journal of the Interamerican Society for Tropical Horticulture, etc.
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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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Cover photograph: Bean seeds. Photo by Alan Taylor and Masoume Amirkhani, Cornell AgriTech. See article p.12.

One of the challenges of our time: what can we, as individuals, do?

Jill Stanley, ISHS Vice-President and Scientific Coordinator

› Jill Stanley

In August 2021, the Intergovernmental Panel on Climate Change (IPCC) prepared and delivered a comprehensive assessment report on global climate change (IPCC, 2021). They determined, in clear terms, that a global warming of 1.0°C above pre-industrial levels has occurred. The global surface temperature in July 2021 was the highest for July since records began in 1880 at 0.93°C above the 20th century average (NCEI, 2021). Overall, global temperatures are now higher than at any other time in the past 125,000 years.

Changes in climate, such as temperature and CO_2, will affect crops, both positively and negatively (Bisbis et al., 2019). There is already evidence of climate change affecting horticultural production, e.g., warmer winters affecting winter chill in berry crops (Jones and Brennan, 2009), and earlier grape harvests (The Economist, 2021).

Anthropogenic warming has produced fierce heat waves, heavy rainstorms, and violent cyclones. In the coming decades, hotter heat waves and worse floods and storms are expected. Events that are now considered rare or extreme will be commonplace. The U.N. Secretary-General, António Guterres, pronounced the report as a "code red for humanity." This report is not only sobering but terrifying. The report suggests that we must strengthen the global response to the threat of climate change.

We horticulturists have seen the devastation of these effects close at hand. We have seen years of drought in Australia, throughout Africa, USA (e.g., Alaska, Oregon, California), Canada, Russia, Greece, and Italy (e.g., Sicily), causing issues with domestic water supplies, water stress issues for horticultural crops and horrific wildfires killing forests, wildlife, and humans.

In other areas, flooding is occurring in low elevations including in Belgium, Germany, India, Japan, Thailand, Vietnam, New Zealand, and China, in association with hurricanes, cyclones, tornados, and other wind events. These floods have washed away entire crops in fields or protected structures. They have displaced millions of people from their homes.

Besides fires caused by lightning and other events, the changing jet stream high pressure zones can stagnate and cause "heat domes." These weather domes bring record high temperatures, day and night, for an extended number of days. These events can scorch leaves or flowers on trees and shrubs, halting their development early in the season. The bark of young trees or skin of developing pome or stone fruit that are in the direct rays of the intense afternoon sun can be scalded and burned. In the Pacific Northwestern North America, the leaves on the southwestern or western sides of trees and shrubs were singed by the never-seen-before heat dome of June 2021. During this dome event, chlorophyll was destroyed in many plants and development of plant parts was halted. Whole leafy branches became dried, and fruit shriveled.

While governmental groups are talking about taking the lead to make the difference in this situation, bureaucracy takes a while. The UN report suggests that we are due for global warming for the next three decades at least. In the meantime, some of us wonder what we can do individually to mitigate the effect of global climate change. What choices can we make to live more sustainably and keep the world livable for our children and grandchildren?

Possibilities to contemplate

It would be better for our planet if we humans did not pump any more carbon from below ground. Until governments and those in power make that change, we individuals can help reduce the amount of carbon going into the atmosphere. Sustainable sources of energy will be the positive way of the future. Our individual and collective carbon footprint is measured in tons of carbon dioxide emitted per year, or t CO_2e. You may wish to use an online calculator to estimate your individual carbon footprint. Mossy Earth (2021) has a calculator for this, but there are others on-line as well.

As a reference, an average individual footprint in 2021 is about 16 t in the US, 8 t in Europe and China, and 5 t globally. For the global population to have a reasonable chance of preventing a 2°C rise in global temperatures, the global individual average needs to drop below 2 t per person by 2050.

Several categories of activities affect an individual's carbon footprint including diet, travel, and food waste, and we can choose to make some changes on a personal level. Many of you can contribute to research or technology projects that will have a positive impact, but we could also consider how to contribute within our working environments to reduce our carbon footprint.

Diet

On average diet accounts for about 40% of the total human carbon footprint. Choosing to eat less or consume no beef or dairy products would significantly reduce the total footprint. Diets that are high in vegetables, fruits, and grains, and low in dairy or red meat have a lower carbon footprint. As Poore and Nemeck (2018) determined: "*If every family in the UK swapped a red meat meal to a plant-based meal just once a week, the environmental impact would be the same as taking 16 million cars off the road.*" This fits well with the theme within the International Year of Fruits and Vegetables (http://www.fao.org/fruits-vegetables-2021/en/). As horticultural scientists, we can promote an increase of fruits and vegetables in people's diets.

Travel

Sustainable energy has a low carbon footprint. Commuting by walking, biking, taking public transportation, carpooling, or using hybrid or electric vehicles can be a choice to reduce an individual carbon footprint. Travelling further afield for work contributes to your carbon footprint, so there are alternatives to consider to achieve your goals. When planning a trip, think about using videoconferencing, or commissioning a local person to finish your research activities in that location. Reducing the number of long-distance flights per year will make a difference. When you fly, choose non-stop routes. Fewer take-offs and landings reduce the plane's fuel use. Your greenhouse gas emissions can be offset through a recognized scheme, e.g., one that

plants trees or deploys renewable energy, and some organisations are starting to cover this for employee's travel.

Food waste

Annually, Hegnsholt et al. (2018) estimated that about 1/3 of all the food produced in the world is wasted. Whilst there are only estimates of the food loss along the value chain, we know that the proportion of waste differs depending on the product and the issues within a country or region. We, as part of the community working in horticulture, can make a difference every day by working on enhancing the best practices for reducing the food losses in our region, so that the resources used for growing, processing, packaging, and marketing are directed for the safest and best products. Water, energy, fertilizers, land use, just to name a few, wasted in growing those crops are considerable. As an example, the EU set the goal to reduce 30% of food waste by 2030, and called for projects to tackle the issue from production along the chain. The Horizon Europe funding programme includes emphasis on the reduction of inputs required to produce food. Is there an opportunity to embrace a worldwide dimension to such a goal?

With the future projecting an increase in population growth and fewer resources, we must enhance the efficiency in production ("produce more with less"). In addition to the food loss in the production and supply chain, we need to think to reduce food waste once it reaches the retailers and then the consumers. Research in understanding household food waste has highlighted it is very complex, but these studies can help identify ways to reduce waste by the consumer. Most consumers consider food waste from a social viewpoint, rather than an environmental or economic viewpoint (Gonzalez-Santana et al., 2020). As horticultural scientists, we can play a role in awareness of food waste in topics that are relevant to our own research.

Carbon sequestration

Some of you may be involved in projects that focus on increasing carbon storage in soils or plants. Some companies are setting aside portions of land for long-term tree plantations, and as horticultural scientists, we can encourage this activity, both with our own employers and with those we work with. Such plantations have many benefits besides carbon sequestration, including providing ecosystem services like encouraging biodiversity of flora and fauna.

This article shares a few ideas and suggestions and is by no means comprehensive. You can contribute by making individual changes in your everyday lives. Consider that every positive step that we as individuals do now, could, when taken collectively, be a positive change for the future earth of the next generations.

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Call for nominations: ISHS Honorary Membership and Fellowship

Nominations for new Honorary Members and Fellows of the ISHS will be considered by the Council at its meeting in France next year (IHC2022). All nominations for these awards should be received at the Secretariat preferably **no later than 31 December 2021**, to be considered by the ISHS Awards Committee prior to the meeting of the Council.

ISHS Honorary Membership

Honorary Membership of the ISHS will be presented by the Council to a person who is a member of the ISHS, in recognition of his/her exceptional service to the Society. A certificate will be given to the recipients of this ISHS award. Honorary Members are appointed for life by the General Assembly.

ISHS Fellow Award

The ISHS Fellow Award will be presented to a person who is a member of ISHS, in recognition of his/her outstanding contribution to horticultural science worldwide. A precious medal pin and a certificate will be given to the recipients of this ISHS award. Awarded by Council, the total number of living ISHS Fellows should not exceed 1% of the total membership, averaged over the previous 5-year period.

Horticulture Innovation Award

The Horticulture Innovation Award is the highest recognition granted by ISHS Council to a person or institution for an exceptional contribution to horticulture innovation. This award is especially addressed to those with innovative ideas to create new products and services that are seen as important landmarks in the progress of horticulture at an international level. A plaque and a certificate will be given to the recipients of this award.

Procedure

The ISHS Awards Committee (hereafter AC) invites the members of the Society, through the announcement in *Chronica Horticulturae*, to bring possible candidates for an ISHS Honorary Membership and Fellow Award to the attention of the Society.

Nominations must be received by the Executive Director (info@ishs.org) preferably no later than 31 December 2021. A nomination letter, to meet the requirements, should be accompanied by five duly signed letters of support, giving reasons why a nominee is considered worthy of the honour. These letters must come from members in no less than three different countries/regions.

The Executive Director must receive the nominations at least 3 months prior to the next Council meeting. The Executive Director will receive and collect the complete nomination files and send them (together with the letters of support), to the AC for their consideration. The AC Chair will submit the AC recommendations for awards to Council. AC recommendations must be balloted by Council members, either by electronic voting (one vote per country/region as for other Council matters) prior to a Council meeting, or by a secret ballot at a Council meeting. Two-thirds of Council votes present at the meeting, or electronically voting, must be in favour of a nominee for the award to be granted.

Important

When taking the lead in nominating someone or when supporting a nomination, please do not confuse the two types of awards. The criteria for both awards are very clear and the ISHS Board wishes to stress that nominations should therefore be based on the specific criteria for each distinct award category, namely:

- ISHS Honorary Member: in recognition of his/her exceptional service to the Society (not related with their contribution to horticultural science).
- ISHS Fellow: in recognition of his/her outstanding contribution to horticultural science worldwide (not related with their contribution to ISHS).

More information on the ISHS awards can be found at https://www.ishs.org/ishs-awards

Spotlight on Honoured ISHS Members

› Schuyler Korban

Position or previous position

Currently: Professor Emeritus of Molecular Genetics & Biotechnology at the University of Illinois at Urbana-Champaign, Urbana, Illinois, USA
Previous position: Vice Provost for Global Programs and Professor of Molecular Genetics & Biotechnology at the University of Massachusetts Boston, Boston, Massachusetts, USA

ISHS honour

ISHS Fellow

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

I completed my BS and MS degrees at the American University of Beirut (Lebanon), and then pursued my PhD at the University of Nebraska-Lincoln (USA). I have lived the majority of my adult life in Champaign, Illinois, USA, except for a four-year period in Boston, Massachusetts, USA. My wife, Tammy, and I, now live in Champaign. We have three adult boys: Chris, a CPA in Champaign; Charles, a graduate student in Computer Science in Chicago; and Colin, an epidemiologist in Chicago. My hobbies include music, gardening, reading books, and travel. I have travelled to various countries around the world, including countries in Europe (France, Belgium, Germany, Italy, Switzerland, Luxembourg, The Netherlands, Sweden, Poland, Croatia, Czech Republic, Romania, Greece, Cyprus, Ireland, United Kingdom, Channel Islands), Australia, New Zealand, Canada, Mexico, Brazil, UAE, Qatar, Lebanon, Syria, Jordan, Egypt, Tunisia, Ghana, Rwanda, India, and China.

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

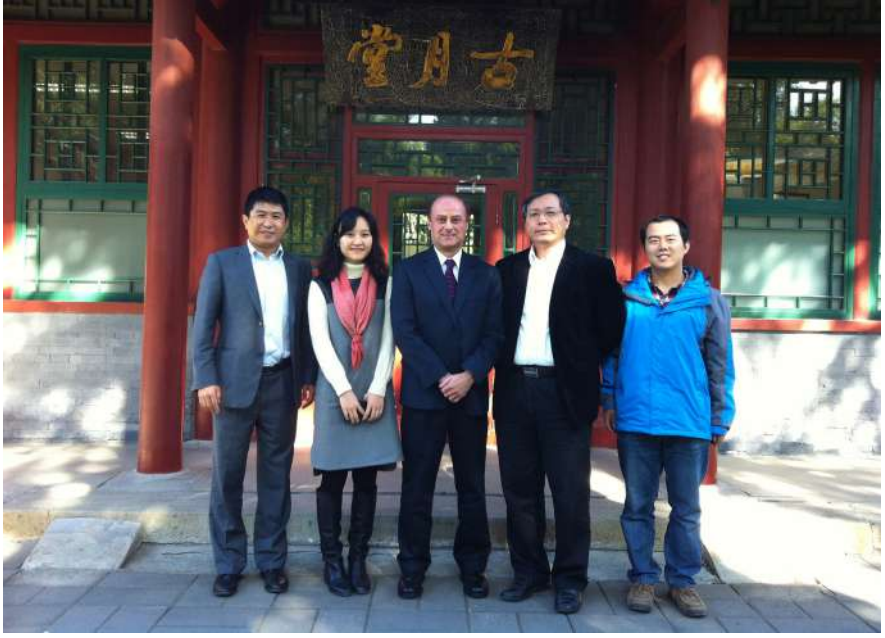
Following completing my Bachelor's degree in Biology and Chemistry (double-major), I was rather undecided how to move forward with my education. At one point, I was planning to pursue a graduate degree in music as I studied music (piano) for a period of 12 years at a conservatory, but then I contemplated going for a degree in Architecture. I talked to various experts in the field of both music and architecture, as I was craving an interest in having a creative career, but remained conflicted, as I did not want to abandon my interest in biological science. So, a family member suggested that I take a look at the field of Horticulture, with which, at that time, I was unfamiliar. I went ahead and met with one of the professors in Horticulture, who was both an affable and a very approachable man. He shared with me the wide diversity of horticulture, whether in the area of plant physiology, genetics, production, and propagation, among others. He described the expansive and wide incredible groups of crops that it covers, including fruits (apples, peaches, cherries, oranges, lemons, grapes, figs, and strawberries, among others), vegetables (tomatoes, cucumbers, lettuce, and peppers), flowers (roses, carnations, daisies, snapdragons, and lilies), and ornamentals (dogwood, rhododendron, hydrangea, and spirea). I think after listening to him and weighing my options, I thought that pursing a graduate degree in horticulture would satisfy my interest in biological science, as well as allow me to work with diverse and intriguing groups of colourful, tasty, delicious, and interesting plants/crops. From then on, I found horticultural science to be not only that, but much more.

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

I received my PhD in plant genetics from the University of Nebraska-Lincoln, working on genetic traits of dry beans under the supervision of the late Professor Dermot P. Coyne. I then took a postdoc position at the University of Illinois at Urbana-Champaign, working with the late Professor Daniel F. Dayton. In that position, I was introduced to the world of breeding and genetics of a long-lived fruit crop, apple. After a year and a half, I was offered a tenure-track position as an assistant professor, involved in research and teaching, at the University of Illinois, taking over the genetics and breeding program from Professor Dayton. This was followed by my promotion to associate professor and gaining tenure, and subsequently promotion to full professor. During my 32-year career at the University of Illinois, my program was heavily involved in developing a better understanding of the genetics of various diseases, including apple scab, powdery mildew, cedar-apple rust, and fire blight, and then expanded into fruit quality traits.

Over the years, research projects in my laboratory branched out to cover several other horticultural crops, including peach, pear, rose, tomato, snapdragon, phlox, impatiens, and rhododendron, several forest species, such as Scots pine, stone pine, and redwood, as well as an important agronomic crop, soybean. This diversity of interesting and important crops and plants that I was involved in satisfied my curiosity in the field of horticultural science, as well as helped in broadening my knowledge of the diversity of these various groups of plant systems.

› Top row (left to right): Dr. Joann Lau and Dr. Leslie Heffron (Ph.D. graduate students); middle row (left to right): Dr. Tae-seok Ko (Postdoc), Dr. Sergei Krasnyanski (Postdoc), Dr. Scott Schaefer (Ph.D. graduate student), Ray van Voorhis (undergraduate student), Dr. Ksenija Gasic (Postdoc); bottom row: Prof. Schuyler Korban (2003).



› Prof. Korban with host at Tsinghua University in Beijing, China (2015).

Throughout my career, my research has undergone continuous growth, change, and evolution, in terms of scope of investigations, as well as of new approaches, tools, and strategies that have become available in the field of molecular biology and biotechnology. Therefore, my program transitioned from pursuing traditional genetics studies, relying on controlled sexual hybridizations to identify genes involved in control of diseases and disorders, for apple scab, powdery mildew, cedar-apple rust, fire blight, bitter pit, among others, to developing protocols to isolate, clone, and sequence single genes, to identify biochemical and molecular markers linked to genes of interest. I established regeneration and genetic transformation systems for pursuing functional gene expression analysis, to genome-wide expression analysis of genes, to comparative analysis of whole genome sequences. Moreover, my research capitalized on the tools of biotechnology to use plants (tomato, apple, lettuce, carrots, and soybean) as bioreactors for developing candidate plant-based vaccines and therapeutic proteins against various human and animal diseases, such as the respiratory syncytial virus (RSV), diphteria-pertussis-tetanus (DPT), *Yersinia pestis* (plague), human immunodeficiency virus (HIV), *Plasmodium falciparum* (malaria), and porcine reproductive and respiratory syndrome (PRRS), among others.

4. What do you consider to be your greatest achievements?

On the human side, I think my greatest achievements are those undergraduate students, graduate students, postdocs, and visiting scientists/scholars that I have taught, mentored, or supervised. There is a tremendous satisfaction in having come across these various individuals, and to know that I may have made a difference in their lives during the course of my interactions with them in a classroom or in my laboratory. All of them have gone on to pursue their own careers, and have succeeded. This indeed gives me a sense of pride and of great satisfaction.

As for my professional achievements, I think that like anyone else who has had a long career, there are many achievements along the way that I take pride in. For example, my group's work on identifying, cloning, and characterizing the apple scab resistance gene, *Vf* (now referred to as *Rvi6*), is one that stands out in my mind. This gene, originating in a wild crab apple species, *Malus floribunda* clone 821, has been introduced into the cultivated apple using traditional cycles of sexual hybridizations (each cycle taking anywhere from 5 to 7 years), in a long-term collaborative apple breeding program, the Purdue-Rutgers-Illinois (PRI), that was launched back in the 1950s and remained active until the early 2010s, releasing over 18 cultivars and over 44 advanced selections. It also contributed to the development of other scab-resistant cultivars in different apple breeding programs around the world that have used advanced selections and named cultivars from this PRI program in their breeding efforts.

In other research areas, my research group has been involved in isolating, characterizing, and analyzing expression of genes and quantitative trait loci (QTLs) involved in other diseases, such as fire blight and powdery mildew. We also worked with genes and transcription factors associated with flowering and fruit quality traits, such as those playing critical roles in the anthocyanin biosynthesis pathway, as well as those involved in acidity and sugar content in the fruit. In another thrust, I take pride in moving my research program into the arena of genomics. I launched an apple expressed sequence tag (EST) project, funded by the National Science Foundation (NSF), in a collaborative effort that generated over 177,000 apple ESTs, from a variety of cDNA libraries constructed from various tissues and organs of apple and apple genotypes. These data have been deposited in the NCBI database, and are available to the scientific community.

These ESTs were also used to develop a 40K apple microarray, with supplemental funding from a USDA collaborator (Dr. Michael Wisniewski), that was used in pursuing genome-wide expression studies of various traits, including biotic and abiotic stress, as well as fruit quality traits. This was followed by an expansion of my group's involvement in a variety of genome-wide studies in apple and other *Rosaceae* species. We pursued comparative genomic studies, genome-wide association studies, as well as participated in whole genome sequencing efforts, for the Asian pear and for strawberry. These latter genome sequencing studies were led by colleagues either in China (Professor Jun Wu at Nanjing Agricultural University) or in the United States (Professor Kevin Folta at the University of Florida, and Professor Vladimir Shulaev, now at the University of North Texas), along with participation by many collaborators from different laboratories and in different countries. These large joint collaborative research efforts are of particular significance as they serve as testaments to the value and importance of undertaking collaborative projects, as scientific research can move at a faster pace and yields major outcomes when scientists pool their resources, including intellectual, plant materials, financial, technical, and their expertise.

In another thrust, my laboratory was involved in using plant systems as platforms for developing plant-based vaccines/therapeutic proteins using both nuclear transformation and plastid transformation protocols. As noted above in the earlier sections, we introduced antigenic proteins against various human and animal pathogenic viruses/organisms in different plant systems, including tomato, carrot, lettuce, and soybean. We assessed their feasibility as candidate vaccine against these pathogens in test animals, mice and pigs, and obtained promising results in designating some of these candidate vaccines as quite promising.

Yet in another area, I take pride in leading the traditional apple breeding program at Illinois, and in my continued collaboration with colleagues at Purdue (Professor Jules Janick) and Rutgers (Professor Joseph Goffreda) universities. During my tenure, we named and released over a dozen new apple cultivars along with dozens of advanced selections that are characterized by their resistance to apple scab along with some levels of resistance to other fungal and bacterial diseases of the apple. Some of these named cultivars include 'WineCrisp', 'Juliet', 'Crimson Crisp', 'Pixie Crunch', 'GoldRush', 'Enterprise', 'Dayton', 'Williams' Pride', 'Sundance', 'Pristine', and 'Scarlet O'Hara', among others.

› Prof. Korban with educators from different universities at a workshop in Patras, Greece (2016).

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

As to be expected, encountering difficulties is inevitable when working in scientific research, particularly when the plant systems one is working with are long-lived fruit crops in a region (State of Illinois) where there is a small fruit industry, and therefore, there are very limited funding sources that are available. Moreover, early on in my career, public funding sources for genetics research on fruit crops were also quite limited. After trying repeatedly to obtain competitive funding from public funding agencies for my work on genetics and biotechnology studies on apple, I decided to branch out to other crops, including ornamental and forest trees. I was then able to succeed in receiving my first large competitive grant. This grant has not only expanded my field of research, but allowed me to think about expanding my horizons and opportunities. It allowed me to cast a wider net in pursuing research projects and funding opportunities that would not only support the proposed research project, but also helped in supporting my research on fruit crops.

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

While I had many exciting and interesting experiences throughout the course of my career, I think it is the images that I have seen while interacting with and being around colleagues, friends, and family that are what I truly value and remember quite vividly. For example, seeing the Great Wall of China, in Beijing, with colleagues and former postdocs; walking through the beautiful gardens of the Wuhan Botanical Garden (China) with my former postdoc and now both colleague and friend, Professor Yuepeng Han, along with my eldest son Chris; observing the beautiful old architecture of buildings that were reconstructed/renovated in Dresden (Germany) while riding a tour bus with colleagues from different parts of the world (China, Japan, Germany, Belgium, Poland) during an excursion hosted by the organizers of an international fruit tree conference; wandering around high-density dwarf apple trees and pear trees while carrying on conversations with colleagues from New Zealand, The Netherlands, and Norway in Switzerland; having a delicious dinner sitting by the seaside in Patras (Greece) while carrying on conversations and having laughs with new colleagues from Lithuania, Greece, and Ireland; and treading on old cobblestone walkways of Cluj Napoca (Romania) to visit gothic churches while having chats with new colleagues from Romania and the United States. It is looking at spectacular scenic views from a mountaintop while standing by the gigantic Statue of Christ the Redeemer near Pocos de Caldas (Brazil) while chatting with colleagues from Brazil, Italy, Canada, and Argentina. These images, settings, and conversations are those experiences that I find memorable, interesting, exciting, and funny, all rolled into one.

› Prof. Korban at the Botanical Garden of Alexandru Ioan Cuza University in Iasi, Romania (2017).

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?

Throughout my career, I looked forward to attending various professional society scientific conferences and annual meetings held either in the United States or in different parts of the world. I think becoming a member of ISHS has allowed me the opportunity to engage with fellow horticultural scientists from around the world. Moreover, ISHS symposia are specialized on major topics focusing on either a commodity, such as apple, pear, cherries, or a group of commodities, such as stone fruits, pome fruits, or citrus fruits, or a particular discipline, such as genetics, breeding, biotechnology, genomics, postharvest, diseases, and production, among others. Therefore, ISHS symposia are highly relevant, valuable, and focused. They attract experts from different parts of the world. These meetings are held in different countries and locations around the world. Moreover, the symposia are highly engaging, interactive, useful, and productive. All ISHS symposia yield research articles, published in the series of *Acta Horticulturae,* covering all talks presented during these symposia, and so there is yet another tangible benefit and outcome in contributing a presentation (oral or poster) to these symposia. A unique feature of ISHS membership is having access to these published articles, as well as to various other communications and newsletters, such as *Chronica Horticulturae*.

Therefore, this highly international, engaged, scientifically focused, and communicative professional society is what first attracted me to and has maintained my interest in keeping my membership active in ISHS. I have highly benefited from my ISHS membership, both professionally and personally, as I have been able to develop wide and expansive professional relationships with peer scientists from various institutions in different countries that have enriched my research program. Some of these relationships have resulted in joint research collaborations or joint published articles, while others have facilitated opportunities for my students and postdocs to engage with some of these colleagues, while I was able to call on others for research materials, or to ask them to serve on editorial boards for a couple of journals that I was serving as editor-in-chief for at the time.

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

I would say that for any young individual who has any interest in working with a vari-

ety of plants, whether for their aesthetic beauty and sensory attributes, such as flowers, landscape shrubs, ornamental trees, and turf grass, or for their varied and delicious and nutritious fruits and vegetables, such as oranges, pears, peach, plums, apples, passion fruit, mangoes, figs, walnuts, almonds, grapes, blackberries, bananas, tomatoes, lettuce, cabbage, sweet potatoes, carrots, or peppers, there is no better field to work with than the field of horticulture. This discipline allows one to gain knowledge and pursue new discoveries about these widely diverse groups of important food and ornamental crops, as there is so much to learn about these different groups of crops.

Whether it is to develop new propagation methods, new production systems, innovative management systems, innovative postharvest and storage technologies, or to understand the biology, physiology, and genetics, or to breed/genetically modify either new, enhanced, or diverse cultivars for purposes of either enhanced nutritional contents, improved sensory or aesthetic qualities, or for enhanced disease and insect resistance, or for water, salt, and heat stress tolerance, the field of horticultural science offers such a vast pool of possibilities, challenges, and opportunities that bring both professional and personal satisfaction, as well as exciting and fulfilling outcomes. A young horticulturist or a horticultural scientist will enjoy the "fruit" of their own work, and will be able to capitalize on using novel and innovative technologies, whether it is in the field, greenhouse, or laboratory, for the purposes of cultivation, management, production, breeding, and improvement, or for mere fundamental discovery and knowledge of the biology of these extraordinary and breathtaking groups of plants/trees.

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

There are many emerging opportunities for the future of horticultural science. These opportunities are highly influenced and/or dictated by climate change, population growth, population migration, changing human health conditions in different regions of the world due to either malnutrition, obesity, health consciousness and fitness, cultural demands, or lifestyle changes and desires. Moreover, there will be more and continued emphasis on quality of horticultural crops, whether it is to alter aesthetic value of flowers and ornamentals, to modify nutritional composition of fruits and vegetables, either to bio-fortify particular nutrients, vitamins, or antioxidants or to remove allergens or allergenic components, or to prolong storage and shelf-life of these horticultural crops, along with targeted and reduced input of the overall horticultural agricultural industry.

There are various opportunities to exploit advanced technologies and/or to develop new and novel technologies and softwares to deal with plant status monitoring, assessment, production, management, postharvest, and treatment; data collection, cataloguing, mining, and interpretation; as well as multidisciplinary research efforts for investigating and solving complex problems related to plant architecture, growth, development, reproductive trait analysis and improvement, postharvest, and shelf-life. There will be more advances and developments in the use of drones, monitoring devices, nanotechnology, biotechnology, and various 'omics', including genomics, transcriptomics, proteomics, metabolomics, nutrigenomics, phenomics, metamoics, precision gene/genome editing, as well as bioinformatics, among others, that will necessitate continued launch of large, collaborative, and integrative approaches and efforts in addressing complex problems in horticultural science.

Horticultural Science Focus

Deliberation on culturally insensitive plant names: what are plant scientists doing?

Kim E. Hummer

During the past several years, schools, stadiums, sports teams, and industry brand names have changed insensitive appellations or icons. These groups have changed, or are changing, names that imply subversion of race or indigenous community, misogynistic or insensitive slurs on people's culture, religion, or heritage.

Public sentiment is swaying these responses. Recently, opinions (Hunter, 1991), garden blogs (Bradford, 2018) or botanical on-line forums (iNatForum, 2020) have pointed to plant names that are racist, offensive, derogatory, insensitive, or at the very least, inappropriate. Some are asking if botanists and horticulturists are considering changing offensive plant names. In this article, we outline the different kinds of plant names and the possible approaches to dealing with offensive names for each of them. The process of naming of plants includes several types producing multiple names for one organism:

- Common names: These are vernacular names coined by the general public. There may be multiple common names in separate regions as well as additional names in different languages.
- Botanical names: These Latin binomial names were initiated by Linnaeus (1753) and are defined by the rules of the International Code of Nomenclature for Algae, Fungi and Plants (Turland et al., 2018). These names are used consistently by botanists around the world for plants in the wild.
- Cultivated plant names: These are formal names used for plants raised in cultivation and are defined by the International Code of Nomenclature for Cultivated Plants (Brickell et al., 2016).

Insensitive names at each of these naming types will be briefly discussed.

Common names

Currently, common plant names follow no specific rules and have no governance on popular use. People think of a name for a plant and that name gets translated into wider use among the public community. Rather than using common names, most scientists or plant encyclopedias refer to plants using botanical names. Common names are applied regionally and some names in one region can be applied to a completely different plant in another region. The way to change common names that are slurs, insulting, or blatantly offensive would be simply to stop the common usage. Many well-known plants have multiple common names. One option is to adopt one of the existing but not offensive common names to replace one that is offensive.

The challenge, then, is to get the community to use the changed plant name and to agree on the improved name for wide usage. In some cases, the particular word which is an insult for one culture, may not be recognized or realized as offensive in another culture. In this case, communication and collaboration is needed.

Where an institution records the use of common names, a decision can be made by their editors and compilers to suppress any names that are deemed offensive, although there is no concerted agreed upon approach at this time. No single organization alone polices common names or their usage. Each offensive name would need to be vetted in the open and changed individually.

Botanical names

The scientific community is also considering changing their standard rules, the International Code of Nomenclature for Algae, Fungi and Plants, to change some of the scientific nomenclature where European colonizers or visiting botanists chose names that were insensitive. This would mean changing the code to be more inclusive of indigenous beliefs and values, and less flagrantly offensive, or omissive of indigenous cultures, in the establishment of species nomenclature. Gillman and Wright (2020) envisioned and described taxonomic rules to promote retrospective name changes. They suggest that the establishment of names occurs on the basis of precedence, with recognition of pre-existing indigenous names for species where possible. The first step in this rule changing process would be a general debate on the merits of this new approach. This debate must include indigenous peoples and indigenous scientists as prominent stakeholders in the nomenclatural discussions. Gillman and Wright (2020) submitted a letter that has acted as a catalyst for such debate. Since, their publication support has built around this idea.

Knapp et al. (2020) concurred that Gillman and Wright (2020) opened an important topic for discussion in the nomenclatural community and more widely in the study of algae, fungi, and plants. They stated that affirmation and acknowledgement of the contribution of local and indigenous people to nomenclature, and to the knowledge of biodiversity, is an important step in the "de–colonisation" of science. Even though the changes they propose to the International Code of Nomenclature for Algae, Fungi, and Plants need further thought and refinement, now is the time to begin the conversation. Previously, only 20 years ago, the nomenclatural community could not have conceived approving electronic publication of new names. In the next 20 years this movement towards consideration and recognition of indigenous nomenclature could easily occur.

Cultivated names

The issue of offensive elements in cultivated plant names is of concern. To avoid offending groups of people, an understanding of a wide range of languages, cultural traditions and history must be researched. When someone alerts authorities to the offensiveness of a plant name, that name is checked and insensitive names are removed from visibility on the internet. However, the RHS, for example, retains all common names in the background database, so that any names could be cross-referenced for future needs. People will continue to need to know what plants particular names relate to and will ask for background information.

Conclusion

These days, culture has more available tools to examine humanity with a more thorough and equitable lens of reason than in previous generations. A collective movement to choose and use less offensive common plant names is in process but will only be successful through united public determination for positive change. Scientists are considering changing rules of botanical nomenclature to recognize indigenous people's contributions to knowledge and civilization. Each step in this process can promote our generation's legacy towards a more diverse and inclusive horticultural future.

Acknowledgement

The author is grateful for the suggestions and input to this article by Dr. John David, RHS Head of Horticultural Taxonomy, Chairman of the RHS's Nomenclature and Taxonomy Advisory Group and Chairman of the IUBS International Commission on the Nomenclature of Cultivated Plants.

The Royal Horticultural Society (RHS) has supported the ISHS Commission Cultivar Registration by providing a Secretary to the Commission as well as maintaining and updating the ICRA information on the ISHS website. The ISHS greatly appreciates and recognizes this collaboration with RHS. The International Code of Nomenclature for Cultivated Plants, 9th edition, was published as *Scripta Horticulturae* 18 by ISHS (Brickell et al., 2016). This year the RHS initiated a Cultivar Registration Bulletin as an annual publication, wherein new registrations can be published.

› Kim E. Hummer

› About the author

Kim E. Hummer is Research Leader at USDA National Clonal Germplasm Repository, a genebank in Corvallis, Oregon, USA; and Board Member of the International Society for Horticultural Science. Dr. Hummer curates more than 12,000 genotypes of berry, tree fruit, nut trees, and specialty crop genetic resources. She is ardently concerned with correct and appropriate application of botanical and horticultural taxonomy. E-mail: hummerk@oregonstate.edu

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› Can horticulture feed a challenging world?

Francisco Pérez-Alfocea and Daniel I. Leskovar

Introduction

In a world challenged by increasing population, limited natural resources, land fragmentation, urban encroachment, extreme abiotic stresses, incidence of new pests and diseases, and ecosystem destruction, horticulture must find the way and engage the necessary tools to secure food production, tackle malnutrition and to make the planet a better place to live. Different toolboxes belonging to basic and applied sciences such as biology, ecology, agronomy, and engineering should be identified, optimized, and integrated into a highly efficient and adaptive horticultural machine, coupled and uncoupled from natural rhythms and from local to global scales.

In any natural sustainable ecosystem, the population of any species is controlled by food availability. In the case of humans, food availability seems to be controlled by the growing population, leading us to Malthusian alarmism. Since uneven coefficients drive food production and growing human population, predictions estimate that an increase in 20% people will require a 70% increase in food production, a situation that is expected by 2050. This challenge is derived in part from human nature itself but becomes more and more challenging as population trends escape from the control of food availability, which itself is continuously facing limits imposed by resource scarcity and environmental constraints. In a population approaching 8 billion people, about 10% (more than 800 million) worldwide are chronically hungry, while 25% (2 billion) are suffering from micronutrient deficiencies (FAO, 2019). Therefore, feeding and nourishing 10 billion people in an unstable and degraded environment is an uppermost challenge of modern agriculture for the 21st century (Lynch, 2019).

Plant breeding along with massive use of natural land and freshwater, coupled with artificial fertilizers and agrochemicals, have strongly contributed to reducing hunger and malnutrition in the last 100 years, but to the detriment of the planet's health, which is no longer an option. How can agriculture in general and horticulture contribute to achieving the United Nations (2015) Sustainable Development Goal #2 "Zero Hunger and Improved Nutrition" by 2030, and therefore (at least) delaying Malthus' predictions from coming true? Optimizing, integrating, and adopting existing and emerging biological and technological strategies is required but might not be enough, making major transformations of global food production systems a potential necessity (Qaim, 2020). All these strategies together certainly have the power to meet the food demand without causing additional problems to the planet, but can this continue indefinitely, or are there any limits?

› Bean seeds. Photo by Alan Taylor and Masoume Amirkhani, Cornell AgriTech.

How do our Society and Division contribute towards the increased food demand?

ISHS and its members are poised to address these challenges through basic and translational research, education, and delivery of data-driven science not only to improve food systems within the context of environmental sustainability, ecological balance, and social equality but also to quickly respond to reduce the fragility of human health and nutrition such as is currently underway with the COVID-19 pandemic. Within the spirit of cooperation, ISHS must continually improve quality of life and environmental health by increasing the availability of safer and healthier food while reducing waste in both open field and protected cultivation conditions [controlled environment agriculture (CEA), high tunnels, vertical farming]. To accomplish that vision, our Society involves thousands of dedicated professionals and students with multidisciplinary expertise centered around 14 Divisions and 3 Commissions encompassing more than 100 Working Groups (WGs). Our Division "Vegetables, Roots and Tubers," representing more than 10% of the ISHS WGs, vertically integrates knowledge in the seed to harvest to consumer chain and is aimed at the development, adoption, and implementation of technologies to improve yield, quality, and profitability of high-value and nutrient-rich vegetable

crop commodities grown in diverse rural and urban areas of the world. Within that context, the following are key determinants and selective strategies to balance population growth and increased food demand.

The role of seed and transplant quality

Seed quality is fundamental to address the challenges in food production systems. Estimated at $1.8 billion in 2019, the global seed market is projected to reach $3.0 billion by 2025 (https://www.marketsandmarkets.com/Market-Reports/seed-coating-materials-market-149045530.html). This increase is due to the increasing demand for high-quality seeds, handling, precision planting and the need for protection against soilborne pests and diseases. Since the 1950s, many seed technologies, such as seed dressing, film coating, pelleting using polymers, colorants, minerals, or bioactive ingredients, were developed to improve seed germination, seedling emergence, nutritional values, and crop yields for multiple abiotic/biotic stressful environments. In the last decades, plant beneficial microbes (PBMs) such as plant growth-promoting bacteria or rhizobacteria (PGPB or PGPR), arbuscular mycorrhizal (AM) fungi and *Trichoderma* have been promoted as a source of inoculants to increase the yield and resilience of crops in multiple agro-ecosystems, particularly for low-input systems (Rocha et al., 2019). These authors conclude that in the future, microbial inoculations with native species and the use of eco-friendly coating ingredients such as composts or residues from forests or agricultural practices should be explored for integration into management strategies. However, the use of biostimulants such as PGPB or PGPR is controversial and poses challenges since it is difficult to determine their mode of action and their significant synergistic effects on agronomic traits. A more detailed discussion, with challenges and controversies of biostimulant applications, is presented separately later.

High seed quality is the underlying condition that determines the ability of young transplants to develop a balanced root to shoot system with the capacity for a rapid leaf area development and root regeneration upon transplanting under diverse climatic, environmental, and outdoor/indoor growing conditions. Since the 1980s, the use of containerized transplants has transformed the vegetable industry worldwide. Growing high-quality transplants requires a thorough knowledge of the seed quality factors affecting germination and emergence under diverse nursery conditions and a broad understanding of the physiological processes underlying transplant growth and physiology in a “root-confinement” environment. Thus, as in seeds, transplant quality is critical to maximize crop performance, especially under heat and drought stress environments. With modern breeding we expect new vegetable hybrid cultivars will have variable capacities for water, nutrient, and/or light use capture and abiotic stress tolerances. These will create both opportunities and management challenges for the transplant nurseries to manipulate growth. We also expect that rapid industry developments in the mechanization and automation of small-cell transplants will require re-defining transplant quality traits. Evolving research on new biomolecules, plant/root growth regulators, carbon-based media amendments, and spectral light blends are attractive tools to modulate root and shoot growth traits and improve transplant quality and stress adaptation.

› Testing experimental rootstocks for increasing tomato nutrient use efficiency in Murcia.

Grafting

The use of chimeric plants by physically connecting the best of two genotypes, the scion and the rootstock, is becoming a widespread commercial practice in multiple vegetable species in many horticultural areas. It can be considered a surgical alternative to the breeding of new varieties because it strongly reduces the time required to introduce new (root-mediated) traits of interest by at least 50%. This strategy improves yields essentially by promoting the vigor of the scion, which usually is a high-yielding elite variety, and/or minimizing the negative impact of soilborne diseases. However, the potential of this technique is still mostly unexplored and unexploited because the targets are still very reduced beyond those mentioned above (Pérez-Alfocea, 2021). Despite the interest publicly manifested by seed companies, no varieties have been developed with increased tolerance to salinity, drought, heat, or mineral deficiencies or increased water or nutrient use efficiencies. Those tolerances and efficiencies are difficult to demonstrate or are based on the classic ‘yield per unit of water or fertilizer applied’ which is a result of the rootstock-imposed vigor rather than a capacity of the rootstocks to increase or maintain yield with a reduced percentage of water or nutrients applied compared to ‘optimal’ levels. As a whole or provided by the rootstocks, the use of water or fertilizer efficient varieties should be regulated by agricultural policies, certified by seed companies, and quickly adopted by farmers to meet ‘Green Deal’ initiatives worldwide (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en).

The approach should also be affordable for processing crops such as industry tomatoes, where grafting could solve significant problems such as the incidence of broomrapes that make the crop non-viable in many developing countries. Rootstocks can provide benefits to secure food production by interacting with the elite varieties and improving the synergistic symbiotic relations with below- (soil microorganisms) and above-ground (animal pollinators) organisms. While increasing soil exploration and resource uptake capacities, rootstock-mediated increase in rhizosphere activity can also strongly contribute soil CO_2 sequestration through root and biota development and root exudation. Additional advantages such as improving fruit nutritional properties (antioxidants, micronutrients, or nutraceuticals) should also be included in the targets of rootstock breeding, which probably requires the widening of views and the genetic biodiversity used in the development of new rootstocks.

NPBTs (new plant breeding technologies): gene edition and breeding assisted by ecological decisions

Achieving additional significant increases in food quality and quantity without using more natural resources and preserving the

› Testing rootstocks for conferring resistance to broomrapes in tomato. Photo by Puri Martinez Megarejo.

› Transplanting watermelon in a cover crop field amended with solid humic substances in Texas.

environment has proven to be complicated by using current accepted technologies. However, new technologies particularly in the field of plant biology, should be explored for this purpose. New plant breeding technologies (NPBTs) include the powerful but controversial genetically modified organisms (GMOs) and gene-edited (CRISPR) crops. Powerful because they can change the current paradigm in plant breeding; and controversial because they find societal and political barriers for their universal deployment. While their potential and benefits are being demonstrated at the research level and many start-up companies offer their services to the plant breeding sector, their commercial implementation is hampered by (over-) regulatory policies in many developed and developing countries. The benefit/risk balance of these technologies is the main important criterion where the benefits must be demonstrated with respect to their potential transformation in agriculture. The possible risks also need to be fully identified, assessed, and minimized regarding possible adverse health (modified organic molecules of unknown properties), environmental (biodiversity loss), economic (benefit distribution) and societal (power concentration and price control) consequences. But the reality is that after 30 years of research and commercial deliveries, no clear evidence has been obtained to prove that GMOs are riskier to humans and the environment than conventionally bred varieties. Regardless, GMOs are the most highly regulated and tested foods in the world (reviewed in Qaim, 2020). A meta-analysis of the impact of GMOs' adoption related to herbicide tolerance and insect resistance reveals increases up to 29% in yield and 78% in farm profit, while it decreases pesticide use and its poisoning incidences by 30-40% (Klümper and Qaim, 2014; Qaim, 2020). Even if caution is always necessary when implementing new technologies, if the benefit/risk balance is not demonstrated adequately along with safety, people will certainly maintain the preference for conventionally produced foods. Meeting food demand is an unquestionable benefit that should not be overlooked.

Gene editing technologies can also contribute to the *de novo* domestication or re-domestication (Fernie and Yan, 2019), thus easily contributing to recover forgotten or neglected wild traits of interest that have been ignored or lost during the natural domestication process by humans, which usually requires decades of plant selection and breeding. The recent discovery of multiple key domestication genes and scientific breakthroughs in introducing multiple genomic changes in plants simultaneously by using CRISPR/Cas9 enables the domestication of wild species within a single plant generation (Schindele et al., 2019). *De novo* domestication can enhance agrobiodiversity and dietary diversity with possible benefits for the environment and human nutrition (Singh et al., 2019). Gene editing can also contribute to increase the genetic yield potential of crops beyond the biological limits reached by Green Revolution approaches. During the past 50 years of the first Green Revolution, improved genetics and agronomic practices favoring more biomass partitioning to reproductive organs (harvest index) and chemical crop protection led to impressive yield increases in major field crops (Long et al., 2015). Now, a "Second Green Revolution" paradigm explores the possibility of changes in central plant metabolism as a way forward to increase yields. Increasing atmospheric CO_2, a limiting substrate for C_3 photosynthesis, is generating interest in the possibility of artificially improving the capacity and efficiency of carbon uptake crops. Past efforts applying classical plant breeding approaches were not successful due to negative tradeoffs with other plant traits (Long et al., 2006). Now gene-editing combined with high-performance computing and extensive knowledge of the dark/light reactions in the photosynthesis process and the photosynthetic machinery offers an exciting possibility to elevate crop yield potential as already shown in tobacco plants with a 40% increase in growth. If the introduction of regulatory genes (reduced photorespiration from CAM or C_4 plants) to elevate the photosynthesis conversion into C_3 plants, such as tomato, proves achievable in the near future, that would constitute not only a significant breakthrough in synthetic plant biology (Orr et al., 2017) but also a crop improvement solution in the food supply. However, this is undoubtedly still challenging.

Returning to *de novo* domestication, a putative new breeding technology can be based on ecological decisions, which have also been ignored during human-driven domestication. For example, beneficial microorganisms such as PGPR or mycorrhizal fungi can contribute to improve yields and resource use efficiency, but the preference of those microorganisms to associate with not only different plant species but with different genotypes could be useful in search of significant synergistic positive effects on agronomic traits. The same applies for the pref-

erence of pollinating insects that also feed on the flowers and the capacity of the plant to produce nutritious food, while the animal pollinates the plant for the benefit of yield. The selection based on those ecological decisions can open new breeding opportunities. It must be considered that while pollinators rely on the plants that they feed, flowers are the most sensitive plant structure to abiotic factors, and therefore, pollinator-assisted selection can be a valuable indicator to identify the most resilient individuals, thus ensuring their food security. However, far from protecting pollinators, current agronomic practices contribute to their decline through the use of monocultures, pesticides, and the aggravation of climate change. Pollinators are required for food production in 90% of the species used by humans, providing major nutrients, while cereals mainly provide calories. Moreover, the insect foraging decisions could also be used to optimize water and fertilization management, therefore synergistically contributing to sustainable food security by increasing plant resilience and pollinating services and reducing water and fertilizer inputs.

Can biostimulants contribute to resilience and sustainable food systems?

Biostimulants are to agriculture as herbalism is to medicine; some extracts or formulations can have positive effects on some crop species in some conditions. However, scientific evidence about their safety and efficacy, active molecules, mode of action, and optimal compositions, dosages and application modes is limited. Given the phase-out of many bioactive chemical formulations, the natural biological origin of the products and their relevant potential role in the circular economy, there is an important opportunity for the booming biostimulants sector in contributing to a more sustainable, organic, and hopefully, more productive and high-quality horticulture, with a significant environmental and positive societal impact.

A plant biostimulant can be defined as “any substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutritional content” (du Jardin, 2015). These substances range from the classic humic and fulvic acids, protein hydrolysates from plant and animal origin, seaweed extracts, and chitosans to the more specific molecules such as glycine-betaine, polyamines, methanol, myo-inositol, and more recently melatonin (Arnao and Hernández-Ruiz, 2021). A plethora of physiological benefits to plants have been described, including antioxidant functioning, improved nutrition, defense response elicitation, primary and secondary metabolism promotion, hormonal or para-hormonal effects with specific (either root or fruit) or general plant growth or yield promotion effects, often combined in the same product.

Rhizosphere microorganisms (usually bacteria and fungi) can benefit plant health and crop sustainability in several ways, some of them through the same substances that take part in biostimulants formulations: improving nutrition, boosting root and/or shoot growth, and protecting against pathogens and abiotic stresses. Therefore, it seems reasonable that a combination of several beneficial microorganisms can provide synergistic effects. That may be the main reason for developing prebiotic strategies to promote the natural beneficial soil microbiota, although inoculation with standard microbial products or standard products mixed with biostimulant formulations is currently the most conventional commercial approach. Although all the traits provided by soil biota are of great interest, the identification and optimization of high-efficiency phosphorous and nitrogen nutrition promoters and salinity/drought stress alleviators could have the most significant impact.

Humic substances (HS) result from the decomposition of plant, animal, and microbial residues. They are carbon-rich materials extracted from natural organic matter (peat, coal, leonardite), with humic and fulvic acids being the main active components. They are biostimulant products containing bioactive compounds that can benefit plant growth. Despite some inconsistent results, a meta-analysis of HS applications to plants has shown an increase in root and shoot dry weights of 21 to 22% (Rose et al., 2014). As carbon-rich products, amending soils with solid HS can improve soil health (organic matter content, soil respiration, soil nitrate retention), plant biomass, and root traits as has been shown in one of our studies (Qin and Leskovar, 2018). HS also showed beneficial effects on water and nitrogen use efficiency and improvements of plant tolerance to abiotic stresses such as heat and drought when applied in the substrate media in containerized vegetable transplants (Qin and Leskovar, 2020) or soils (Qin et al., 2019). However, despite these positive results, there is little understanding of these promotive effect mechanisms.

Although the risks of applying biostimulants to plants are assumed to be low, as for any “new technology,” the safety and the benefit/risk aspects should be technically demonstrated and scientifically validated in the field. For example, melatonin has a high potential interest as a plant biostimulant and is classified as a non-hazardous agent but given its possible effects as hormonal disruptor in animals, the impact on the ecosystem must be analyzed before its application at commercial scale (Arnao and Hernández-Ruiz, 2021). However, increasing product development costs could negatively impact the survival of small companies and the adoption by farmers. The positive counterpart would be the market availability of safe and highly efficient standardized products. Investigating plant biostimulants is necessary to demonstrate their potential to address many of the challenges facing horticulture. As du Jardin (2015) described, data that demonstrated positive results in the laboratory must be further validated under field or controlled environments both at research and farm levels. This will require partnerships, collaborations, and funding commitments from the biostimulant industry to engage in sustained public research and farmer field validations.

Concluding remarks – call for ecosystems services

Considering the challenging scenarios laying ahead (rapid rising population, limited natural resources, climate change coupled with extreme abiotic/biotic stresses imposing pressures on food systems), sustained fundamental and translational research are needed for the development of resilient production systems in order to provide means of increasing food supply, nutritional quality, and biodiversity, while reducing food waste and environmental pollution. In addition to supporting the best large-scale farmers, we shall keep in mind that smallholder farms are major contributors to regional economic development, food security, and ecosystem services of cultural and social values. They have developed an extraordinary ability to balance the use of natural resources preserving the ecosystem services and the generation of economic and social benefits (Manyise and Dentoni, 2021). Some examples of ecological functionalities include biocontrol agents, beneficial growth promoting biofertilizers, and protecting soil microorganisms, water pollinating animals, and capitalizing from beneficial plant-to-plant interactions. To ensure economic, social, environmental, and sustainable resilient agro-systems, a continuous effort should focus on targeting critical resource bottlenecks (less fertile lands or water availability), developing high-efficiency technologies and crop management strategies, assisting crop improvement by accelerating the integration of molecular and conventional practical crop breeding, and addressing scalability issues and barriers to expansion into traditional and non-traditional markets.

› Francisco Pérez-Alfocea

› Daniel I. Leskovar

› About the authors

Francisco Pérez-Alfocea is Research Scientist at the Department of Plant Nutrition at CEBAS-CSIC, Murcia, Spain. The research interest focuses on the regulation of source-sink relations to alleviate the impact of abiotic stresses (salinity, drought, nutrient deficiency and temperature) on crop productivity, and the interaction with pollinators as natural phenotypers of those relationships. Through using natural and biotechnological genetic variability of *Solanum* and other vegetable species as rootstocks, he investigates the effects of hormonal and nutritional signals on plant performance and fruit quality (root metabolomic fingerprint). He is the current vice-chair of ISHS Division Vegetables, Roots and Tubers. E-mail: alfocea@cebas.csic.es

Daniel I. Leskovar is Professor in Vegetable Physiology at Texas A&M University and Director at the Uvalde and Dallas AgriLife Centers in USA. His research is centered in understanding plant adaptation mechanisms to abiotic stresses and in developing sustainable vegetable cropping systems. His current focus is on seed-transplant physiology; soil/plant growth biostimulants; protected cultivation and hydroponic systems; tomato grafting; and genotype screening for heat and drought stress tolerance, water and nitrogen use efficiency, yield, and quality traits in hot and sweet pepper, tomato, and melon. He is the current Chair of ISHS Division Vegetables, Root and Tubers. E-mail: d-leskovar@tamu.edu

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› Drone monitoring crop growth and health in vineyard. Source: Biological Systems Engineering, Washington State University.

› ISHS Division Precision Horticulture and Engineering: sustaining the future with precision horticulture and engineering

Murat Kacira, Pierre-Emmanuel Bournet, Lav R. Khot, Qichang Yang, Irineo Lopez Cruz, Weihong Luo, H. Jochen Schenk, Hicham Fatnassi and Roberto Lopez

According to the Food and Agriculture Organization (FAO) of the United Nations, the world's population is expected to grow to almost 10 billion by 2050. This means that food demand will increase by approximately 70%. In addition, the need for ornamental plants will increase given the high demand of people for nature and the necessity of cities to implement nature-based solutions, not only to improve the well-being in urbanized areas, but also to find a way to mitigate the effect of global warming. Furthermore, in the era of climate change, agriculture is currently responsible for 20% of greenhouse gas emissions (including methane and nitrous oxide) due mainly to the use of synthetic nitrogen-based fertilizers, fossil fuel combustion, and electricity used in both field and controlled environment agriculture. During the next decade, horticultural science should be focused on generating fundamental and applied scientific knowledge to contribute to producing more food (increasing productivity) and ornamental plants in a sustainable way, with not only better quality using fewer natural resources but also with zero or reduced emissions of greenhouse gases and much less water. Integrating precision engineering and smart technologies to horticultural practices will be a key as well. One of the most significant resource inputs in a vertical farm system (and also in greenhouse operations) is labor mainly for crop maintenance and produce harvesting.

In the last few years, the precision horticulture and engineering domain has been seeing a technological transition with a focal shift from mechanization to real-time sensing and big-data driven decision support as well as smart actuation with robotic systems both in the field and within controlled environment horticulture, which includes greenhouses and indoor farming. The concept capabilities of digital agriculture have become a reality for precision operations management with futuristic technology infusion. The Internet-of-Things (IoT), compatible soil, in-field climate, and crop variability mapping sensors are becoming rugged, miniaturized, and affordable to increase our understanding of crop stressors, associated plant response traits and quality attributes. Data from such in-field sensor networks can now be supplemented with an overlay of aerial imagery with high spatiotemporal resolution. Apart from drones integrated with optical sensors, the imagery captured by low orbital satellites can now map geospatial variability at a few cm per pixel resolution and at the frequency of a few days. This big-data can now be analyzed either on the edge of the field (edge-compute), or can be transmitted to the cloud for machine learning driven-decision-making (cloud-compute), and real-time actuation of smart in-field systems. The advancement in reliable, economical farm connectivity options and smart decision aid solutions offered via a mobile device friendly application is needed and will further empower growers' capabilities for horticultural applications. Integrated production systems combined with computational modeling and augmented reality (AR) with interactive visualizations of the microclimate and biotic parameters will further advance success in precision horticulture. This information fed into agronomic and horticultural models by integrating biotic

› Organic photovoltaics covered greenhouse. Source: University of Arizona-Controlled Environment Agriculture Center.

› Plant factory with artificial lighting/vertical farm. Source: University of Arizona-Controlled Environment Agriculture Center.

and abiotic stress data will empower growers' decision-making for farm management. Efforts will need to be focused on models to 1) describe the cross-talk among physiological processes at multiple plant scales, 2) diagnose biotic and abiotic stresses based on high-throughput plant phenotyping data, 3) utilize climate-smart, resource use aware production system designs and management practices, and 4) parameterizations.

Machinery utilized in horticulture for inputs management, harvest operations, and phenotyping have become smarter (e.g., intelligent sprayer, efficient harvesting robots) in terms of actuation with either embedded sensor suits or using connected data feeds. They are now being equipped with hybrid energy drivetrains and self-guidance toolkits to make them work independently off-road and for extended hours per day. Overall, state-of-art horticultural crop monitoring and management is seeing a dramatic shift with prototype development of smart, energy, resource use and operation efficient technologies. Plant response-based sensing, monitoring and environmental control of environment is needed for better management of resources such as nutrients, water, and electricity for indoor plant lighting and environmental control. The incorporation of real-time crop data has been gaining interest to be part of environmental controls and will ensure to empower the crops for optimal growth based on current conditions and will provide growers with enhanced production quality and capabilities within controlled environments and in the field of horticulture.

Given a warming planet and a growing global population, conserving and optimizing irrigation water inputs in horticulture will become ever more important, and plant-based methods to determine irrigation needs and schedules will become more commonly used. Currently, many of these methods are still unaffordable for most small growers, often requiring high maintenance and specialized training.

Inexpensive, practical, and reliable sensors are under development and their applications will be adapted by the growers. Future research will continue to advance developments for crop production under controlled and protected environments. Precision horticulture and engineering will help adapting the designs, technologies, and environmental control strategies considering crop specific needs, regional climatic conditions, consumer and market demands, economics, and availability or resources towards more resilient and resource conserving production practices both with greenhouse and indoor vertical farming-based production systems.

During the next decade, horticultural engineering will continue to appreciate the public-private industry partnership-driven research and development efforts to further innovate technological solutions on capturing quality data, artificial intelligence-guided (machine learning and evolutionary computing-based artificial intelligence and fuzzy logic technologies) farm operations, intelligent and smart robotic platforms. Connectivity, smart-links and autonomy of farm operations both in field and controlled environment systems are going to improve drastically. Research and technology development should also focus on supply chain and postharvest technologies as the post-production waste of horticultural products is greater than 50%. Circular and integrated systems approaches must be considered to re-cycle resources and meanwhile better manage waste products converting them into usable inputs within the production system, thereby enhancing resource use efficiency, minimizing environmental footprints, and enhancing sustainability in horticultural production.

Precision horticulture technologies with affordable cost that can benefit growers on a small and local scale will also be needed. Research and development with new crop varieties that are resilient for environmental stressors will allow using resources more effectively both in field condition and under controlled environment systems. The use of local crop varieties and organic horticulture can also be considered. Empowering small farmers worldwide with technology and knowledge will also be an important part

› Crop health monitoring with mobile phone. Source: Biological Systems Engineering, Washington State University.

of the sustainable solution for feeding the world.

Through scientific events such as webinars, workshops, symposia, and conferences, we will advance the understanding of our stakeholders and members of these concepts and emerging technologies. We will continue to embrace multidisciplinary approaches and meetings within and outside the Society. Encouraging and growing private industry participation in ISHS forums and events will enhance discussions, collaborations, and further contribute to innovations in precision horticulture and engineering. Case-specific infusion of brainstorming and learning sessions that meet at the intersection of horticultural science, engineering and emerging technology will play a key role and advance participation, collaborations, and innovations in precision horticulture and engineering. We will continue to harness the opinions and perception of our young minds as new horticulturists, students, and postdocs to ensure that their voices are taken seriously as we continue identifying and implementing future requirements, advancements and innovations in precision horticulture and engineering. Their participation beyond conferences and symposia within the Division and Working Groups activities will play an important role and will continue to be encouraged. It will be critical to enhance our interactions and collaborations with our peer societies such as Institute of Electrical and Electronics Engineers (IEEE), American Society of Agricultural and Biological Engineers (ASABES), International Commission of Agricultural and Biosystems Engineering (CGIR), International Federation of Automatic Control (IFAC) with targeted efforts including organizing joint technical events with webinars, workshops, and with concept papers and thematic/special issue journals. The field of scientific publication is ever changing, and thus are the expectations about publishing for scientists. As open access publishing is on the rise, preprints are becoming a normal and citable mode of publication.

Adaptation to functional changes in the post-COVID-19 world will be needed. As the pandemic challenged many societies with organizing scheduled scientific events, there will be critical need to transition from traditional models of organizing scientific events to hybrid models and to adapt in times of crisis by developing new and innovative ways to inspire, attract, and enable diverse participation and networking from within the ISHS network and other societies. There is also a need to adapt to global changes by continuing to develop and implement action plans, considering the strategic direction of world horticulture "Growing the future while improving the environmental sustainability." Division Precision Horticulture and Engineering, with its working groups, members, partnering industries, under the umbrella of ISHS, will continue to focus on enhancing education, collaboration, innovation, and implementation of precision and digital horticulture both in the field and under controlled environments to contribute to our Society's efforts to help shape the future of horticulture on Earth and beyond.

› Murat Kacira

› Pierre-Emmanuel Bournet

› Lav R. Khot

› About the authors

Murat Kacira is Director of the Controlled Environment Agriculture Center and he is a Professor in the Biosystems Engineering Department at the University of Arizona, USA, and the Chair of ISHS Division Precision Horticulture and Engineering. His research involves automation, environmental control, alternative energy in controlled environment agriculture systems (CEA) and resource use optimization in CEA systems including greenhouses and vertical farming-based plant factories with artificial lighting. E-mail: mkacira@arizona.edu

Pierre-Emmanuel Bournet is Professor and Head of the Environmental Physics and Horticulture Research Unit at the Agro Institute, Angers, France, and is Vice-Chair of ISHS Division Precision Horticulture and Engineering. His research focuses on modeling of greenhouse distributed climate and urban climate with emphasis on radiative transfers and interactions of the crop or trees with the local climate. E-mail: pierre-emmanuel.bournet@agrocampus-ouest.fr

Lav R. Khot is Associate Professor in the Biological Systems Engineering Department and Interim Director of WSU's Agricultural Weather Network at Washington State University, USA, and is Chair of ISHS Working Group Mechanization, Digitization, Sensing and Robotics. His research focuses on precision agriculture, sensing and automation technologies to support fruit and berry crop production. E-mail: lav.khot@wsu.edu

› Qichang Yang

Qichang Yang is Director general of Institute of Urban Agriculture, Chinese Academy of Agricultural Sciences (CAAS), China, and the IEAS (International Eurasian Academy of Sciences) Academician, is Chief Scientist and the Director of Key Lab of Energy Saving & Waste Management of Agricultural Structures, Ministry of Agriculture and Rural Affairs, China, and is the Chair of ISHS Working Group Design and Automation in Integrated Indoor Production Systems. His main research activities include energy storage and thermoregulation of greenhouse, and the improvement of light and energy efficiency of plant factory. E-mail: yangqichang@caas.cn

› Irineo Lopez Cruz

Irineo Lopez Cruz is Professor in the Mechanical Engineering Department and Graduate Agricultural Engineering Program at the University of Chapingo, Mexico, and is the Chair of ISHS Working Group Greenhouse Environment and Climate Control. His research is on mathematical modeling, optimization and control of biosystems, greenhouse environment, and crop growth, greenhouse-type solar dryers, and artificial intelligence. E-mail: ilopez@correo.chapingo.mx

› Weihong Luo

Weihong Luo is a Professor in Nanjing Agricultural University, China, and is the Chair of ISHS Working Group Modelling Plant Growth, Environmental Control, Greenhouse Environment. Her research activities focus on greenhouse climate and crop growth modeling, model-based optimization for greenhouse climate and crop management. E-mail: lwh@njau.edu.cn

› H. Jochen Schenk

H. Jochen Schenk is Professor in the Department of Biological Science at California State University Fullerton, USA, and Chair of ISHS Working Group Sensing Plant Water Status. His basic research addresses the physiology and biophysics of water transport in plants, including structure-relationships in xylem. His horticultural research uses plant-based measures to determine water use in avocado, citrus, woody landscaping plants, and in bamboo. E-mail: jschenk@fullerton.edu

› Hicham Fatnassi

Hicham Fatnassi is a Senior Horticulture Scientist at ICBA International Center for Biosaline Agriculture in Dubai, United Arab Emirates, and is the Chair of ISHS Working Group Computational Fluid Dynamics. His research focuses on modeling, analysis, and design of innovative and environmentally friendly greenhouse systems, greenhouse ventilation, climate control, and alternative energy. E-mail: h.fatnassi@biosaline.org.ae

› Roberto Lopez

Roberto Lopez is Associate Professor in the Department of Horticulture at Michigan State University, USA, and is the Chair of ISHS Working Group Light in Horticulture. His research focuses on propagation and production of young and finished plants (including bedding plants, specialty cut flowers, leafy greens, culinary herbs, and hemp) in greenhouses, growth rooms/containers, warehouse-based plant factories, and vertical farms. E-mail: rglopez@msu.edu

Understanding plant physiology and plant-environment interactions in field systems is crucial in a changing world

Evelyne Costes

Our world and everyday environment are changing dramatically. Rapid climate change plus the pandemic context that we are experiencing worldwide are alarming. However, they favor changes in our collective perception of what the key priorities and urgencies are for preparing the future of our planet and the livelihood of humans. We are all aware that the need for food is increasing proportionally with increases in population, and that Horticulture must contribute to this challenge. Fruit and vegetables are key for the human diet and health. Demands for healthy products produced in healthy environments have strongly increased. Different solutions to face these issues are emerging, including those deeply anchored in new technologies for managing water, light and nutrient supplies. However, growing plants in field systems is, and will certainly remain, the most common way to produce food around the world, especially where costly technologies are not affordable or appropriate. Therefore, solutions and innovations accounting for the diversity of field systems and environments must be urgently explored to face ongoing changes and to promote the sustainability of cultivation systems.

Climate and field systems are diverse and are rapidly changing

Field systems are currently diverse because, after 50 to 60 years of massive intensification and industrialization of food production systems in industrialized countries, we are now observing that other systems, which have promoted the maintenance of biodiversity, present key advantages for plant and soil health and possibly for production. Those systems range from organic production, agro-ecology and agro-ecological intensification, mixed cropping systems and agro-forestry. These systems are experienced worldwide and, as many plantation designs and associations between crops are possible, a large range of combinations and agronomic techniques are being tested. Those experiences open the way to combine food production while increasing quality and health; including soil, air, plant and human health. This vision is now promoted through the One Health concept and shared by all crops, including Horticulture. This concept underlines the close interdependence of human, environment, animal, socio-economy and agro-ecosytem health and supports a systemic approach for their study, considering these health dimensions altogether.

In parallel, changes in our collective perception of key priorities for our future also result from the alarming modifications of climate. With global warming, there are more frequent extreme events such as storms, cyclones, diluvian rains or drought periods. Depending on the region around the world, the challenges may be different with more stress put on water shortage or flooding risks, high temperatures and solar radiation damage, lack of cold in winter for temperate crops or late frosts that can kill flowers and decrease fruit production, as we have experienced in Europe in 2021. Therefore, adapting cultivated plants and making appropriate choices in terms of variety and/or cultivation systems in a given environment are crucial and urgent.

Plant physiology may help finding robust and long-term solutions

In the context of climatic and field systems being diverse and under rapid change, why is it so important to persevere in increasing understanding of plant physiology and interactions between plants and environments? First, biological and biochemical solutions that are currently present in the different species we are using for cultivation and food have been selected across the thousand years of evolution of plants and their co-evolution with associated organisms. Those solutions are thus most likely robust and reliable. Having thought that artificialization and intensification of agronomic field systems would emancipate humans from natural selection and its fine-tuned combinations of plant functions is a dream that is currently being challenged. Therefore, understanding the complex networks of solutions that have led to plant adaptation in the evolutionary process, represents a solid basis for preparing future breeding and cultivation practices for food production. We need drastic and rapid innovations, whereas plant physiology will not change as fast as "environments" (due either to changes in climate or cultivation practices). We may not have enough time to understand and make use of the knowledge of the mechanisms involved in plant adaptation and resilience capacities before the current ongoing changes occur. We will thus have to develop new knowledge and make use of genetic resources as well as new technologies, including biotechnologies, whilst carefully examining their respective potentials together with societal and ethical consideration.

The richness of plant physiology is being deciphered

Second, the richness of plant physiology is progressively being deciphered in very encouraging ways thanks to the progress since the 19th century. Major discoveries of plant functions and responses to the environment have been made since the deciphering of photosynthesis, biochemical reactions, hormone roles, etc. Knowledge has increased remarkably during the 20th century with the discovery of DNA and genome expression. Originally carried out on the plant model *Arabidopsis thaliana*, studies that aim at deciphering the molecular and genetic mechanisms of plant perception and responses to their environment are progressively benefiting studies of horticultural crops. Species such as tomato, grapevine or rose have emerged as "model" plants for studying fruit development, maturation, and quality (including volatiles), to cite a few examples of functions that could not be studied in *Arabidopsis*. Currently, even perennial species, especially fruit trees and ornamentals, are studied through "translational biology", by

checking whether – and to which extent – a mechanism described in a model plant is conserved among crop and native species.
With the emergence of "omics", the different levels of plant physiology from gene expression, regulation, protein production and interactions, and metabolite production are being investigated in numerous key processes of plant production. Such processes concern plant growth and development, flowering, fruit set, leaf gas exchange, water use and transpiration, carbon allocation, and root nutrient uptake and distribution. Nowadays, the expectations for the 21st century, being announced as the century of Biology, are immense. A new paradigm is appearing with the discovery of epigenetic regulation and the role of small RNA that plays a key role in the regulation of the genome(s) expression during the interactions between plants and their environment (in the large sense). This reveals the fascinating complexity and fine tuning of plant functions that are likely keys for understanding the success of flowering plants despite their immobility and the multiple abiotic or biotic stresses they have to face during their life.

Where can innovations be expected?

Despite huge progress, knowledge in plant physiology is still missing in recently arising domains, especially those linked to agro-ecological transitions and to systems where more biodiversity and plant services are considered. Up to now, physiological mechanisms have been preferentially explored from genes to individual organism scales, more rarely at coarser scales. However, increasing biodiversity in cultivation systems often requires better understanding of plant-plant, plant-microbiome and root-soil interactions. While monocultures rely on the dogma derived from plant and species competition, association studies promote concepts in which plants might cooperate. The observation of between plants beneficial effects originates from ecology, where plants are studied in their biotopes, as cohorts of associated species. In natural biotopes, complementation of plant architectures and functions is often considered as the basis of selection and co-evolution. This has led to the concept of "complementation of niche" which is now being considered in agriculture, in plant associations or mixture studies. Similarly, the need for reducing inputs while maintaining soil fertility and organic matter content has put more stress on the descriptions of soil composition and root-soil exchanges. These descriptions have highlighted depletion of soil quality or, in other situations, richness and complexity of microbiomes. Studies of microbiomes, although not really new, are becoming more numerous and raise questions regarding plant nutrition, root absorption as well as rhizodeposition that will require further attention.

What are the bottlenecks?

These developing topics require studies across multiple scales, from genes to individuals but also from individuals to plots and landscapes. They multiply the functions and scales of description. These topics also require inclusion of more "players" than the ones previously considered: in addition to plant organs and climatic environment, associated plants, fungi, bacteria, other micro-organisms and pathogens will have to be considered. The new challenges of addressing multi-scale mechanisms and multiple interactions imply addressing more complexity. As many plant-plant, plant-micro-organism or plant-pathogen combinations are possible in agro-ecological or mixed systems, it will be impossible to conduct experiments on all of them. Moreover, studies regarding plant responses to environmental conditions must be continued since multi-site experimentations are still of key importance for finding appropriate plant material and cultivation systems for many horticultural crops. Altogether, these challenges constitute bottlenecks in terms of research capacities and techniques, but also urge development of innovative solutions.

Future directions for studying plant physiology in field systems

Different complementary directions are emerging that will likely drive the future of studies on plant physiology in field systems. They involve: i) experiments on innovative systems and screening of genetic resources; ii) phenotyping with digital techniques to help capture relevant information on plant physiological status in different climatic or cultivation situations; iii) producing molecular and "omics" data to decipher functions and mechanisms involved in interactions between various types of organisms, plants and the environment; iv) organizing and making data and metadata on phenotypes, genotypes, and physiological properties accessible at all scales; v) developing models to aggregate knowledge at different scales and elaborate more complex comprehension of plant physiology to predict behaviors in a broad range of situations that are not achievable by experimentation.
In the future, carefully designing field experiments, including multi-site comparisons and new cropping systems, will be crucial for collecting new datasets that will help to elaborate new knowledge and promote attenuation and/or adaptation of plants for future conditions. These experiments will need to involve new phenotyping techniques, i.e. both automated and high throughput, that are quickly developing. However, to serve our comprehension and use of plant physiology in interactions with the environment, relevant links will have to be established between numeric outputs and traits that are meaningful with respect to plant biology and plant performance. Among those traits, plant phenology, architecture and vigor, eco-physiological and functional traits are certainly the most important, especially for screening genetic resources and describing plant adaptation or resilience capacities to biotic and abiotic stresses.
The production of molecular and omics data is very actively ongoing and is now leading to the construction of genetic regulatory networks that can be compared across conditions and species. The comprehension of epigenetic regulation is more at its infancy but is also rapidly progressing. These studies with phenotyping contribute to a "data deluge". Regarding the organization and access of those data into databases, the example of genomics, for which online international databases are well accepted and widely used (e.g. NCBI), needs to be extended to phenotypes and metadata. Huge efforts are performed in this direction, with the concept of FAIR (Findable, Accessible, Inter-operable and Re-usable) data becoming the standard. Data Management Plans and Dataverse online systems, which accompany most of our projects, are also adding value to the collected data.
Finally, modelling will be the corner stone for aggregating knowledge, testing new ideas, predicting and exploring future or possible scenarios regarding plant behaviors and their variability in relation to cultivation systems and climatic conditions. Experimental results as well as virtual scenarios, including climatic projections, will have to be considered. Modelling constitutes a possible way for gaining time against ongoing rapid changes. But, as for phenotyping, models will be useful when conceived in multi-disciplinary approaches, combining skills in computer science with those in agronomy, biology and physiology.

In conclusion

Horticultural crop physiology in field systems and interactions with the environment is a fascinating domain that has the ability to contribute to the many challenges for sustainable and adapted horticultural crop production. The ten working groups that constitute ISHS Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems are currently very active and contribute greatly to scientific progress within ISHS. This domain will have to consciously adopt an adequate use

of new technologies, including biotechnologies, that address both the hopes and threats for our future. Promoting debates and interdisciplinarity, including multiple – and possibly divergent – visions across crops, countries and societies, is an additional challenge we must face as an International Society for Horticultural Science.

› Evelyne Costes

› About the author

Dr. Evelyne Costes is Chair of ISHS Division Physiology and Plant-Environment Interactions of Horticultural Crops in Field Systems. She is Director of research at INRAE Montpellier, France. She studies fruit tree architecture and flowering in relation with genetic variations and eco-physiological functions, mainly on the apple tree. She develops and makes use of functional-structural plant models and high-throughput phenotyping methods. E-mail: evelyne.costes@inrae.fr

An international competition for those who have recently completed their Ph.D to present their thesis in 3 minutes at the IHC2022 plenaries

The Education Committee of IHC2022 is pleased to launch an international competition for PhD theses in Horticulture, in the form of a "My thesis in 3 minutes" competition. This new competition, named 3MHT, is conceived as a specific event, designed for this congress. It is distinct from the existing ISHS awards, more directly related to the symposia of the international congresses and often dedicated to young people in the course of their studies. The 3MHT is designed to showcase the work of young scientists who have recently defended an outstanding PhD in the field of horticulture, with a vote by the congress audience.

A maximum of two candidates (female and male) per country, with academic approval by the national institution responsible for Horticulture – ISHS Council member or not – can participate in the competition. The best accredited candidates, after a pre-selection step by an international jury (spring 2022), will compete orally during IHC2022. The pre-selected participants will be awarded a free registration to the congress and the three winners according to the audience vote of the IHC2022 plenaries will be granted a prize with an estimated value of 2,000 to 2,500 Euros, resulting from an endowment by our sponsors.

We count on you for ensuring that this competition is effectively publicized to the national institutions of your choice, which will likely organize this competition at national level.

Competition rules

Within the IHC2022 (www.ihc2022.org) organized in France under the aegis of the ISHS, it appeared important to promote and reward young scientists – women and men – most able to communicate in 3 minutes in a very effective and convincing way on their research, using a language adapted to a non-specialist audience. The competition "My 3-Minute Horticultural Thesis" (3MHT) is open to any candidate who has defended her/his PhD thesis between October 2020 and February 2022. The topic of candidate PhDs must be consistent with one of the major topics of IHC2022:

- Competitiveness and skills for horticultural value chains;
- Food, human health and well-being of citizens;
- Sustainability of production systems;
- Adaptation to climate change and mitigation.

The candidate PhDs shall bear applications for the progress and transitions of global horticulture in these domains. The Organizing Committee will circulate the competition rules to all countries where the horticultural sector is an important issue, including ISHS Council member countries.

A sovereign international jury, set up by the organizing committee of IHC2022, will include scientists and professionals from all over the world. It will ensure a pre-selection of the candidate PhDs and arbitrate the competition during the congress, based on oral performances in 3 minutes. The final ranking will lead to the choice of three winning PhDs according to the votes of the audience. This competition is distinct from the ISHS awards attributed to the best oral presentation and the best poster usually linked to the symposia. The competition consists of three stages summarized below.

Stage 1: National pre-selections (December 2020 - March 15, 2022)

This step is organized at the initiative (and under the responsibility) of each country. It can be based on a pre-existing national competition or be organized de novo. Eligible candidates from a university or a laboratory in the country (but not necessarily native to that country), must have defended their PhD between October 2020 and February 2022. The qualification criteria are academic (quality of research, valorization, etc.). At the end of this stage, a maximum of two candidates per country (1 man and 1 woman) are encouraged to present themselves at stage 2 by submitting their application to the international jury (see below). One of the representatives of the country accredits the applications to the jury by March 15, 2022.

Stage 2: International pre-selection (March 15 - May 15, 2022)

An international jury of seven members, balanced and impartial (no conflict of interest), will ensure a pre-selection on the basis of the applications received. The application of each accredited PhD candidate shall include: a curriculum vitae, a personal video explaining in a very synthetic way the scope of her/his research work for the progress of horticulture, and a 1,500-word abstract. These applications will be graded by the jury, according to a multi-criteria grid (quality and originality of communication, English proficiency, innovation potential for the horticultural sector). The main pre-selection will consist of 12 candidate PhDs and a complementary list of 6, with the whole respecting gender equity and diversity of origins. Candidates shortlisted in the main list will be informed of this decision

in mid-May 2022 by the international jury: they will benefit from a free IHC2022 registration and are expected to attend the congress physically. The abstracts of the 12 pre-selected PhDs will be published in Chronica Horticulturae (end of 2022), with a short presentation of the author. The complementary list may be called, in order of merit, if some of the PhD candidates on the main list are not able to present orally their thesis during the Congress.

Stage 3: Competition during the IHC2022 (August 14-18, 2022)

The pre-selected PhDs will be divided into three groups by the competition's organizing committee on Sunday, August 14 (upon registration). At the end of each plenary session (Monday 15, Tuesday 16 and Thursday 18 August), the candidates will orally present their research work in 3 minutes, according to the principles of national 3MT competitions (e.g. https://threeminutethesis.uq.edu.au/). This oral communication in English must be convincing and understandable by a non-specialist audience, and recall the main results and their application scope. The jury will establish the ranking according to the votes of the audience at the end of each plenary session, then compile the rankings of the three sessions. A prize will be awarded to each of the three laureates during the ISHS General Assembly (August 18, 2022). The prizes awarded, with an estimated value of 2,000 to 2,500 Euros, will result from an endowment by the sponsors of the Congress.

› Contact

Jean-Luc Regnard (jean-luc.regnard@supagro.fr) or Rémi Kahane (remi.kahane@cirad.fr)

› ISHS Young Minds Award winner summaries

Below is a selection of research summaries from winners of ISHS Young Minds Awards for best oral and poster presentations at ISHS symposia. To view other exciting research summaries by other winners, please visit www.ishs.org/young-minds-award.

Supporting family farming resilience to climate change impact sustainably: the contribution of climate-smart agriculture under North African context

› Youssef Brouziyne

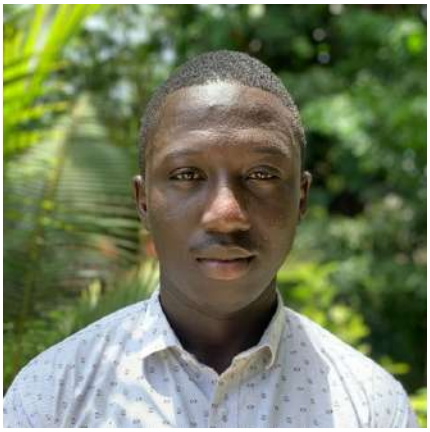
Dr. Youssef Brouziyne has an agronomic engineering degree from the Hassan II Agronomic and Veterinary Medicine Institute in Morocco, and a Master of science degree in integrated crop management from the Mediterranean Agronomic Institute of Bari, Italy. He completed his PhD in the Department of Water and Environment at the Faculty of Sciences and Technologies of Fez, Morocco. He gained international experience in sustainability management and research and development while serving world-class agri-business corporations in north-western Africa, southern Europe, and in the UK. Currently, he is a researcher and lecturer at Mohammed VI Polytechnic University in Morocco. His research focuses on the response of crops to climate change impacts and how to increase the resilience and sustainability across the agricultural value chain. His research on farming systems in Africa designs specific climate-smart agriculture (CSA) systems based on agronomic knowledge, experimentation, and modelling. His results examined the increased resilience and productivity of widely grown crops for small-holder farmers in northern Africa under a changing climate, just after implementing affordable and sustainable CSA-based approaches. This investigation involved high resolution geophysical databases, data about local agronomic knowledge, physical models, projected climate data, as well as ground experiments to identify crops parameters required for model's calibration. Results showed that adopting a no tillage strategy, combined with a shift in the usual planting times in some situations, might increase both wheat and sunflower crop water productivity by up to +25% and +47%, in some scenarios, while preserving up to +6% of annual water yield in the study watershed. The outcomes of this project helped to advance knowledge about the input of CSA in making family farming systems resilient to climate change in northern Africa and proved that adaptation could be achieved sustainably.

Youssef Brouziyne won the ISHS Young Minds Award for the best oral presentation at the IV All Africa Horticultural Congress (AAHC2021), which was held virtually in Senegal in March 2021.

› Contact

Dr. Youssef Brouziyne, International Water Research Institute, Mohammed VI Polytechnic University, Lot 660, Hay Moulay Rachid Ben Guerir, 43150, Morocco, e-mail: youssef.brouziyne@gmail.com

Effectiveness of vermicomposts from horse, cow and poultry manure on lettuce growth



› Issa Alé Ndiaye

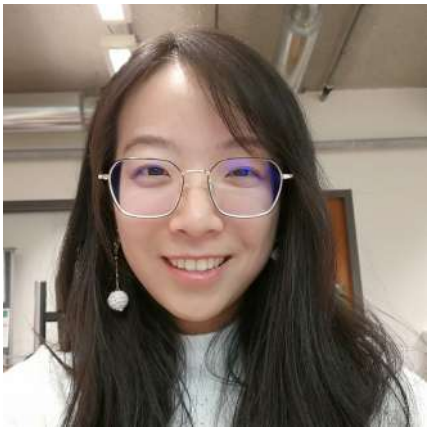
I am a teacher-researcher at the Cheikh Anta Diop University in Dakar, Senegal. My Ph.D. in Agroecology has allowed me to gain expertise in urban agriculture, waste management and vermiculture technologies. In the context of the reduction of arable land and urbanization, sustainable techniques must be developed to guarantee food quality. My current research involves soil-less crops and organic fertilizer production. My research examined the possibility of increasing crop productivity through micro-gardening, and the substitution of chemical fertilizer with vermicompost. This study aimed to determine the effectiveness of vermicomposts from three types of manures on the agronomic parameters of lettuce. The objectives are i) to evaluate the toxicity of vermicomposts on seed emergence and ii) to evaluate the efficacy of vermicomposts on lettuce growth. A mixture of sand and vermicompost was used for each type of vermicompost, D1 (25% vermicompost + 75% sand), D2 (50% vermicompost + 50% sand), D3 (75% vermicompost + 25% sand), D4 (100% vermicompost). These treatments were compared to a synthetic chemical fertiliser. The results showed that the soil amended with vermicompost gave a higher yield than the synthetic chemical fertiliser. The results also determined an optimal dose for the agronomic parameters of each crop. The vermicompost from horse manure (D3) was more suitable for germination and increased leaf surface of lettuce. Vermicompost based on poultry manure (D4) produced a higher number of leaves. For increasing the weight of lettuce, the cow manure vermicompost (D1) gave the best result. This research has contributed to the use of vermicompost as an alternative to synthetic chemical fertilizer.

Issa Alé Ndiaye won the ISHS Young Minds Award for the best poster at the IV All Africa Horticultural Congress (AAHC2021), which was held virtually in Senegal in March 2021.

›Contact

Issa Alé Ndiaye, Cheikh Anta Diop University of Dakar, Faculty of Science and Technology, Department of Animal Biology, Laboratory of Integrated Production and Protection in Agroecosystems (I2PIA), Mermoz rue 114, Dakar, Senegal, e-mail: zafissa92@gmail.com

Regulation of fruit set by light quality: a case study on pepper



› Sijia Chen

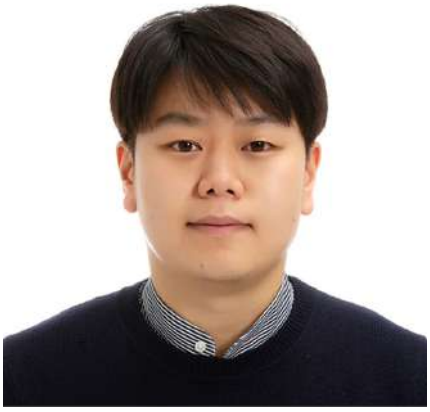
Sijia Chen is a PhD student at Horticulture and Product Physiology, Wageningen University, the Netherlands, supervised by Dr. Ep Heuvelink, Professor Leo Marcelis as well as Professor Remko Offringa (Leiden University). Her research focuses on the effect of the light spectrum on fruit set in sweet pepper (*Capsicum annuum* L.). Fruit set is a crucial plant developmental process, determining yield in many crops. Pepper, as one of the most important and commonly consumed vegetables, is a crop with poor fruit set as typically about two-third of all flowers abort. Weeks with good fruit set are alternated with weeks with poor fruit set, resulting in a flushing pattern in fruit set and yield. Abortion of flowers and fruit in peppers is an active process involving the formation of an abscission layer, which could relate to the endogenous hormonal signaling. A higher light integral improves fruit set. However, the role of light spectrum has hardly been investigated. Opportunities for detailed investigations of light quality effects on fruit set have strongly increased because of the development of narrow band LED lighting. This research aims to improve the understanding on how fruit set can be manipulated by light spectrum, by studying the physiological and molecular mechanisms. For this purpose, Sijia has conducted a series of climate chamber experiments. She found that far-red radiation increased the fruit abortion in sweet pepper, and this effect was missing when the tops of the plants were removed. The underlying mechanism of this effect awaits further investigation.

Sijia Chen won the ISHS Young Minds Award for the best oral presentation at the IX International Symposium on Light in Horticulture, which was held virtually in Sweden in May-June 2021.

› Contact

Sijia Chen, Horticulture and Product Physiology, Wageningen University, Droevendaalsesteeg 1, 6708PB wageningen, The Netherlands, e-mail: sijia.chen@wur.nl

Anthocyanins increase lighting cost in indoor lettuce production by reducing photosynthetic efficiency



› Changhyeon Kim

Changhyeon Kim is a PhD student supervised by Dr. Marc W. van Iersel in the Department of Horticulture at the University of Georgia, Athens, Georgia, USA. His research focuses on development of a mechanistic model of lettuce dry matter accumulation to optimize lighting cost in controlled environment agriculture (CEA). He completed his BSc and MSc with a focus on fertigation for indoor crop production in the Department of Horticultural Science, Chungnam National University, Republic of Korea, in 2013 and 2015. In 2018, he obtained a second MSc degree with a focus on raspberry transformation in the Department of Plant Sciences, North Dakota State University, USA. Lighting, which accounts for up to 30% of total production cost, greatly impacts economic feasibility in the CEA industry. Lowering the lighting costs can be achieved by improving photosynthetic efficiency. The quantum requirement (QR, photons needed to fix 1 CO_2) of C3 plants is typically estimated as 8-15 mol mol^{-1} depending on temperature and CO_2 concentration. Anthocyanins, non-photosynthetic pigments, absorb photons and dissipate as heat for photoprotection, therefore presence of anthocyanins decreases number of photons for photosynthesis. However, the effect of anthocyanins on photosynthesis and QR is not clear. The objective of this study was to quantify the effect of anthocyanins in nine lettuce cultivars with a range of anthocyanins in their leaves. Greenhouse-grown lettuce was used to measure leaf absorptance, anthocyanin concentration, and leaf photosynthesis at different photosynthetic photon flux densities (*PPFDs*) to calculate QR. Anthocyanin concentration was positively correlated with absorptance, especially in the green part of the spectrum. Anthocyanins decreased the gross photosynthesis (P_g) at all *PPFDs*. P_g at a *PPFD* of 1500 µmol m^{-2} s^{-1} decreased by 69% as anthocyanin increased from 15.1 to 69.3 mg m^{-2}. QR was 275 mol mol^{-1} in plants with high anthocyanin and at high *PPFD*. This was much higher than the typical estimates. Higher anthocyanin concentration and *PPFD* reduce photosynthetic efficiency and increase QR. The inhibitory effect of anthocyanin implies that environmental conditions in CEA should be manipulated to induce anthocyanin accumulation shortly before harvest to reduce lighting cost.

Changhyeon Kim won the ISHS Young Minds Award for the best poster at the IX International Symposium on Light in Horticulture, which was held virtually in Sweden in May-June 2021.

› Contact

Changhyeon Kim, Department of Horticulture, University of Georgia, 1111 Miller Plant Science Bldg, Athens, GA 30605, USA, e-mail: changhyeon.kim@uga.edu

The world of Horticulture

IHC2022: a lively Congress to reconnect with communities of horticulture and beyond

IHC 2022
INTERNATIONAL HORTICULTURAL CONGRESS
ANGERS – FRANCE
www.ihc2022.org

Experience the French "art de vivre" during IHC2022!

You all know about the next International Horticultural Congress to be held in Angers, France, on 14-20 August 2022 (www.ihc2022.org). However, you probably do not know yet how much horticulture in France is highly developed, diversified, and competitive. France is the third largest producer of fruits and vegetables in the European Union, behind Italy and Spain. All kinds of horticultural crops are present in France, from apple to banana, from artichoke to chayote, from lily of the valley to bird of paradise, and from lavender to vanilla, thanks to its temperate and tropical territories. This very diverse sector is dynamic, and can rely on numerous official signs and quality procedures, in food as well as in ornamentals or landscaping production. It is a great source of inspiration for French artists, whether chefs, dress makers, or painters: it is a cultural way of life, continuously studied and reinvented by scientists and professionals.

The host destination of IHC2022 is Angers, a human size city compared with the former hosts of IHC: Istanbul, Brisbane, Lisbon or Seoul. Located in the Loire Valley, a UNESCO World Heritage site, Angers is incontestably the French capital of horticulture, remarkable for its richness and diversity, from tradition to innovation and, from urban to nature. It is France's greenest city and top for quality of life, combining a dynamic economy, and a preserved environment. The region has everything it takes to be a world attraction: nature, history, wines and fine gastronomy (Figure 1).

The diversity and the link research-education-industry will be at the core of the congress as well as at the heart of the city: the venue is organized around the botanical garden "Jardin des Plantes", with the renovated Congress Center and the University of Angers, both served by the tramway. Moreover, the entire city will sound and vibrate under the topics of horticulture, with the support and technical touch of the Angers City Council.

Figure 1. Corniche Angevine (©Sébastien Gaudard).

A scientific programme with cross cutting topics

The organizers realize that IHC2022 will combine the tourist appeal of Angers and the region with the high quality of the presentations, scientific, professional, educational or emotional. In particular, a number of international invitees with various backgrounds will open each day of the congress with their views on the major issues of our time: climate change, the defense of biodiversity, the agro-ecological transition and the sustainability of food systems. The programme of the congress will proceed during the course of five days (Figure 2). Symposia and workshops occur each day in a preferentially on-site status, to stimulate exchanges and interactions, all that was missing during the pandemic, despite all kinds of virtual events. Half a day of a wide array of technical local tours are scheduled. Attendees will relax and benefit from the exceptional number of magnificent sites, well worth the visit.

The main scientific part of the congress is comprised of 25 symposia (Table 1), whose topics have been relevantly discussed and formulated thanks to the IHC2022 Scientific Committee, the ISHS Executive Committee (Division and Commission Chairs), and the respective conveners and scientific committees of each symposium. Each symposium is organized in sessions with keynotes, oral and e-poster presentations, and welcomes academic and applied communications. The topics will stimulate cross cutting exchanges between disciplines, crops and actors. In particular, issues such as climate change, and exchange of experience between South and North, shall be integrated into each symposium. The call for abstracts is open, you are already invited to submit your contributions (https://www.ihc2022.org/submission-registration/abstract-submission/)! A series of workshops will be offered to encourage dynamic exchanges between participants around stimulating questions (see examples at https://www.ihc2022.org/scientific-program/workshops/).

■ Table 1. IHC2022 symposia (see details at www.ihc2022.org/scientific-program/symposia).

Topics	Conveners
S1 - Breeding and Effective Use of Biotechnology and Molecular Tools in Horticultural Crops	Vincent Bus (New Zealand) Mathilde Causse (France)
S2 - Conservation and Sustainable Use of Horticultural Genetic Resources	Tiziana Ulian (UK) Raphaël Morillon (France)
S3 - Quality Seeds and Transplants for Horticultural Crops and Restorative Species	Daniel Leskovar (USA) Olivier Leprince (France)
S4 - In Vitro Technology and Micropropagated Plants	Sandra Correia (Portugal) Stefaan Werbrouck (Belgium)
S5 - Innovations in Ornamentals: from Breeding to Market	Johan Van Huylenbroeck (Belgium) Fabrice Foucher (France)
S6 - Innovative Technologies and Production Strategies for Sustainable Controlled Environment Horticulture	Youssef Rouphael (Italy) Jean-Charles Michel (France)
S7 - II International Symposium on Greener Cities: Improving Ecosystem Services in a Climate-Changing World (GreenCities2022)	Vivian Loges (Brazil) Philippe Faucon (France)
S8 - Advances in Vertical Farming	Eri Hayashi (Japan) Leo Marcelis (The Netherlands)
S9 - Urban Horticulture for Sustainable Food Security (UrbanFood2022)	Kathrin Specht (Germany) Kevin Morel (France)
S10 - Value Adding and Innovation Management in the Horticultural Sector	David Neven (Italy) Syndhia Mathé (Cameroon)
S11 - Adaptation of Horticultural Plants to Abiotic Stresses	Fulai Liu (Denmark) Bénédicte Wenden (France)
S12 - Water: a Worldwide Challenge for Horticulture!	Brunella Morandi (Italy) Marcel Kuper (France)
S13 - Plant Nutrition, Fertilization, Soil Management	Lee Kalcsits (USA) Patrice Cannavo (France)
S14 - Sustainable Control of Pests and Diseases	Lucia Zappalà (Italy) Michel Peterschmitt (France)
S15 - Agroecology and System Approach for Sustainable and Resilient Horticultural Production	Maria Claudia Dussi (Argentina) Sylvaine Simon (France)
S16 - Innovative Perennial Crops Management	Sara Serra (USA) Pierre-Eric Lauri (France)
S17 - Integrative Approaches to Product Quality in Fruits and Vegetables	Alyson Mitchell (USA) Nadia Bertin (France)
S18 - III International Symposium on Mechanization, Precision Horticulture, and Robotics: Precision and Digital Horticulture in Field Environments	Sindhuja Sankaran (USA) David Rousseau (France)
S19 - Advances in Berry Crops	Susan McCallum (UK) Béatrice Denoyes (France)
S20 - The Vitivinicultural Sector: Which Tools to Face Current Challenges?	Ahmet Altindisli (Turkey) Benjamin Bois (France)
S21 - XII International Symposium on Banana: Celebrating Banana Organic Production	Walter Ocimati (Uganda) Thierry Lescot (France)
S22 - Natural Colorants from Plants	Riikka Räisänen (Finland) Anne de la Sayette (France)
S23 - Postharvest Technologies to Reduce Food Losses	Gustavo Teixeira (Brazil) Florence Charles (France)
S24 - IX International Symposium on Human Health Effects of Fruits and Vegetables (FAVHEALTH2022)	Kaleab Baye (Ethiopia) Marie-Jo Amiot-Carlin (France)
S25 - Medicinal and Aromatic Plants: Domestication, Breeding, Cultivation and New Perspectives	Christoph Carlen (Switzerland) Guillaume Frémondière (France)

Figure 2. Programme overview of the congress – www.ihc2022.org.

In order to diversify and enlarge the audience and allow more people to benefit from IHC, the organizers have decided to open the symposia to remote attendance in a hybrid format. People who register for attendance at distance can benefit from plenary sessions and symposia presentations and propose e-posters. However, only those participants on-site will be allowed to make an oral presentation.

IHC2022 seen from an industry point of view

One of the objectives of the IHC2022 is to enlarge the audience and facilitate linkages and exchanges between researchers and companies (from producers to R&D services). It seems essential that companies are aware of the latest knowledge in the world, and that researchers listen to companies' needs. The congress plans various activities to stimulate relationships between scientists and entrepreneurs.

First, the content of the programme is open to industry topics. Thus, companies can participate in various events: the exhibition fair, symposia, workshops, and attend meetings. They can present results of a whole project or a single experiment. For each symposium, conveners will organize, if relevant, a dedicated session for professionals. When necessary, these sessions will be translated into French to facilitate access to producers. Companies are already associated in the scientific committee of symposia, more are expected to join the committees of workshops.

Figure 3. Château d'Angers exterior and gardens (©Dorothée Mouraud).

Figure 4. People behind the IHC2022 organization, with two key contacts for science and for sponsoring.

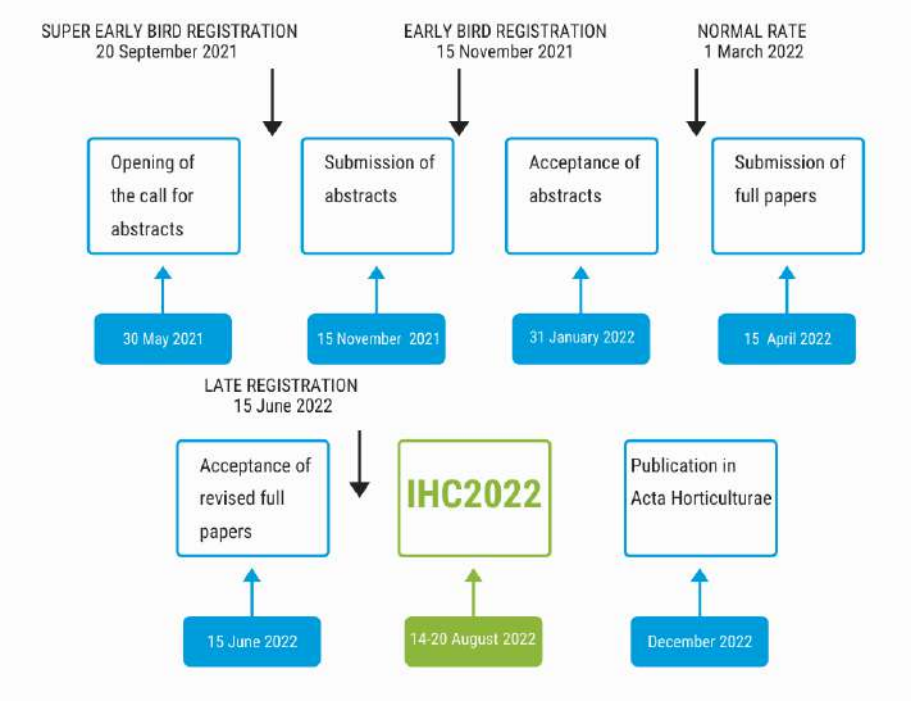


Figure 5. Key dates for the scientific production and registration to IHC2022.

Secondly, the congress will benefit from professionals who share their issues to the global scientific community. A challenge for scientists will be open in the fall. Professionals could share their problems on the website. A committee will guide the answers via a symposium, a dedicated workshop, a meeting, or a face-to-face meeting.

An attractive event for youth

With the aim of promoting stronger interaction between research, training and innovation before, during and after the IHC2022, several activities are proposed to i) involve students and young researchers in horticulture and enhance their scientific and professional skills within IHC2022, ii) promote training and pedagogical innovation in horticulture, and iii) enhance and promote IHC in training and educational institutions.

- The ISHS young minds programme will run in each symposium involving also those who have won national competitions with the exhibition of their achievements before and during IHC2022.
- The first international competition for recently graduated PhD students is inspired by the academic "Three-minute thesis" and will involve an international pre-selection of candidates from their national competition or selection.
- An original workshop on innovation in learning methods will specially focus on e-learning.
- Summer schools or research schools/ workshops before or during the congress on the main themes of IHC2022 will be promoted.
- Networking between PhD and young scientists' associations across the world will be stimulated through BtoB meetings between students and scientists or professionals.

The main argument for attracting young people and encouraging the mixing of generations remains a proactive policy of accessible prices and accommodation: this is a priority set by the organizing committee, that invites all ISHS members to encourage students and young scientists and professionals to register and get their first international experience at IHC2022.

A high quality congress for science... and more

As the congress will be hosted and embedded in the heart of Angers, history, art, and gastronomy will always accompany the participants (Figure 3). Angers will look and sound like horticulture for a full week! The evening social programme will be plentiful and at walking distance, the excursion programme in the region will be attractive and diverse, and opportunities to combine science with tourism will be numerous, from the half-day technical tours to the pre- and post-congress tours in the Loire Valley, in Brittany, or even in Occitanie (south of France). The congress will be a relaxing interlude, reason for attending the place to taste wines, discover art exhibitions, develop friendships during cocktails at botanical sites and at a memorable gala dinner.

A dedicated team for you

The organising committee is made up of men and women of science and experience of public events. The members of the steering committee are each responsible for a specific committee gathering eminent experts in each field. Getting in touch with them is made easy through the generic email addresses (Figure 4).

One of the main challenges of the organizing team is to ensure a high participation level together with a smooth scientific submission process. A simplified road map with few key dates is set up, that offers opportunities of unbeatable registration fees (Figure 5). For a world in transition, let us show that horticulture is central, addressing most of the UN Sustainable Development Goals. Horticultural science is essential to adapt to and mitigate climate change, contribute to nutrition security and human health, and develop attractive and decent jobs in a sustainable and gender equitable environment. We look forward to meeting again and to welcoming all of you next year in Angers for a safe and unforgettable event!

Flowers for all; bridging the gap between science and society

Nereu Augusto Streck and Lilian Osmari Uhlmann

Flowers are more important to humankind than ever. Since the pandemic of COVID-19 broke out at the beginning of 2020, people around the world are socially and physically isolated and therefore the healing power of flowers has played a key role in keeping people's physical and mental health. Floriculture is an important part of Brazilian agribusiness, with an average growth of 10% in 2020 compared to pre-pandemic 2019 (IBRAFLOR, 2021). The potential for a continuous growth in the coming years is huge. Brazilian flower consumption is concentrated on special occasions such as Mother's Day, Valentine's Day, Christmas, New Year's Day, International Women's Day, Secretary's Day, Fathers's Day, and All Souls' Day. As new segments and consumers are emerging in Brazil, new opportunities with local consumers who wish to buy flowers more frequently are building up.

Small landholders constitute the majority of rural families in Brazil. They are typically horticultural farmers who grow fruits, vegetables, herbs, and aromatic and medicinal plants. Only a few of them grow flowers or ornamental plants. The main destination of their fresh products is local markets. Thinking of the big chain, a nationwide project named "Flowers for All" (a translation from Portugues Projeto "Flores para Todos") was started in 2018, by a multidisciplinary and multi-institutional group of scientists, students and extension personnel called the PhenoGlad Team (Uhlmann et al., 2019).

The goals of the project are:

- to introduce flower crops into the production systems for generating profit for small farmers,
- to generate jobs in the community,
- to connect people in the community through local farmers and local consumers,
- to introduce new varieties or species of flower crops in Brazil,
- to teach gardening and flower production techniques to children and teenage students in rural schools.

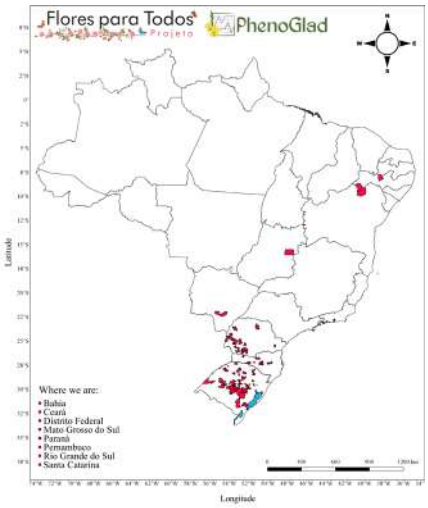


Figure 1. The geography of the "Flowers for All" project in Brazil, June 2021.

Figure 2. The "Flowers for All" project among small landholder family farmers in three states in Brazil: Rio Grande do Sul, Santa Catarina, and Parana. In Rio Grande do Sul State, the project is carried out by extension personnel from Emater/RS-Ascar.

Figure 3. The "Flowers for All" project at elementary schools E.M.E.F. Valentin Bastianello in Dilermando de Aguiar, RS, Brazil, and at Centro Municipal de Educação Infantil Vó Erna in Coronel Vivida, PR, Brazil (two top left photos, respectively), and at the E.E.E.F. Nossa Senhora Aparecida in Júlio de Castilhos, RS, Brazil (top right photo and bottom photos).

To achieve these goals, the project has two main activities: cut flower production by small landholder family farmers, and garden/flower production by students in elementary rural schools. With small landholder family farmers, the project works with cut flower crops that are suitable for open field production, easy propagation and management practices, low production costs, and good acceptance from local consumers. Flowers, such has gladiolus, statice or sea lavender, sunflower, and dahlia, work well.

In rural elementary schools, the project works with gardening and cut flowers. The project takes place every semester and each semester is assigned a phase. The first phase took place during the first semester of 2018, and the seventh phase during the first semester of 2021. During the seven phases so far, the project reached 109 families and 16 elementary schools from 96 municipalities in 8 states, involving more than 3,000 people across Brazil (Figure 1). By June 2021, more than 90 thousand flower stems of gladiolus, 20 thousand flower stems of statice, 2 thousand sunflowers, and 1.5 thousand dahlias were produced.

The approach used in the project among small landholder farmers starts with the selection of the families. Extension personnel from Emater (official state extension agencies) and PhenoGlad members from several universities in different Brazilian states select the farmers (Figure 2). Once farmers are selected, members of the PhenoGlad Team and extension horticulturists visit the farmers to teach them the main management practices, from planting/sowing to harvest. Thus, after the project is concluded, farmers are able to grow the flower crops from new plantings by themselves. More than 95% of the 109 farmers who participated in the project so far did not have any previous experience with growing a flower crop, and more than 80% of them invested in new plantings by themselves as a commercial crop after participating in the project.

In elementary rural schools, the project brings gardening and cut flower production as part of the education curriculum, aiming to trigger the interest and inspire children and teenage students with flowers and ornamental plants (Paiva, 2021). As a practical result of the project in schools, landscaping projects and flower production were developed (Figure 3). Students learn how to cultivate flowers, weed beds, and harvest flowers, bringing a new framework for teachers and students with the flowers produced in the project being used in art, geography, history, math, and biology classes.

During each phase, the results of the project are displayed in field days and on social media of the PhenoGlad Team (Facebook, Instagram, Twitter, Linkedin, and YouTube). After finishing each phase of the project, a technical meeting is held with farmers and extension agents to evaluate and plan future actions. These meetings are a unique moment where all the participants report and exchange the experience that they gained during the project.

In conclusion, the "Flowers for All" project is a successful example of bridging the gap between science and society using flowers to make the connection. The approach involves key players from farmers to consumers throughout Brazil. The community exists thanks to a nationwide network composed of teachers, students (from elementary to PhD students), scientists, extension personnel, and consultants from more than 40 institutions including universities, technological institutes and schools, elementary schools, extension agencies, and private partners who work together under the umbrella of the PhenoGlad Team. To learn more about those who are the participants of the "Flores para Todos" project, visit the PhenoGlad social media.

› Nereu Augusto Streck

› Lilian Osmari Uhlmann

› About the authors

Nereu Augusto Streck and Lilian Osmari Uhlmann are members of the PhenoGlad Team at the Universidade Federal de Santa Maria, Brazil. Professor Dr. Streck has dedicated two decades to studying and understanding the interaction between flower crops and horticultural systems, and how flower crops can provide sustainable profit for small landholder farmers. Professor Dr. Uhlmann dedicated her past decade to understanding and improving flower crops management through on-farm field experiments. E-mail: nstreck2@yahoo.com.br and uhlmannlilian@gmail.com

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Symposia and Workshops

› IV All Africa Horticultural Congress (AAHC2021)

The IV All Africa Horticultural Congress (AAHC2021) was held in Dakar, Senegal, from 29 to 31 March 2021, entirely in virtual mode, on the general theme: "Transformative innovations in horticulture". This congress was the first to be held in French-speaking Africa. This event was organized by the Horticulture Cluster, under the aegis of the International Society for Horticultural Science (ISHS), with the support and participation of the Government of Senegal, through the Ministry of Employment, Professional Training and Handcrafts, and the Ministry of Agriculture and Rural Equipment. An additional challenge was to ensure simultaneous translation of all oral exchanges.

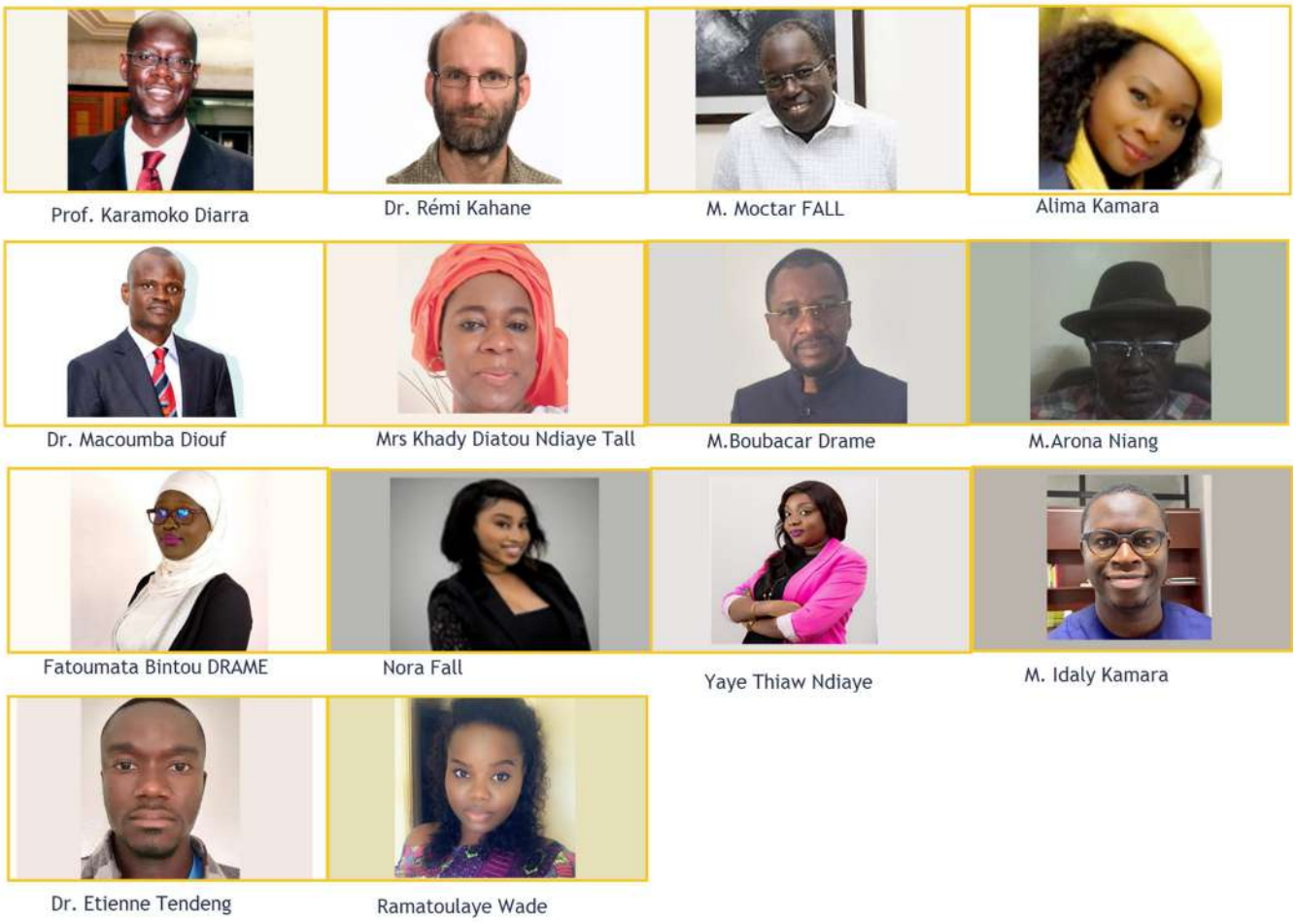
Commitment to promote an African horticulture with international outlook

Despite the sanitary and socio-economic constraints related to the COVID-19 pandemic, 226 participants from academia, research, the private sector, and national, African, and international public institutions from 37 countries were able to exchange during three days, around scientific sessions and debates on the sub-themes mentioned in Tables 1 and 2.

The congress was placed under the sponsorship of the city of Dakar. The Mayor of Dakar, Mrs. Soham El Wardini, as well as the Minister of Agriculture, Mr. Moussa Baldé, and the Minister of Vocational Training, Mr. Dame Mbodj, proceeded to the official opening of the congress. They all delivered a message of commitment and support to the scientific community and the horticultural economic sector.

The congress also obtained the support of the FAO regional office, the American cooperation (USAID), the Japanese cooperation office (JICA), the IHC2022, and many national and regional institutions, without forgetting the national and international companies that kindly sponsored the congress. It also received logistical and financial support from France (Embassy services, Business France, CIRAD).

The opening session was moderated by the Horticulture Cluster with messages from FAO, ISHS, Dakar City Hall, the French Embassy, the Ministry of Vocational Training, Apprenticeship and Insertion (MFPAI) and the Ministry of Agriculture and Rural Equipment (MAER). The FAO regional representative in West Africa and the French ambassador to Senegal presented the importance of such an event at the continental and international levels. The main challenges of horticulture in Africa were reminded each day by renowned speakers: Ousmane Badiane (Akademiya2063) on economic prospective, Boitshepo Giyose (African Union Development Agency-New Partnership for Africa's Development (AUDA-NEPAD)) on nutrition security policies, Million Belay (Alliance for Food Sovereignty in Africa (AFSA)) on food sovereignty, or Marco Wopereis (WorldVeg) on the development of under-used genetic



› Local Organizing Committee members. In a pandemic context and with many challenges, this team managed with great pleasure and constant dedication to organize the IV All Africa Horticultural Congress.

resources. The private sector had its place and delivered messages encouraging young people to invest in horticulture, in the field of seeds (Marco Van Leeuwen, Rijk Zwaan) or digital services to small producers (Daniel Annerose, Manobi).

Horticultural science in debate

The research results were presented in three parallel scientific sessions in both oral and poster formats. In total, 74 oral presentations and 33 e-posters were provided according to a program led by the President of the scientific committee, Professor Karamoko Diarra, and his Assistant, Dr. Etienne Tendeng, from Cheikh Anta Diop University (UCAD). About 28 students participated in the different panels thanks to the support of the congress sponsors.

For the Young Minds Awards of the ISHS, the jury selected Youssef Brouziyne from Morocco and Issa Alé Ndiaye from Senegal for their work on "Supporting family farming resilience to climate change impact sustainably: the contribution of climate-smart agriculture under North African context" and "Effectiveness of vermicomposts from horse, cow and poultry manure on lettuce growth", respectively.

The five workshop debates of the congress gave rise to exchanges between research and various actors of the horticultural sector (Table 2).

A continental impact

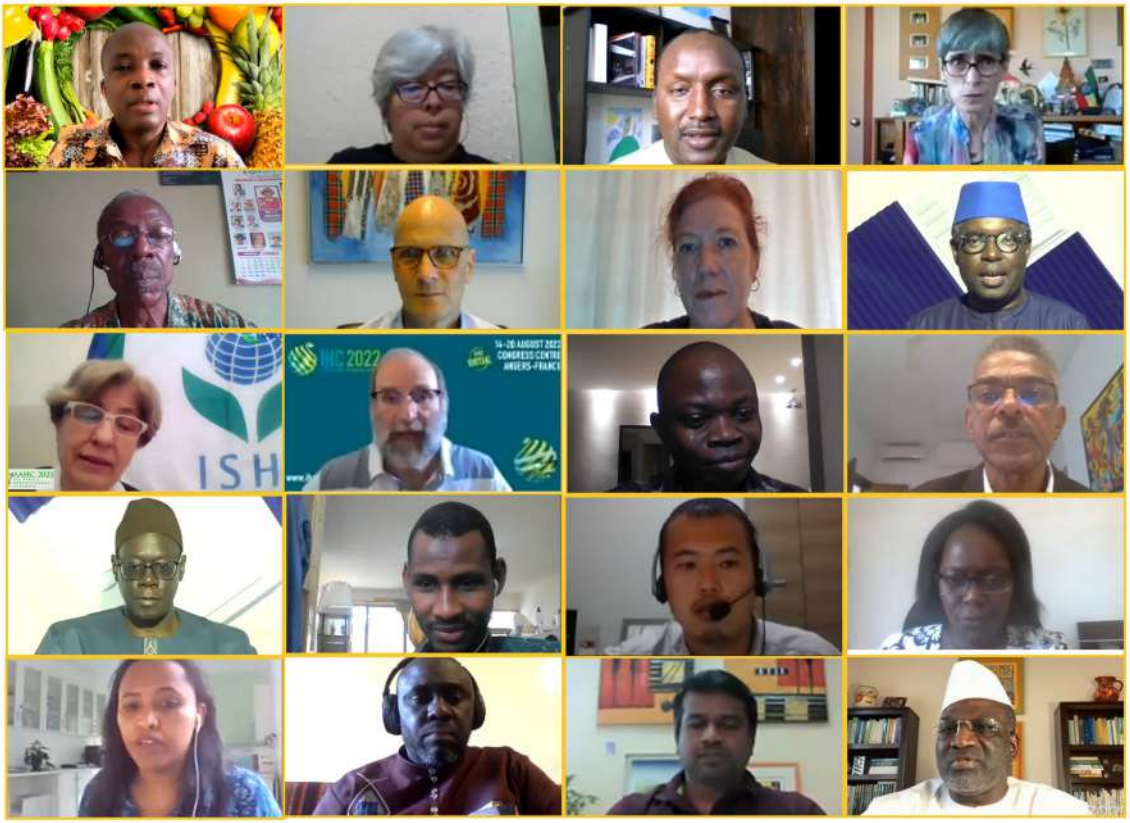
During the Business meeting, the Chairman of the Congress Organizing Committee called for the revival of the African dynamics within the ISHS, and for more exchanges between

■ Table 1. Themes for presentations during the scientific sessions.

Scientific sessions
Theme: Environment and sustainable resource management Sub-themes: Climate change, Agro-ecological transition, Horticulture and innovative technologies
Theme: Nutrition and health Sub-themes: Nutritional quality of fresh and processed horticultural products, Making value of African horticultural species, Food safety of fresh and processed horticultural products
Theme: Value chain Sub-themes: Productivity, Competitiveness, Normalisation and labellisation

■ Table 2. Topics for discussion during the congress in workshop debates.

Workshop debates
The seed systems for vegetables in Africa
The agroecological transition in horticulture in Africa
What future for urban horticulture in Africa?
Innovative horticultural financing in Africa
Towards a continental F&L market



› Online session workflow.

institutions, between actors and between countries, to make these meetings more durable, more valorizing and more fruitful. The opening to French-speaking countries will continue with the next AAHC to be held in 2024 in Morocco: all sub-regions of Africa will then have received and organized an AAHC.

To complete the event, taking the opportunity of the United Nations' celebration of the International Year of Fruits and Vegetables, the FAO organized a side event on all its horticultural activities in Africa.

This successful participation and the high level of interaction, even in virtual mode, have undoubtedly made the congress a real achievement in Africa, or at least a reference in Senegal, where this sector lacks visibility. Thanks to a partnership between the PCO of the congress, ACT Afrique, and the audio-visual group label, TV & Radio, the opening and closing ceremonies were broadcast live. Nearly 5 million households in Africa and in the rest of the world were able to follow them and thus be informed on the current events and made aware of the challenges of African horticulture.

All oral presentations, workshops and documents of the congress are available online at www.aahc2021.org for all registered participants. They will remain available until 31 March 2022, as well as the virtual stands of sponsors and partners.

Moctar Fall, Rémi Kahane, Karamoko Diarra and Etienne Tendeng

› Winners of the ISHS Young Minds Awards: A) Youssef Brouziyne (best oral presentation), B) Issa Alé Ndiaye (best poster).

› Contact

Moctar Fall, Cluster Horticulture, 2,5 km Route de lAéroport, Immeuble MSA - BP 25 852, Dakar, Senegal, e-mail: Moctarfall63@gmail.com

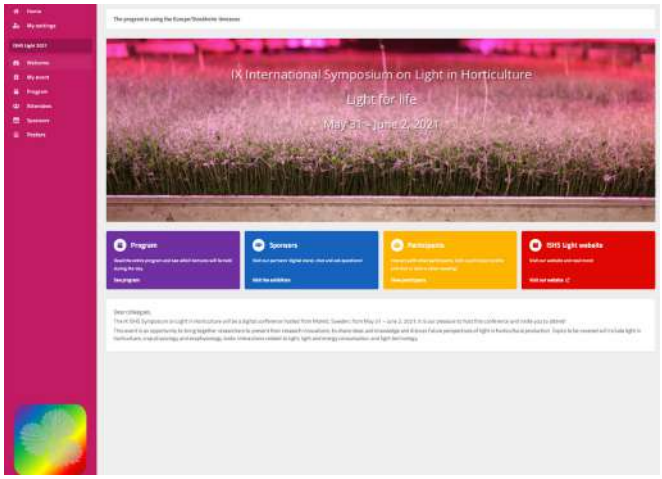
Rémi Kahane, CIRAD, Research Unit HortSys, International campus of Baillarguet, 34398 Montpellier cedex 5, France, e-mail: remi.kahane@cirad.fr

Karamoko Diarra, Cheikh Anta Diop University, Fac. des Sciences et Techniques, BP 5005, 99 000 Dakar, Senegal, e-mail: Karamoko.diarra@ucad.edu.sn

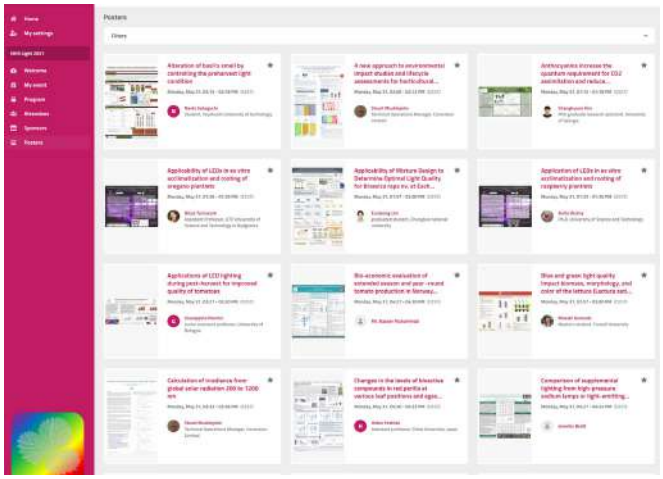
Etienne Tendeng, Cheikh Anta Diop University, Fac. des Sciences et Techniques, Laboratoire L2PIA, Dakar, Senegal, e-mail: etiennetendeng@gmail.com

› IX International Symposium on Light in Horticulture

Division Precision Horticulture and Engineering #ishs_deng
Division Landscape and Urban Horticulture #ishs_durb
Division Protected Cultivation and Soilless Culture #ishs_dpro
Commission Agroecology and Organic Farming Systems #ishs_cmor



› Virtual platform of the symposium.



› Poster presentations in the virtual platform.

The microbial horticultural group at the Department of Biosystems and Technology, Swedish University of Agricultural Sciences, hosted the IX International Symposium on Light in Horticulture on May 31 to June 2, 2021. The symposium was performed in a virtual format with 170 participants from Canada, China, Europe, Japan, Korea, USA and New Zealand.

Environmental impact and the need to save energy in indoor horticultural production have encouraged research for alternative and sustainable lighting strategies in production systems. Through research, LED lighting has shown a potential to achieve environmental and economical benefits in horticultural production. Positive effects of LED light on plant growth and development, as well as on plant quality, have been established. However, many factors are still under research and with great international interest to strengthen the application of LED light in the production system.

The symposium was greatly honoured to host three keynote speakers: Professor Leo Marcelis from Wageningen University, The Netherlands, with his keynote presentation "Light for life: prospects of plant phenotyping"; Professor Robert Morrow from Sierra Nevada Corporation, USA, with his keynote presentation "Light for life: innovative approach for future food production in space"; and the third and final keynote speaker, Associate Professor Marie-Claude Dubois, Swedish University of Agricultural Sciences, with her keynote presentation "Light for life: new light solutions for urban plant sites."

The oral and poster presentations were of high quality and covered topics related to crop physiology, biotic interactions related to light, light and energy consumption, light technology, light and plant quality, and plant protection, as well as topics related to light and modelling, light on system perspective, and quality of light interactions with growth and quality parameters. Plant protection and microbial aspects related to LED light is a topic to strengthen in future research.

The symposium recognized two ISHS Young Minds Award winners. Sijia Chen, PhD student from Wageningen University, The Netherlands, received the award for the best oral presentation regarding how light quality can be used to regulate fruit set in pepper; and PhD student Changhyeon Kim from the University of Georgia, USA, was awarded the best poster entitled "Anthocyanins increase the quantum requirement for CO_2 assimilation and reduce photosynthesis of lettuce."

Due to COVID-19, the symposium was shifted from a physical to a virtual format using the digital system AppInConf conference & events (www.appinconf.com), which is greatly acknowledged. Acknowledgements are also directed to the sponsors: Heliospectra (www.heliospectra.com), Seoul Semiconductor (www.seoulsemicon.com), Partnerskap Alnarp (https://www.slu.se/centrumbildningar-och-projekt/partnerskap-alnarp/)

› ISHS Young Minds Award winners: A) Sijia Chen (best oral presentation), B) Changhyeon Kim (best poster).

and the Microbial Horticulture group at the Swedish University of Agricultural Sciences (www.slu.se). The conveners' group and the organization committee are also greatly acknowledged.

Sammar Khalil, Maria Karlsson, Karl-Johan Bergstrand, AnnaKarin Rosberg and Naznin Most Tahera

› Contact

Sammar Khalil, Maria Karlsson, Karl-Johan Bergstrand, AnnaKarin Rosberg and Naznin Most Tahera, Swedish University of Agricultural Sciences, Department of Biosystems and Technology, Box 190, 23422 Lomma, Sweden, e-mail: sammar.khalil@slu.se, maria.e.karlsson@slu.se, karl-johan.bergstrand@slu.se, anna.karin.rosberg@slu.se and naznin.most.tahera@slu.se

› IX International Strawberry Symposium

Division Vine and Berry Fruits	#ishs_dvin
Division Horticulture for Development	#ishs_ddev
Division Horticulture for Human Health	#ishs_dhea
Division Plant Genetic Resources and Biotechnology	#ishs_dbio
Division Protected Cultivation and Soilless Culture	#ishs_dpro
Commission Agroecology and Organic Farming Systems	#ishs_cmor

We were given a great opportunity to bring the ninth ISHS International Strawberry Symposium (ISS) back to Italy (9th ISHS-ISS2020). This was very important for us to show the world the considerable and extensive strawberry production in our country. The plan was that the ISS would help promote and relaunch strawberry production by allowing our growers and industry to have contact with the most advanced knowledge of researchers from all over the world, through the rich scientific program and their visits to experimental fields from the south to the north within our country.

Unfortunately, the COVID-19 pandemic, which began in early 2020, changed the world by spreading death, sadness, and poverty. As organizers of ISS2020, we found it very difficult to make decisions on the meeting details. Over time we realized that it would be inappropriate to wait any longer. Therefore, the entire symposium was reset in hybrid form (in presence and virtual). We were aware that the virtual presence would be almost symbolic given the continuous evolution of the pandemic restrictions persisting in several countries, including Italy. The virtual version, held on May 1-5, 2021 (ISS2021), was reorganized with a new portal dedicated to the symposium and allowed all authors to present and give ample visibility to their research, thanks to the high number of registrations (854). With the same online tool, we could show our production through virtual visits to experimental fields and companies, from the south to the north. This activity was made possible thanks to the support of 23 companies that sponsored the symposium (1 gold, 2 silver sponsors), which were also present in the virtual stands provided on the online platform. For the entire event, 40 hours of live streaming were recorded. All this recorded material, the book of abstracts and the videos of the various sponsoring companies will remain available on this platform and accessible to all registered participants until May 2022.

› Opening ceremony at the congress center with the presence of the three conveners: Maurizio Battino (left), Bruno Mezzetti (center), Gianluca Baruzzi (right).

These numbers have been reached thanks also to the collaboration from the Chinese Strawberry Association, which involved many researchers who followed the scientific and technical contributions of the symposium virtually.

The opening of the symposium, after the greetings of various authorities, was dedicated to the past of strawberry research, with tributes to Pasquale Rosati, Chad Finn, Rolf Nestby, and Edward Zurawicz, no longer with

us, though they contributed their careers to developing the strawberry industry and the technical-scientific community that distinguishes it globally.

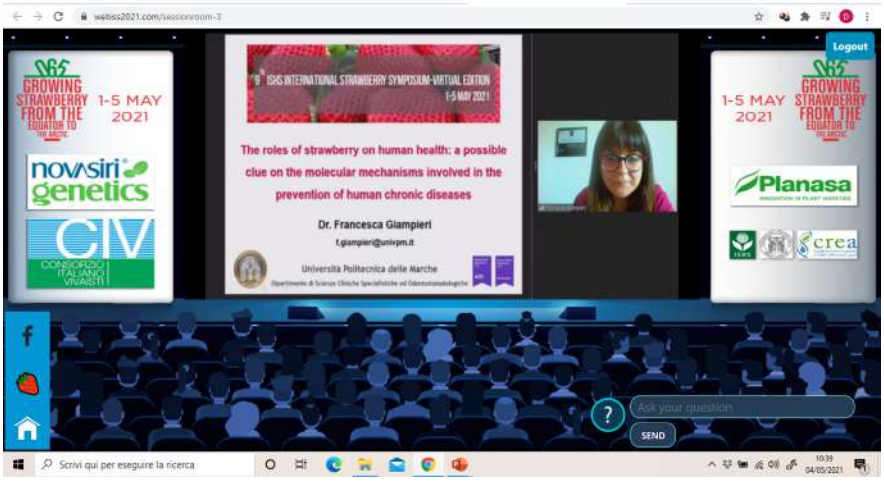
The ISS2021 program included 15 invited lectures, 116 oral presentations (divided into three parallel sessions) and 140 posters. All presentations (invited lectures and orals) contributed to high quality scientific insights into four major thematic areas identified of interest for the symposium.

As for the sessions relating to the various aspects of genetics, relevant lectures were presented by Aaron Liston, who revisited the origins of the octoploid strawberry in the light of new genomic knowledge; Steven J. Knapp, who described the benefits of the genomic tools in producing new strawberry cultivars; Beatrice Denoyes, who highlighted the importance of breeding programs to create new, high-quality strawberry cultivars; and Qing-Hua Gao on the importance of germplasm to identify new genetic sources of disease resistance.

Several presentations reported the new advances developed for improving strawberry cultivation systems (open field, protected and soilless), plant nutrition, irrigation, light and climate control, scheduled production, work reduction, harvesting technologies, quality increase. In this context were the lectures by Anta Sonsteby, who reported in-depth knowledge on the physiology of dormancy and flowering in response to climate change; Peter Melis, who highlighted the importance of the type of substrates to minimize residues in strawberry; and Yiannis Ampatzidis, who synthesized the novelties of the automation, artificial intelligence and robotics applied to strawberry cultivation systems. Finally, the presentation by Yuntao Zhang highlighted the progress in strawberry cultivation systems that has occurred in China since they organized the 7th ISS in 2012.

Several presentations regarded strawberry pathogens, soil and plant pathogens, plant certification, new fumigation practices, integrated and organic cultivation. The most relevant were by Ioannis E. Tzanetakis on the future of strawberry plant certification system, and Juan Carlos Diaz Ricci on new bioactive molecule for induction and suppression of diseases defense responses.

The factors that determine fruit quality were analyzed in several presentations. Among the most relevant, the lecture by Sonia Osorio Algar described the molecular mechanisms that determine the accumulation of important metabolites for fruit quality. The lecture by Stephen Predieri targeted consumer science. This presentation highlighted the importance of knowing the factors that determine the perception of the consumer



› Francesca Giampieri giving a presentation on the virtual platform.

› Winners of the ISHS Young Minds Awards: A) Francesca Negrini (best oral presentation), B) Sebastian Soppelsa (best poster).

to select successful quality strawberries for the market.

In the session entitled "Consumer Healthy Benefits", four international speakers presented their data about different aspects related to the effects of strawberry on human health. Dr. Josè Quiles, from the University of Granada in Spain, gave an interesting talk on the effects of strawberry polyphenols on longevity in *C. elegans*, demonstrating the efficacy of this berry in increasing lifespan and preventing some events associated with age-related diseases, such as Alzheimer's disease. The second speaker, Dr. Tamara Forse-Hernandez from the University of Vigo in Spain, explained in detail the effects of strawberry extract in reducing the pre-adipocytes differentiation and lipid accumulation via the modulation of different genes involved in the lipid metabolism, suggesting the potential anti-obesity properties of the bioactive compounds present in strawberry fruits. Dr. Francesca Giampieri, from the Polytechnic University of Marche in Italy, discussed the antioxidant, anti-inflammatory, and anti-tumor activities of strawberry. She spoke of different in vitro and in vivo models, highlighting the capacity for regulating the expression of several genes involved in the antioxidant defense, in the inflammatory response, and in some biological phenomena related to tumor onset and progression. Finally, two of the four speakers, Prof. Josè Quiles and Dr. Francesca Giampieri, were nominated in the past two consecutive years as "Highly Cited Researchers" by Thomson Reuters/Clarivate Analytics. These prestigious Awards highlight how the interest in the strawberry field has reached, in recent years, extraordinary levels in the scientific community worldwide.

During the symposium, an interdisciplinary panel, led by Kim Hummer, evaluated the oral and poster presentations and nominated the following young researchers for the different prizes:

ISHS Young Minds Awards:

- Francesca Negrini from the Alma Mater Studiorum - Università di Bologna, Italy, for the best oral presentation entitled "Rapid alkalinization factor (RALF) gene family genomic structure and transcriptional regulation during host-pathogen crosstalk in *Fragaria vesca* and *Fragaria × ananassa* strawberry";
- Sebastian Soppelsa from the Laimburg Gruppo di lavoro piccoli frutti e drupacee, Italy, for the best poster presentation entitled "Optimizing plant density in

› Winners of the Memorial Awards for Professor Pasquale Rosati, Dr. Chad Finn, and Professor Rolf Nestby: A) Zhen Fan, B) Brian Farneti, C) Luca Mazzoni.

strawberry cultivation in Martell Valley (South Tyrol, Italy)".

Memorial awards for Professor Pasquale Rosati, Dr. Chad Finn, and Professor Rolf Nestby:

- Zhen Fan from the University of Florida, USA, for the presentation entitled "Sensory and chemical analysis of strawberry fruit: important volatiles and prediction ability for sensory characteristics and consumer preference";
- Brian Farneti from the Foundation Edmund Mach, Italy, for the presentation entitled "A new phenotypic roadmap to improve strawberry aroma";
- Luca Mazzoni from the Università Politecnica delle Marche, Italy, for the presentation entitled "Variation of polyphenol and vitamin C fruit content induced by strawberry breeding".

The symposium continued with two additional activities:

- the technical day, a virtual visit to the strawberry field including new cultivars recently released by nine EU breeding programs, a workshop presenting the new Horizon2020 project on "Pre-breeding strategies for obtaining new resilient and added value berries," and the workshop organized by CIVI-Italia and SOI focusing on the certification schemes to qualify the nursery strawberry industry;
- the berry school, including eight virtual lectures on important topics for strawberry industry, such as new breeding techniques and quantitative genetics, physiology and evolution of cultivation systems at changing climatic conditions, plant quality to improve diseases control, metabolomic approaches to improve aroma and nutritional quality, consumer science, and the strawberry nutritional value.

Despite the many initial concerns, the virtual edition of ISS2021 has been highly successful, not only for the number of subscribers reached (854 from 32 countries) but also for interactions registered by the virtual platform, which recorded 58,000 views, with a simultaneous access record of 758 contacts and 4,096 daily interactions. A post-symposium survey reported very high levels of satisfaction from both the participants and the companies that sponsored the symposium.

The other major success for the symposium was the publication and distribution to registered people of the two volumes (1068 pages) of *Acta Horticulturae* 1309, collecting all top scientific contributions presented at the symposium.

Our strong thanks goes to all the colleagues who have assisted us in this period and to all the authors and virtual participants who have continued to believe in the importance of keeping the ISHS strawberry group active, giving us the necessary strength to carry out the symposium and to publish the *Acta*.

This symposium will probably go down in history more for what happened worldwide than in the strawberry world, but we still hope that it could have helped to bring together and strengthen our community, to make it more solid in facing the challenges that await us in the future. We hope the organizers of the next strawberry symposia in China in 2025 will be able to carry out the symposium in a more traditional way, recovering the desire to be together and to discuss the reality on the ground, as we have always been used to.

We would have been very pleased to show you our beautiful country, unfortunately this time it was not possible; but here we remain, always ready to welcome you with friendship.

Bruno Mezzetti, Francesca Giampieri, Gianluca Baruzzi and Maurizio Battino

› Strawberry cultivars field trials set up for the symposium. A) Italian strawberry breeders attending the virtual tour. B) Bruno Mezzetti illustrating a cultivar.

› Contact

Prof. Dr. Bruno Mezzetti, Dip. Sci. Agrarie, Alimentari ed Ambientali, Università Politecnica delle Marche, Via Brecce Bianche, Ancona 60100, Italy, e-mail: b.mezzetti@staff.univpm.it

Francesca Giampieri, Dept. of Clinical Sciences, Sect Biochemistry, Università Politecnica delle Marche, Via Ranieri 65, 60100 Ancona, Italy, e-mail: f.giampieri@staff.univpm.it

Dr. Gianluca Baruzzi, Council for Agric. Research & Economics, via La Canapona 1 bis, Magliano, 47100 Forlì, Italy, e-mail: gianluca.baruzzi@crea.gov.it

Prof. Dr. Maurizio Battino, Dept. of Clinical Sciences, Sect Biochemistry, Università Politecnica delle Marche, Via Ranieri 65, 60100 Ancona, Italy, e-mail: m.a.battino@staff.univpm.it

› UrbanFarm2021 – International Student Challenge

Division Landscape and Urban Horticulture #ishs_durb

› Soul Farmers team, winner of the prize for Salus Space area (Bologna).

Innovation, reciprocal cross-fertilisation between concepts and skills, teamwork and intercultural dialogue are the key points of the success of UrbanFarm, the international student challenge on urban agriculture organized by the University of Bologna, Italy.

Now in its third year, the 2021 competition brought together more than 150 students from ten different countries, with the aim of rethinking urban areas and their food production in more livable, attractive, inclusive, and sustainable ways.

As in previous editions, teams were asked to bring their multidisciplinary expertise to re-design three abandoned spaces. The target locations of UrbanFarm2021 were Salus Space (Bologna, Italy), Troisi Park (Naples, Italy) and the Cité Maraîchère (Romainville, France).

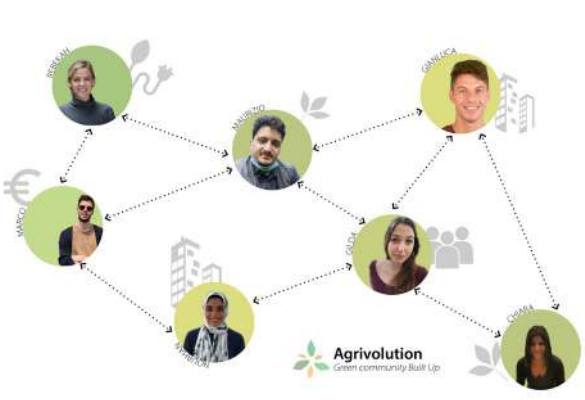
With the challenge launched in October 2020, the final phase of the competition took place for the first time entirely online on June 9, 2021. On this occasion, the nine selected teams presented their projects in front of an international jury of experts that included Mohsen Aboulnaga (Cairo University, Egypt), Chiara Cirillo (University of Naples, Italy), Runrid Fox-Kamper (ILS-Research Institute for Regional and Urban Development, Germany), Xavier Gabarrell Durany (Universitat Autònoma de Barcelona, Spain), Agnès Lelièvre (AgroParisTech, France) and Giorgio Prosdocimi Gianquinto (University of Bologna, Italy). Aleksandar Atanasov, from Hague Company, moderated the event.

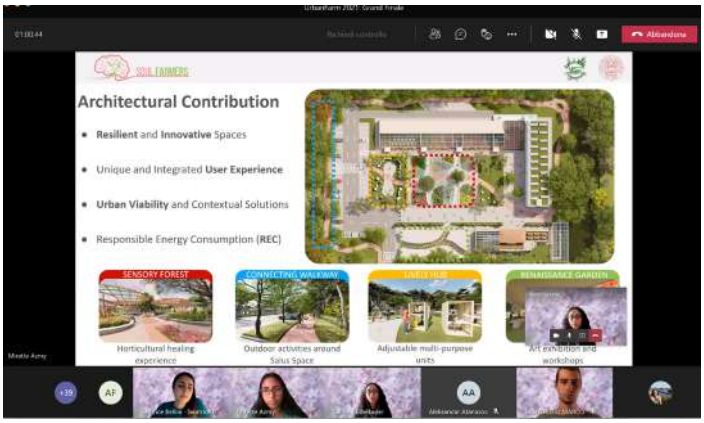
Teams were ranked based on their solutions in terms of use of resources and urban infrastructures, innovation of the technologies proposed (growing systems, climate management, energy and water supply) economic competitiveness of the systems, as well as ability to promote social cohesion, inclusion and development.

To allow the audience and any stakeholders to express their preferences, the event was broadcast on several social media channels. The points collected by the public and the jury were added to those already obtained in the previous stages of the competition determining the three winning teams of UrbanFarm2021.

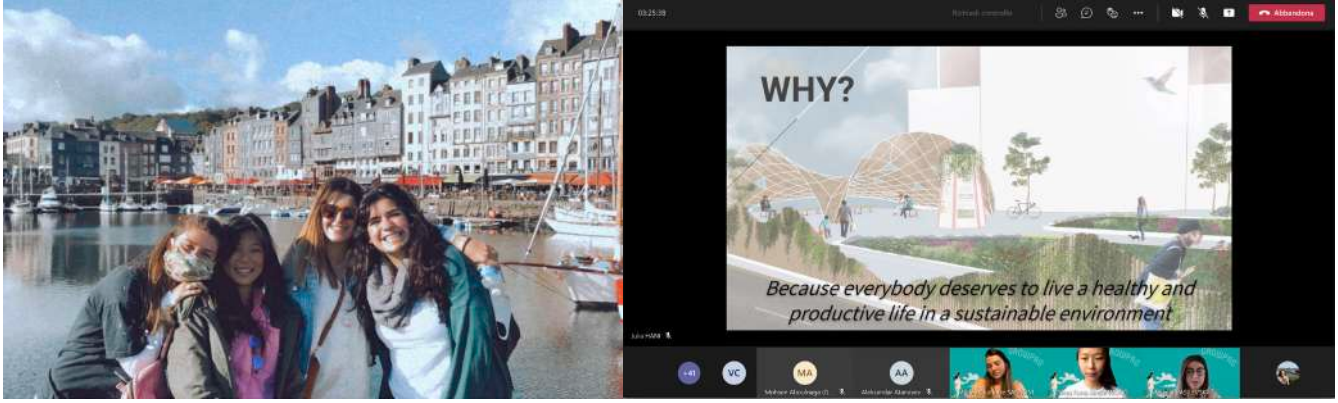
For the requalification of the green area in Salus Space (Bologna) the prize of €4000 was awarded to the team *Soul Farmers* composed by Mirette Aziz, Salma Mosaad and Mostafa EL Kady (Cairo University, Egypt), Beatrice Bellini, Giacomo Buldrini, Marco Coluccia, Aurora Cravino and Licia Signoroni (Alma Mater Studiorum University of Bologna, Italy), Marco Monticelli (University of Camerino, Italy) and Loay Radwan (Zewail city of science and technology, Egypt), who focused their project on providing a sustainable source of protein through insect farming and solving the problem of technology addiction taking advantage of the contact with nature.

Members of the *Agrivolution* team were awarded €4000 for the best project for the renewal of Troisi Park (Naples). The team, composed of Chiara Amitrano, Gianluca Cop-





› Agrivolution team, winner of the prize for the Troisi Park (Naples).



› GrowPro team, winner of the prize for Cité Maraîchère (Romainville).

pola and Maurizio Iovane (Federico II University of Naples, Italy), Nourhan El-Naggar (Cairo University, Egypt), Gilda Menichini (Alma Mater Studiorum University of Bologna, Italy), Marco Rossitti (Polytechnic of Milan, Italy) and Rebekah Waller (University of Arizona, USA), elaborated a proposal on low-impact technology and the active involvement of communities and stakeholders in the design of the public space.

Finally, for the Cité Maraîchère (Romainville), the winner of the €4000 prize was the *GrowPro* team, composed of Julia Hani, Ching Fung Janice Wong, Marley Sansom and Mihaela Vasilevska (Institut Polytechnique UniLaSalle, France). They proposed solutions for social inclusion by promoting local and ethnic food along with the possibility of living hunter-gatherer-like experiences.

In addition to the presence of three winning teams, another novelty this year was the possibility for some ideas and concepts embedded in the projects to be further implemented through co-design activities in the three selected European cities, partners of the EU H2020-862663 Project: Food Systems in European Cities (FoodE).

Thanks to the participative approach of the UrbanFarm international student challenge, promising students not only have the opportunity to engage with peers from different origins and disciplines, but also to learn how to deal with private companies, administrations and legislative frameworks toward the implementation of an executive project. They are also encouraged to become responsible citizens and active participants in the sustainable improvement of global urban realities.

The ISHS awarded the ISHS Young Minds Award to the members of the three winning teams with agronomic and plant science backgrounds, who received an ISHS certificate and a complimentary subscription to the ISHS for the year 2021.

The organizing committee of UrbanFarm2021 would like to express heartful thanks to Alma Mater Foundation (FAM), for generously supporting the organization of the competition; the company Flytech srl and the United Bank of Egypt for their contributions; the municipal administrations of Bologna, Napoli and Romainville; and, of course, all the other sponsors and partners listed on the UrbanFarm website (https://site.unibo.it/urbanfarm/en).

Elisa Frasnetti, Giuseppina Pennisi and Francesco Orsini

› Contact

Elisa Frasnetti, Giuseppina Pennisi and Francesco Orsini, Department of Agricultural and Food Sciences (DISTAL), University of Bologna Alma Mater Studiorum, Viale Fanin 44, 40127 Bologna, Italy, e-mail:, elisa.frasnetti@unibo.it, giuseppina.pennisi@unibo.it and f.orsini@unibo.it

From the Secretariat

› New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Australia: Dr. Shahla Bai, Dr. Dorin Gupta, Dr. Puthiyaparambil Josekutty, Dr. Peter Keating, Dr. Roberto Marques, Ms. Joanah Midzi, Mr. Pietro Previtali, Mr. Mohammad Rahman, Ms. Diane Robinson, Mr. Ramandeep Singh Sidhu, Mr. Muhammad Sohail; **Austria:** Dr. Maximilian Lackner; **Belgium:** Mr. Han Palmers, Mr. Karimi Solomon, Mr. Lieven Van de Vondel, Mr. German Vighi; **Brazil:** Prof. Marcelo Ferreira, Prof. Dr. Luiza Helena Meller da Silva, Dr. Servulo Silva, Dr. Poliana C. Spricigo; **Cameroon:** Dr. Syndhia Mathé; **Canada:** Erin Agro, Mr. Patrick Diep, GoodLeaf Farms, Mr. Pete Hendriksen, Curtis Sandhu, Mr. Romuald Sodokin, Dr. Josh VanderWeide; **Chile:** Ms. Daniela Araya, Ms. Josefina Jahn, Prof. Dr. J. Alberto Pedreros, Manuel Yrarrazaval; **China:** Jingkai Bao, Prof. Jianmin Fu, Dr. Yaojun Geng, Bangchu Gong, Dr. Qing Ji, Ms. XiangRui Meng, Dr. Xianwei Meng, Mr. Noor Muhammad, Dr. Zhang Saiyang, Prof. Jun Sun, Assoc. Prof. Peng Sun, Mr. Ying Lun Tong, Linxia Wang, Dr. Wen-qiu Wang, Prof. Dr. Xianghong Wang, Ms. Shuo Wu, Dr. Liqing Xu, Yang Xu, Assist. Prof. Lei Yang, Mr. Shunyang Yao, Prof. Xue-ren Yin, Ms. Fengjiao Yu, XINYI Yu, Ye Yuan, Assoc. Prof. Guixia Zhang, Dr. Qiong Zhang, Mr. Wei Qiang Zhao, Dr. xin Zhao, Qingyou Zheng, Assoc. Prof. Qinggang Zhu; **Costa Rica:** Dr. Maricruz Ramírez-Sánchez; **France:** Dr. Fernando Andres, Dr. Klervi Crenn, Mr. Philippe Faucon, Mr. Julio Garighan, Prof. Eric Gomès, Ms. Julia Gouot,

Dr. Ghislaine Hilbert, Ms. Anne Janoueix, Dr. Marcel Kuper, Ms. Cécile Laurent, Mr. Grégoire Loupit, Dr. Michel Peterschmitt, Dr. Bernadette Rubio, Dr. Patrice This, Dr. Lina Wang; **Germany:** Ms. Nele Bendel, Dr. Pablo Carbonell-Bejerano, Dr. Amelie Detterbeck, Runrid Fox-Kämper, Mr. Patrick Lehr, Dr. Sophia Müllner, Dr. Franco Röckel, Ms. Olivia Tetteh; **India:** Mr. Hitul Awasthi, Dr. Rajiv Arvind Marathe, Mr. Nahar Singh Megharikh, Mr. Shubham Singh Rathour, Mr. Arun Sawhney; **Indonesia:** Mr. Trisan Andrean Putra, Mr. Satria Bhirawa Anoraga, Ms. Elisa Apriliani, Mr. Ade Buchori, Dr. Nizar Nasrullah, Mr. Yoshua Yudha; **Israel:** Dr. Charles Krasnow, Dr. Itay Maoz, Taly Trainin, Kamal Tyagi, Ms. Lina Zhao; **Italy:** Dr. Chiara Alisi, Chiara Amitrano, Paola Bettinelli, Dr. Luca Brondino, Prof. Dr. Gabriella Cirvilleri, Dr. Benjamin Franchetti, Ms. Jessica Genovese, Prof. Tommaso Giordani, Dr. Marco Moretto, Dr. David Neven, Dr. Elena Paoletti, Dr. Marco Peruzzo, Dr. Stefania Pilati, Dr. Daniela Segantini, Dr. Paolo Sivilotti, Dr. Cristina Sudiro, Dr. Gianni Tacconi, Dr. Evangelos Xylogiannis, Prof. Lucia Zappala; **Japan:** Ms. Siti Aisyah Abdullah, Mr. Hideaki Asakuma, Nanae Chino, Mr. Yosuke Fujiwara, Mr. Takahiro Furuta, Ms. Ei Hitomi, Masaya Hojo, Dr. Sachie Horii, Ayaka Ishii, Tomomi Kakeya, Prof. Dr. Akira Kitajima, Ms. Akane Kusumi, Ms. Kanae Masuda, Prof. Dr. Kazumitsu Miyoshi, Tsuyoshi Nakamura, Mr. Ryotaro Nishimura, Dr. Kazuya Ohata, Ms. Akari Oka, Dr. Yutaro Osako, Ms. Asuka Sonoda, Ms. Mayu Sugiura, Maria Suzuki, Chika Takemura, Ms. Shizuka Tanaka, Tomoyuki Tsujimoto, Yoko Tsurunaga, Dr. Atsushi Yamamoto, Dr. Ryohei Yamamoto, Dr. Atsu Yamasaki; **Jordan:** Dr. Mohunnad Massimi; **Kenya:** Dr. Samuel Nyalala; **Korea (Republic of):** Dr. Younsup Cho, Prof. Dr. Gyoung Hee Kim, Mr. Youngmin Kim, Dr. Md. Rayhan Ahmed Shawon; **Kuwait:** Sudhersan Chellan; **Malaysia:** Asmah Awal, Norrizah Jaafar Sidik; **Mexico:** Mr. Raphael Dard, Ms. Marianela Hazel Ivarez-Hernández, Prof. Dr. Ramiro Maldonado Peralta, Ms. Itzel Rojas Puebla; **Morocco:** Prof. Ali Boularbah; **Netherlands:** Sijia Chen, Mr. Michel van Ruijven, Dr. Bram Vanthoor; **New Zealand:** Dr. Maryam Alavi, Dr. Brad Howlett, Dr. Sara Jaeger, Dr. Indrakumar Vetharaniam; **Peru:** Ms. Sofia Jesus Flores Vivar; **Philippines:** Mr. Wilfredo Bacena; **Poland:** Dr. Ewa Furmanczyk, Dr. Maciej Helbig, Dr. Malgorzata Tartanus; **Portugal:** Vinicius Casais, Mr. João Constantino, Cristiana Correia, Dr. Nuno Mariz Ponte, João Pedro Pinto, Ms. Rute Rego, Estefania Uberegui; **Romania:** Dr. Orsolya Borsai, Aurelia Diaconu, Dr. Mirela Gabriela Heizer, Mr. Ioan Stoli; **South Africa:** Ms. Anke Berry, Alwyn de Waal, Mr. Riedwaan Jacobs, Mr. Jaco Luus, Ms. Sibongile Miya, Ms. Matholo Joyce Mothapo, Mr. Abraham Mouton, Ms. Dembe Dynne Mushanganyisi, Mr. Wessel Oosthuysen, Ms. Mareli van der Merwe, Ms. Nicole Venter; **Spain:** Dr. Ignacio Buesa, Dr. Patricia Castro, Mr. Alvaro Delgado Delgado, Assist. Prof. Jose Escalona, Mr. Diego José Fernández López, Dr. M. Engracia Guerra Velo, Mr. Jesús Guillamón, Dr. Sara Ivarez, Mr. David Navarro-Payá, Dr. Vanesa Redondo-Fernández, José Antonio Rubio Cano, Dr. Nazareth Torres, Sergio Vélez, Ms. Ana Villa Llop; **Sri Lanka:** Ms. Sandunika Kithmini; **Switzerland:** Ms. Carrol Plummer; **Syria:** Mr. Hassan Ali; **Thailand:** Mr. Sirawich Chotikakham, Mr. Natthapong Janhom, Assist. Prof. Matchima Naradisorn, Mr. Possathorn Nopun, Ms. Naruemon Piyasathianrat, Dr. Thamarath Pranamornkith, Ms. Piyachat Sunanta, Mr. Tibet Tangpao, Ms. Puping Ta-oun, Ms. Kanchana Thinnabut, Mr. Thanakorn Vichaiya, Ms. Cholakarn Visutipitakul; **United Kingdom:** Ms. Sarah Eberle, Mr. Murali Krishna-Murty, Dr. Tiziana Ulian; **United States of America:** Dr. Mohamed Abdou, Yosef Al Shoffe, Brendon Anthony, Daniel Chellemi, Mr. Tino Cota, Mr. Jacob Cowger, Mr. Dan Danh, Mr. Paul De Filippi, Lloyd Farley, Ms. Kate Fessler, Christopher Fragoso, Prof. Dr. Harold Freeman, Richard Frost, Philip Gauthier, Laura Hillmann, Adrienne Johns, Mr. Michael Kelly, Changhyeon Kim, Taylor Livingston, Dr. Shahla Mahdavi, R. Theo Margelony, Assist. Prof. Anna Paltseva, Luke Peterson, Dr. Ilse Renner, Dr. Alicia Rihn, Anabel Rivas, Faisal Shahzad, Julieta Sherk, Mr. Mark Tanouye, Mr. Trey Thies, Michael Thiffault, Dr. Anna Wallis; **Uzbekistan:** Ms. Gulcherkhra Karakhodjayeva, Mr. Abdurashid Kayumov

› In memoriam

Harold Bradford Tukey, Jr. (1934-2020)

Harold Bradford Tukey, Jr., died December 1, 2020, in Seattle, Washington, after a very distinguished career in horticulture. He is survived by his wife of 65 years, Helen ("Tish"), daughters Ruth Thurbon Tukey and Carol Schwartz (Tom) and son Harold B. Tukey, III, his sister Ann Harrison, two grandchildren, three great grandchildren and many nieces and nephews.

Dr. Tukey was born in 1934 in Geneva, New York, USA. In 1940, he moved with his family to East Lansing, Michigan, where his father was a professor and Horticulture Department Chair at Michigan State University (MSU). He attended MSU receiving his BS, MS, and PhD degrees in horticulture there. In 1959, he joined the faculty of Cornell University, Ithaca, New York, where he rose to become department chair. In 1980, he was recruited by the University of Washington, Seattle, to create the world's first Center for Urban Horticulture where he worked until his retirement in 1992.

Professionally he was active in the American Society for Horticultural Science (Fellow), the International Society for Horticultural Science (Vice President, President, Past President, Council Member, Honorary Member), and the International Plant Propagators Society (International President and President of the Eastern Region IPPS). He was also active in the American Horticultural Society, serving as a Board member and as the AHS representative on the 3-person U.S. delegation to the ISHS Council. He was honored by being invited to present the 1987 B.Y. Morrison lecture, which is sponsored by the Agricultural Research Service, U.S. Department of Agriculture.

The Center for Urban Horticulture (CUH) was established within the College of Forest Resources at the University of Washington and was designed to combine research and teaching with outreach programs and library facilities available to scholars, professionals

and the general public. Dr. Tukey was the first director and was responsible for setting program and facility guidance. He hired faculty and staff and engaged in a vigorous fundraising campaign that brought in $5 million within 5 years. These funds were used to construct the first three buildings, which were ready for use when the CUH officially opened in 1984. The CUH grew and is now a part of the University of Washington Botanic Gardens.

Throughout his career, Dr. Tukey traveled extensively linking with horticulturists throughout the world. He regularly attended ISHS activities, particularly the Congresses. In the fall of 1993, he attended the ISHS Board and Executive Committee joint meeting in the Republic of South Africa. When the meeting became quite contentious, he was asked to chair the remainder of the meeting. He did this with his impeccable skill and diplomacy, and proposed a workable compromise to a key issue for the Society. He was able to continue successfully in this role until the 1994 International Horticultural Congress in Kyoto, at which time the governance of the Society was completely revised. To me, his skill and presence in this instance was his most significant contribution to our Society.

Richard H. Zimmerman,
ISHS Honorary Member

› Calendar of ISHS events

For updates and more information go to www.ishs.org › calendar of events. For a comprehensive list of meetings in each Division or Working Group use the "science" option from the website navigation menu. 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 2021

- October 6-9, 2021, Toluca (Mexico): **V International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions.** Info: Prof. Dr. Omar Franco Mora, Laboratory of Horticulture, Faculty of Agriculture, Universidad Autónoma del Estado de México, Toluca, México, 50140, Mexico. E-mail: franco_omar@hotmail.com E-mail symposium: convener@pqmhp2021.com Web: https://pqmhp2021.com/
- October 29-30, 2021, Kansas City, MO [virtual symposium] (United States of America): **XV International People Plant Symposium and II International Symposium on Horticultural Therapies.** Info: Dr. Candice Shoemaker, 2021 Throckmorton, Department of Hort, Forestry, Rec Res, Kansas State University, Manhattan, KS 66506, United States of America. Phone: (1)7855321431, Fax: (1)7855326849, E-mail: cshoemak@ksu.edu Web: http://ipps2020.org/
- October 31 - November 5, 2021, Stellenbosch (South Africa): **XI International Symposium on Grapevine Physiology and Biotechnology.** Info: Prof. Melané A. Vivier, Institute for Wine Biotechnology, Department of Viticulture and Oenology, Private Bag x1, Matieland, 7602, South Africa. Phone: (27)218083773, Fax: (27)218083771, E-mail: mav@sun.ac.za or Johan Burger, Stellenbosch University, Department of Genetics, Private Bag X1, Matieland, 7002 Stellenbosch, South Africa. E-mail: jtb@sun.ac.za Web: https://isgpb2021.com/
- November 8-12, 2021, Montpellier (France): **I International Symposium on Reproductive Biology of Fruit Tree Species.** 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@inrae.fr or Prof. Dr. Henryk Flachowsky, Pillnitzer Platz 3a, 01326 Dresden, Germany. E-mail: henryk.flachowsky@julius-kuehn.de Web: https://symposium.inrae.fr/reproductive-biologyfruittree/
- December 1-3, 2021, Bangkok (Thailand): **V Asia Symposium on Quality Management in Postharvest Systems.** Info: Prof. Dr. Varit Srilaong, Posth.Tech., School of Biores.&Technology, King Mongkut's Univ. of Technol.Thonburi, 126 Pracha-Uthid Road, Bangmod, Thungkru, Bangkok 10140, Thailand. E-mail: varit.sri@kmutt.ac.th E-mail symposium: asqp2021@kmutt.ac.th Web: http://www.asiapostharvest2021.kmutt.ac.th/

NEW

- December 13-17, 2021, [virtual symposium] (USA) / (Singapore): **XV International Symposium on Virus Diseases of Ornamental Plants.** Info: Dr. John Hammond, USDA, ARS, B-010A, Rm. 238, Barc-West, 10300 Baltimore Avenue, Beltsville, MD 20705, United States of America. Phone: (1)3015045313, Fax: (1)3015045096, E-mail: john.hammond@usda.gov or Dr. Sek-Man Wong, Department of Biological Sciences, National University of Singapore, 14 Science Drive 4, Singapore 117543, Singapore. E-mail: dbswsm@nus.edu.sg or Dr. Scott Adkins, USDA ARS, 2001 S. Rock Rd, Ft Pierce FL 34945, United States of America. Phone: (1)7724625885, Fax: (1)7724625986, E-mail: scott.adkins@ars.usda.gov Web: https://www.dbs.nus.edu.sg/isvdop2021/
- December 14-17, 2021, Catania (Italy): **III International Organic Fruit Symposium and I International Organic Vegetable Symposium.** Info: Prof. Dr. Ferdinando Branca, Di3A, Università di Catania, Via Valdisavoia 5, 95123 Catania, Italy. Phone: (39)095234307, Fax: (39)095234329, E-mail: fbranca@unict.it or Dr. Alberto Continella, University of Catania, Via Valdisavoia 5, Catania, Italy. Phone: (39)095-234455, Fax: (39)095-234406, E-mail: acontine@unict.it or Dr. Alessandro Tribulato, via Valdisavoia, 5, 95123 Catania, Italy. Phone: (39) 095 234328, Fax: (39) 095 234329, E-mail: atribula@unict.it E-mail symposium: info@orghort2020.it Web: https://www.orghort2020.it/
- December 15-17, 2021, Catania [virtual symposium] (Italy): **VIII International Conference on Landscape and Urban Horticulture.** Info: Prof. Daniela Romano, Universitá de Catania, Dip. DOFATA, Via Valdisavoia 5, 95123 Catania, Italy. Phone: (39)095234306, Fax: (39)095234329, E-mail: dromano@unict.it or Dr. Francesca Bretzel, CNR, IRET Istituto di Ricerca sugli Ecosist, Via G. Moruzzi 1, Pisa 56124, Italy. Phone: (39)0506212485, Fax: (39)0506212473, E-mail: francesca.bretzel@cnr.it or Dr. Stefania Toscano, Via Valdisavoia 5, 95123 Catania(CT), Italy. Phone: (39)0954783303, E-mail: stefania.toscano@unict.it E-mail symposium: info@luh2021.it Web: https://www.luh2021.it/

Year 2022

- February 7-10, 2022, Bangalore (India): **International Symposium on Tropical and Subtropical Viticulture.** Info: Prof. Dr. Dilipraj Patil, Associate director of Research, MHREC, University of

Horticultural Sciences, Udyanagiri, Bagalkot, 587104, India. E-mail: adrebagalkot@uhsbagalkot.edu.in or Dr. Girigowda Manjunatha, Officer In-charge, Bio-control laboratories, Directorate of Horticulture, University of Horticultural sciences, Bagal, Karnataka, 570020, India. Phone: (91)9916219697, E-mail: gmanjunath2007@gmail.com

- February 14-18, 2022, Stellenbosch (South Africa): **V International Symposium on Pomegranate and Minor Mediterranean Fruits.** Info: Prof. Dr. Olaniyi Fawole, Department of Botany and Plant Biotech, University of Johannesburg, Auckland Park Campus, South Africa. E-mail: olaniyi@sun.ac.za E-mail symposium: info@ishsstellenbosch.org Web: https://ishsstellenbosch.org/stellenbosch/

NEW

- February 16 - April 16, 2022, Riva del Garda, Trento (Italy): **XIV International Symposium on Plant Bioregulators in Fruit Production.** Info: Dr. Fabrizio Costa, Via Mach 1, 38010 San Michele all'Adige, Trento, Italy. Phone: (39)0461615563, E-mail: fabrizio.costa@fmach.it Web: https://eventi.fmach.it/ISHS-2021
- March 6-10, 2022, San Juan (Argentina): **XVI International Symposium on Processing Tomato - XIV World Processing Tomato Congress.** Info: Dr. Luca Sandei, SSICA, Tomato Department, Viale f.Tanara 31/a, 43121 Parma (PR), Italy. Phone: (39) 0521795257, Fax: (39) 0521771829, E-mail: luca.sandei@ssica.it or Dr. Cosme A. Argerich, Instit. Nac. de Tecnol. Agro., C.C. Nro. 8, La Consulta, 5567 Mendoza, Argentina. Phone: (54)2622470304, Fax: (54)2622470753, E-mail: argerich.cosme@inta.gob.ar E-mail symposium: symposium@worldtomatocongress.com Web: http://www.worldtomatocongress.com
- March 13-18, 2022, Brena Baja (La Palma) & La Laguna (Tenerife) (Spain): **XIV International Protea Research Symposium.** Info: Prof. Dr. Juan Alberto Rodríguez Pérez, Àrea de Producción Vegetal, Universidad de La Laguna, Calle Dinamarca 29, 38300 La Orotava, Tenerife, Spain. Phone: (34)666695267, E-mail: jarodrip@ull.es Web: https://proteas2020.asocan.net
- March 28-31, 2022, João Pessoa, Paraíba (Brazil)**: X International Congress on Cactus Pear and Cochineal.** Info: Mr. Mário Borba, 1571 Rio Grande do Sul Avenue, 58030021 João Pessoa-Paraíba, Brazil. E-mail: presidente@faepapb.com.br E-mail symposium: cactuscongress2022@faepapb.com.br Web: http://www.cactuscongress2022.com
- April 18-21, 2022, Murcia (Spain): **III International Symposium on Beverage Crops.** Info: Rocio Gil Muñoz, Avda Ntra Sra de la Asunción N24, 30520 Jumilla, Spain. E-mail: mariar.gil2@carm.es or Prof. Dr. Encarna Gómez-Plaza, Universidad de Murcia, Fac. Veterinaria, Dep. Tecnología Alimentos, Campus Espinardo, 30071 Murcia Murcia, Spain. Phone: (34) 868887323, E-mail: encarna.gomez@um.es or Prof. Dr. Cristina Garcia-Viguera, Phytochemistry and Healthy Foods Lab, Dept Food Science Technoloy CEBAS-CSIC, Campus Espinardo 25, Espinardo, 30100 Murcia, Spain. Phone: (34) 968396200, Fax: (32)9686213, E-mail: cgviguera@cebas.csic.es Web: https://www.bevcrops21.es/

NEW

- April 24-29, 2022, Davis, CA (United States of America): **VIII International Symposium on Rose Research and Cultivation.** Info: Dr. Deborah Golino, 2828 Loyola Dr, Davis Ca 956181633, United States of America. Phone: 5307548102, E-mail: dagolino@ucdavis.edu or Brent Pemberton, Texas A&M, Agric. Research & Ext. Ctr., PO Box 200, Overton, TX 75684, United States of America. Phone: (1)9038346191, Fax: (1)9038347140, E-mail: b-pemberton@tamu.edu Web: https://ucanr.edu/sites/ISHS/
- May 23-26, 2022, Pula (Croatia): **VIII International Symposium on Edible Alliums.** Info: Smiljana Goreta Ban, Institute of Agriculture and Tourism, Department of Agriculture and Nutrition, Karla Huguesa 8, 52440 Porec, Croatia. E-mail: smilja@iptpo.hr
- May 29 - June 2, 2022, Limassol/Lemesos (Cyprus): **VI International Symposium on Postharvest Pathology: Innovation and Advanced Technologies for Managing Postharvest Pathogens.** Info: Assist. Prof. Nikolaos Tzortzakis, Dept. Agricultural Sciences, Biotechnology, Food Science, Cyprus University of Technology, 3036, Lemesos, Cyprus. Phone: (35)7 25002280, Fax: (35)7 25002838, E-mail: nikolaos.tzortzakis@cut.ac.cy Web: http://web.cut.ac.cy/postharvestpathology2021/
- May 30 - June 3, 2022, Naoussa (Greece): **X International Peach Symposium.** Info: Prof. George Manganaris, Anexartisias 57, PAREAS Building, P.O. Box 50329, 3603 Lemesos, Cyprus. Phone: (357)25002307, Fax: (357)25002804, E-mail: george.manganaris@cut.ac.cy or Dr. Athanassios Molassiotis, Pomology lab, Faculty of Agriculture, AUTH, 54 124 Thessaloniki, Greece. Phone: (30)2310 998882, Fax: (30)2310 998882, E-mail: amolasio@agro.auth.gr Web: https://www.fruitsciences.eu/peach2021
- June 12-15, 2022, Cordoba (Spain): **XV International Asparagus Symposium.** Info: Juan Gil, Plaza de la oca, 1, 2-1, Córdoba, Spain. E-mail: juan.gil@uco.es or Dr. Roberto Moreno, Universidad de Córdoba. Genetics Department, Campus de Rabanales. Edificio C5. 2ª planta, 14071, Córdoba, Spain. E-mail: g12mopir@uco.es or Dr. Patricia Castro, Universidad de Cordoba. Genetics Department, Campus de Rabanales Edificio C5 2 planta, 14071 Cordoba, Spain. E-mail: patricia.castro@uco.es Web: https://www.ias2022.com/
- June 19-24, 2022, Davis, CA (United States of America): **VIII International Symposium on Almonds and Pistachios.** Info: 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 Dr. Thomas M. Gradziel, Department of Pomology, University of California, 1 Shields Avenue, Davis, CA 95616-8683, United States of America. E-mail: tmgradziel@ucdavis.edu or Bruce Lampinen, Dept of Plant Sciences, University of California, 1 Shields Avenue, Davis, CA 95616, United States of America. E-mail: bdlampinen@ucdavis.edu Web: https://ucanr.edu/sites/Almond_Pistachio_2021/
- August 14-20, 2022, Angers (France): **XXXI International Horticultural Congress: IHC2022.** Info: Dr. François Laurens, INRAE, Centre d'Angers, 49071 Beaucouzé, France. Phone: (33)2 41 22 56 00, Fax: (33)2 41 22 57 55, E-mail: francois.laurens@inrae.fr E-mail symposium: info@ihc2022.org Web: https://www.ihc2022.org/

Symposia at IHC2022:

- August 14-20, 2022, Angers (France): **International Symposium on Breeding and Effective Use of Biotechnology and Molecular Tools in Horticultural Crops.** Info: Dr. Vincent Gerardus Maria Bus, Plant and Food Research, Private Bag 1401, Havelock North 4157, New Zealand. Phone: (64)69758946, Fax: (64)69758881, E-mail: vincent.bus@plantandfood.co.nz or Dr. Mathilde Causse, INRA-GAFL, BP 94, 84143 Montfavet Cedex, France. E-mail: mathilde.causse@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s1-breeding-and-effective-use-of-biotechnology-and-molecular-tools-in-horticultural-crops/
- August 14-20, 2022, Angers (France): **International Symposium on Conservation and Sustainable Use of Horticultural Genetic Resources.** Info: Dr. Tiziana Ulian, Royal Botanic Gardens, Kew, Wellcome Trust Millennium Building, Wakehurst, RH17 6TN West Sussex Ardingly, United Kingdom. E-mail: t.ulian@kew.org or Dr. Raphael Morillon, Station CIRAD de Roujol, Petit Bourg, 97170 Guadeloupe, Guadeloupe. Phone: (33)590386162, E-mail: raphael.morillon@cirad.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s2-conservation-and-sustainable-use-of-horticultural-genetic-resources/

- August 14-20, 2022, Angers (France): **International Symposium on Quality Seeds and Transplants for 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. Olivier Leprince, 42 rue Georges Morel, 49070 Beaucouzé, France. E-mail: olivier.leprince@agrocampus-ouest.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s3-quality-seeds-and-transplants-for-horticultural-crops/
- August 14-20, 2022, Angers (France): **International Symposium on In Vitro Technology and Micropropagated Plants.** Info: Dr. Sandra Correia, Department of Life Sciences, University of Coimbra, Calcada Martim de Freitas, 3000-456 Coimbra, Portugal. Phone: (351)239240700, Fax: (351)239240701, E-mail: sandraimc@uc.pt or Prof. Dr. Stefaan Werbrouck, University Gent, Department Applied Biosciences, Valentin Vaerwyckweg 1, 9000 Gent, Belgium. Phone: (32)9 244 88 59, Fax: (32)9 242 42 79, E-mail: stefaan.werbrouck@ugent.beE-mailsymposium:sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s4-in-vitro-techniques-and-micropropagated-plants/
- August 14-20, 2022, Angers (France): **International Symposium on Innovations in Ornamentals: from Breeding to Market.** Info: Dr. Johan Van Huylenbroeck, ILVO- Plant Sciences Unit, Applied genetics & breeding, Caritasstraat 39, 9090 Melle, Belgium. Phone: (32) 9-2722862, Fax: (32) 9-2722901, E-mail: johan.vanhuylenbroeck@ilvo.vlaanderen.be or Dr. Fabrice Foucher, UMR IRHS, Centre INRA, BP 60057, 49071 Beaucouze, France. E-mail: fabrice.foucher@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s5-innovations-in-ornamentals-from-breeding-to-market/
- August 14-20, 2022, Angers (France): **International Symposium on Innovative Technologies and Production Strategies for Sustainable Controlled Environment Horticulture.** Info: Assoc. Prof. Youssef Rouphael, University of Naples, Via Università 100, 80055 Portici(Napoli), Italy. E-mail: youssef.rouphael@unina.it or Dr. Jean-Charles Michel, L¿Institut Agro - Agrocampus Ouest, 2 rue Le Notre, 49045 Angers, France. Phone: (33)241225422, Fax: (33)241225553, E-mail: jean-charles.michel@agrocampus-ouest.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s6-innovative-technologies-and-production-strategies-for-sustainable-controlled-environment/
- August 14-20, 2022, Angers (France): **II International Symposium on Greener Cities: Improving Ecosystem Services in a Climate-Changing World (GreenCities2022).** Info: Dr. Vivian Loges, Univ.Federal Rural de Pernambuco, Rua José Bezerra de Albuquerque 38a, Recife, 54315-580, Brazil. Phone: (51)8134624552, Fax: (51)8133206250, E-mail: vloges@yahoo.com or Mr. Philippe Faucon, 22 rue de l'Arsenal, 17300 ROCHEFORT, France. Phone: (33)546991701, E-mail: p.faucon@critt-horticole.comE-mailsymposium:sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s7-greencities2022/
- August 14-20, 2022, Angers (France): **International Symposium on Advances in Vertical Farming.** Info: Eri Hayashi, 6-2-1 Kashiwanoha, Kashiwa 277-088, Japan. E-mail: ehayashi@npoplantfactory.org or Prof. Dr. Leo F. M. Marcelis, Wageningen University, Horticulture & Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands. Phone: (31)317485675, E-mail: leo.marcelis@wur.nl E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s8-advances-in-vertical-farming/
- August 14-20, 2022, Angers (France): **International Symposium on Urban Horticulture for Sustainable Food Security (UrbanFood2022).** Info: Dr. Kathrin Specht, Arndtstrasse 15, 10965 Berlin, Germany. E-mail: kathrin.specht@ils-forschung.de or Dr. Kevin Morel, 16, rue Claude Bernard, 75231 Paris, France. E-mail: kevin.morel@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s9-urbanhorticulture-for-sustainable-food-security/
- August 14-20, 2022, Angers (France): **International Symposium on Value Adding and Innovation Management in the Horticultural Sector**. Info: Dr. David Neven, FAOB605, Viale delle Terme di Caracalla, 00153 Rome, Italy. E-mail: david.neven@fao.org or Dr. Syndhia Mathé, Direction régional CIRAD Afrique Centrale, BP 2572, Yaounde, Cameroon. E-mail: syndhia.mathe@cirad.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s10-value-addingand-innovation-management-in-the-horticultural-sector/
- August 14-20, 2022, Angers (France): **International Symposium on Adaptation of Horticultural Plants to Abiotic Stresses**. Info: Dr. Fulai Liu, Department of Plant & Environmental Science, University of Copenhagen, Hoeibakkegaard Alle 13, 2630 Taastrup, Denmark. Phone: (45)3533 3392, Fax: (45)35333478, E-mail: fl@plen.ku.dk or Dr. Bénédicte Wenden, INRA - UMR BFP - 71 avenue Edouard Bourlaux, 33882 Villenave d'Ornon Cedex, France. Phone: (33)557122549, E-mail: benedicte.wenden@inrae.fr E-mail symposium: sciences@ihc2022.orgWeb:https://www.ihc2022.org/symposia/s11adaptation-of-horticultural-plants-to-abiotic-stresses/
- August 14-20, 2022, Angers (France): **International Symposium on Water: a Worldwide Challenge for Horticulture!.** Info: Brunella Morandi, Università di Bologna, Viale Fanin 44, 40127 Bologna, Italy. E-mail: brunella.morandi@unibo.it or Dr. Marcel Kuper, 361 rue Jean-François Breton, 34196 Montpellier, France. E-mail: kuper@cirad.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s12-water-a-worldwide-challenge-for-horticulture/
- August 14-20, 2022, Angers (France): **International Symposium on Plant Nutrition, Fertilization, Soil Management.** Info: Assoc. Prof. Lee Kalcsits, Washington State University, WSU-TFREC, Wenatchee, WA 98801, United States of America. Phone: (1)5096638181, E-mail: lee.kalcsits@wsu.edu or Assist. Prof. Patrice Cannavo, Agrocampus Ouest, Unité de Recherche EPHor, 2 rue André Le Notre, 49045 Angers, France. E-mail: patrice.cannavo@agrocampus-ouest.fr E-mail symposium: sciences@ihc2022.orgWeb:https://www.ihc2022.org/symposia/s13-plant-nutrition-fertilization-soil-management/
- August 14-20, 2022, Angers (France): **International Symposium on Sustainable Control of Pests and Diseases.** Info: Prof. Lucia Zappala, viale tirreno, 31, 95123 Catania, Italy. E-mail: lzappala@unict.it or Dr. Michel Peterschmitt, Campus International de Baillarguet, CIRAD, TA A-120K, 34398 Montpellier Cedex 5, France. E-mail: michel.peterschmitt@cirad.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s14-sustainable-control-of-pests-and-diseases/
- August 14-20, 2022, Angers (France): **International Symposium on Agroecology and System Approach for Sustainable and Resilient Horticultural Production.** Info: Prof. Dr. Maria Claudia Dussi, Universidad Nacional del Comahue, Facultad de Ciencias Agrarias, CC 85 (8303) Cinco Saltos, Rio Negro-Patagonia, Argentina. Phone: (54) 299 9 5719365, E-mail: mcdussi@yahoo.com or Dr. Sylvaine Simon, INRAE Gotheron, 460 Chemin de Gotheron, 26320 Saint-Marcel-lès-Valence, France. Phone: (33)432722206, Fax: (33)475588626, E-mail: sylvaine.simon@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s15-agroecology-and-system-approach-for-sustainable-and-resilient-horticultural-production/

- August 14-20, 2022, Angers (France): **International Symposium on Innovative Perennial Crops Management.** Info: Dr. Sara Serra, Washington State University, Department of Horticulture, Pullman, WA 99164, United States of America. E-mail: sara.serra@wsu.edu or Dr. Pierre-Eric Lauri, UMR SYSTEM, INRA, Place Pierre Viala, 34060 Montpellier, France. Phone: (33)499613054, E-mail: pierre-eric.lauri@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s16-innovative-perennial-crops-management/
- August 14-20, 2022, Angers (France): **International Symposium on Integrative Approaches to Product Quality in Fruits and Vegetables.** Info: Alyson Mitchell, Department of Food Science Technology, UC Davis, 1 Shields Ave, Davis CA 95616, United States of America. Phone: (1)5303046618, E-mail: aemitchell@ucdavis.edu or Dr. Nadia Bertin, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722324, E-mail: nadia.bertin@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s17-integrative-approaches-to-product-quality-in-fruits-and-vegetables/
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- August 14-20, 2022, Angers (France): **International Symposium on Advances in Berry Crops.** Info: Dr. Susan McCallum, The James Hutton Institute, Errol Road, Invergowrie, DD2 5DA Dundee, Scotland, United Kingdom. E-mail: susan.mccallum@hutton.ac.uk or Dr. Béatrice Denoyes, 71 avenue Edouard Bourlaux, 33882 Villenave d'Ornon, France. E-mail: beatrice.denoyes@inrae.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s19-advances-in-berry-crops/
- August 14-20, 2022, Angers (France): **International Symposium on the Vitivinicultural Sector: Which Tools to Face Current Challenges.** Info: Prof. Dr. Ahmet Altindisli, Ege University Faculty of Agriculture, Department of Horticulture, 35100 BornovaIzmir, Turkey. Phone: (90)2323882622, Fax: (90)2323881865, E-mail: ahmet.altindisli@gmail.com or Assoc. Prof. Benjamin Bois, CRC - UMR Biogeosciences, 6 Boulevard Gabriel, 21000 DIJON, France. Phone: (33)662605225, E-mail: benjamin.bois@u-bourgogne.fr E-mail symposium: sciences@ihc2022.orgWeb:https://www.ihc2022.org/symposia/s20-the-vitivinicultural-sector-which-tools-to-face-current-challenges/
- August 14-20, 2022, Angers (France): **XII International Symposium on Banana: Celebrating Banana Organic Production.** Info: Mr. Walter Ocimati, Bioversity International, Plot 106, Katalima Road, P.O. Box 24384, 256 Kampala, Uganda. Phone: (256)414286213, Fax: (256)414286949, E-mail: w.ocimati@cgiar.org or Dr. Thierry Lescot, CIRAD, RU GECO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: (33)467615666, Fax: (33)467615821, E-mail: thierry.lescot@cirad.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s21-international-symposium-on-banana-celebrating-banana-organic-production/
- August 14-20, 2022, Angers (France): **International Symposium on Natural Colorants from Plants.** Info: Dr. Riikka Räisänen, Craft Studies P.O. Box 8, 00014 University of Helsinki, Finland. E-mail: riikka.raisanen@helsinki.fi or Ms. Anne de La Sayette, ARRDHOR - CRITT Horticole, 22 rue de l'Arsenal, 17300 Rochefort, France. Phone: (33)546991701, E-mail: arrdhor@wanadoo.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s22-natural-colorants-from-plants/
- August 14-20, 2022, Angers (France): **International Symposium on Postharvest Technologies to Reduce Food Losses.** Info: Gustavo Teixeira, Av. José Adriano Arrobas Martins, 210, 14.883-298 Jaboticabal São Paulo, Brazil. E-mail: teixeiragha@yahoo.com.br or Dr. Florence Charles, Universite d'Avignon, 301 rue Baruch de Spinoza, BP 21239, cedex 9, 84916 Avignon, France. Phone: (33)4.90.84.22.08, E-mail: florence.charles@univ-avignon.fr E-mail symposium: sciences@ihc2022.orgWeb:https://www.ihc2022.org/symposia/s23-post-harvest-technologies-to-reduce-food-losses/
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- August 14-20, 2022, Angers (France): **International Symposium on Medicinal and Aromatic Plants: Domestication, Breeding, Cultivation and New Perspectives.** Info: Dr. Christoph Carlen, Agroscope, Route des Eterpys 18, 1964 Conthey, Switzerland. Phone: (41) 58 481 35 13, E-mail: christoph.carlen@agroscope.admin.ch or Mr. Guillaume Frémondière, Impasse de la Vesc, 26740 Montboucher sur Jabron, France. Phone: (33)475918146, E-mail: guillaume.fremondiere@iteipmai.fr E-mail symposium: sciences@ihc2022.org Web: https://www.ihc2022.org/symposia/s25-medicinal-and-aromatic-plants-domestication-breeding-cultivation-and-new-perspectives/
- September 5-9, 2022, Corvallis, OR (United States of America): **X International Congress on Hazelnut.** Info: Prof. Shawn A. Mehlenbacher, Department of Horticulture, 4017 ALS Bldg., Oregon State University, Corvallis, OR 97331-7304, United States of America. Phone: (1)5417375467, Fax: (1)5417373479, E-mail: mehlenbs@hort.oregonstate.edu Web: https://hazelnut2021.org/
- November 6-11, 2022, Mersin (Turkey): **XIV International Citrus Congress.** Info: Prof. Dr. Turgut Yesiloglu, Cukurova Ünivesitesi, Ziraat Fakültesi, Adana, Turkey. E-mail: tyesil@cu.edu.tr E-mail symposium: info@icc2020.org Web: https://www.citruscongressturkey.org/
- December 15-18, 2022, Guangzhou (China): **IV International Orchid Symposium.** Info: Prof. Dr. Genfa Zhu, Enviromental Horticulture Research Inst., Guangdong Academy of Agricultural Sciences, No. 1 East Jinying Street 1, Wushan Road, Tianhe district, 510640 Guangzhou, China. E-mail: genfazhu@163.com

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