A publication of the International Society for Horticultural Science

Chronica Horticulturae

Horticultural highlights

We should be more honest about what types of research we do and value • Detecting Wisconsin's wild cranberries from space • Horticulture in Thailand & the III Asian Horticultural Congress – AHC2020 • Peonies as field grown cut flowers in Alaska

Symposia and workshops

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› Isaac Aiyelaagbe

Isaac Aiyelaagbe, ISHS Board Member Responsible for Outreach and Innovation

› Retailers of fruits and vegetables in Ibadan, Nigeria. Credit: Rolayo Sholotan.

Horticulture as a science has added value to food and nutritional security, landscapes, and livelihoods in the recent decades. However, the level of development has not been equal globally. While North America, Europe, and parts of Asia have made astronomic advances by migrating high-tech research results into the horticulture industry and reaped the fantastic benefits of such a deft move, in other regions, horticulture remains largely unchanged. In many of these regions, horticulture is undeveloped, is still struggling for attention from investors, and is incapable of making significant contributions to national development. The overall picture is patchy, indicating that the horticultural industry needs to double its effort; its reach must be broadened to globally optimize its potential. Achieving this will make a large contribution towards addressing the United Nations Sustainable Development Goals (no poverty, zero hunger, affordable and clean energy, and decent work and economic growth).

The International Society for Horticultural Science (ISHS) is committed to the promotion of research and education in all branches of horticultural science and the facilitation of cooperation and knowledge transfer on a global scale through its symposia, congresses, courses, publications and scientific structure. The ISHS has recently reconfigured its Board for increased inclusiveness. This change brought representatives from Africa, Oceania, North America (including the Caribbean and Central America), and South America onto the Board, thus increasing the representation and visibility of these regions. The members of these regions are now specifically part of the decision-making process in the ISHS.

Through my position as Board Member responsible for Outreach and Innovation, and with support from the other Board members, ISHS will extend its contact and support into more of these developing countries. It will reach down to the grass roots so that ISHS publications can be read by graduate students and consultants or local horticultural advisors who can pass on the knowledge to small scale growers. By highlighting the multiple benefits of participating in the activities, ISHS envisions that more horticulturists will be motivated to become members of the Society.

To begin this plan, I will expand the reach in gathering and dissemination of information on relatively unknown horticultural crops with high impact potential in nutrition, health, aesthetics, and improved livelihoods. Furthermore, innovations that have improved output and efficiency of the local horticulture industry in spite of limited resources will also receive coverage in the appropriate ISHS publications – *Acta Horticulturae, Chronica Horticulturae, Scripta Horticulturae*, eJHS (*European Journal of Horticultural Science*) and *Fruits* (*The International Journal of Tropical and Subtropical Horticulture*). For instance, in Kenya, the University of Nairobi and Jomo Kenyatta University of Agriculture and Technology, with support from Rockefeller Foundation, are collaborating with mango farmers to extend the shelf life of the fruit by storing them in Coolbot® cold rooms or drying them using solar tunnel driers. This low-cost intervention has almost doubled the farm incomes from mango, and sharing this knowledge will provide opportunities for extending the technology to other crops in other locations.

I have started to work with local horticulturists to encourage them to start national horticultural societies where these do not exist. The nascent national societies can serve as an activity hub to assess the strengths of the local horticulture industry, as well as determine its top-priority constraints such as skill gaps, absence of standards, input supply and logistics of handling and marketing of produce. These societies over time will be nurtured to grow, attain international visibility and ultimately be the conduit for establishing country membership on the Council of the ISHS. Consultations are already ongoing on the possibilities of kick starting national horticultural societies in the Gambia, Liberia, Sierra Leone and Kenya. The outcomes will be used to develop a template for this activity in the Africa Region and possibly modified forms in other regions.

Regional congresses serve as a veritable platform for boosting information exchange on competences and improved technologies as well as the brokerage of intra and inter regional collaboration. I will work with congress conveners to design programmes that are cost-effective, include demand-driven side events, and encourage the increased participation of the private sector (growers associations, industry, and input suppliers). The outcome will be to strengthen research-industry linkages and broaden the

swath of participants in the congresses, which should redress the current skew of membership towards the academia.
In addition to strengthening up-and-coming regions, during my term, I will also publicise breakthroughs in high-tech horticulture for the attention of regions where the results could be reproducible and adopted in teaching, production and handling to encourage sustained development of horticulture in regions that are already on track.
Ultimately, the Board looks forward to a trickle-down impact of the activities of the ISHS. We envision an increased visibility and a slow but steady improvement in horticulture practices, and a subsequent build-up in membership to ISHS from developing countries.

› Fruit seedling nursery in Ibadan, Nigeria. Credit: Isaac Aiyelaagbe.

› ISHS Board and Executive Committee in front of the Congress Center, venue of the XXXI International Horticultural Congress (IHC2022) in Angers, France.

We should be more honest about what types of research we do and value

Theodore M. DeJong, Ian J. Warrington, and Jens N. Wünsche

The name of our Society is the International Society for Horticultural Science and the stated aim of the ISHS is "*...to promote and encourage research and education in all branches of horticultural science and to facilitate cooperation and knowledge transfer on a global scale through its symposia and congresses, publications and scientific structure.*" The stated mission is "*to nurture and deploy scientific growing knowledge for creating a better world.*"

The Society's title, aim, and mission emphasize that we are a scientific society and what we do is "science." However, do these statements actually represent the scope of what we do and what we teach our students to do? Recent experience indicates that that may not be the case. The first ISHS Summer School on Pre- and Postharvest Physiology of Temperate Fruit Crops (organized by J.N. Wünsche at the University of Hohenheim) was attended by graduate students from 17 different countries. During introductions, every student was given the opportunity to state where they were from and what research project they were working on. During this process, it appeared that very few students were actually engaged in "science." Almost all reported doing descriptive, empirical research, with many having titles starting with "The effect of...". This struck a nerve with one of us (T.M. DeJong) because he had been engaged in teaching a graduate course at UC Davis about the difference between "scientific" and "empirical" research for the past 30 years. Therefore, an impromptu lecture was presented on the differences between scientific and empirical research and between developing/testing scientific hypotheses to further knowledge compared with developing/testing technological advancements. Most of the students were surprised when they were told that they didn't appear to be engaged in scientific research but instead were doing empirical research with the primary goal of developing or testing technologies. It was further explained that there was nothing wrong with doing empirical research but that they should be aware of the difference because they would likely have a difficult time publishing their work in high impact scientific journals if it did not attempt to test a hypothesis and further scientific knowledge or understanding. After the students got over the shock of having one of their instructors question whether they were actually engaged in "science," they responded quite well and appreciated having the difference between engaging in science vs. testing/developing technologies pointed out to them.

The confusion about the difference between scientific research and empirical, technology testing research is not limited to our students. Many of the papers published by horticultural researchers and published in horticulturally-oriented journals report on empirical, descriptive research rather than attempting to further scientific knowledge/understanding. The Wikipedia definition of "science" is "a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe." Whereas empirical research is "research using empirical evidence. It is a way of gaining knowledge by means of direct and indirect observation or experience."

From the reaction of the summer school students, our experience in teaching about this for decades, and reviewing manuscripts for horticultural journals, we realized that many horticultural researchers are also unclear about this distinction. Perhaps this is because we blur the lines between scientific and empirical research. Consequently, our colleagues in the more fundamental sciences devalue much of what we do because it is "descriptive" and/or because it is "applied." Selected examples of scientific vs. empirical research publications are provided (Table 1).

To make things even more confusing, in recent years there has been a trend toward accepting some empirical research as science because of the sophistication of the tools or approaches that are used (such as molecular biology, genomics, and other "omics" technologies). Some of that research is just as empirical or descriptive as more traditional empirical horticultural research but it may appear more "scientific" because of the complexity of measurements or procedures being used.

Perhaps it is time to emerge from our thinly veiled closet and embrace empirical or descriptive research approaches to testing and advancing horticultural technologies as an integral part of our mission and goals. Scientific research on horticultural crops is essential to further our working knowledge of horticultural cropping systems, especially in a rapidly changing world. However, that knowledge is of little value to society unless it leads to novel approaches and technologies to improve the efficiency/effectiveness of horticultural production practices. Inevitably, any new horticultural technology or practice, whether developed through advancements in scientific knowledge or through pure empirical research, must be tested and delivered to end users. Horticultural researchers often engage in testing these technologies or practices without necessarily having the goal of advancing scientific knowledge (for example: cultivar and rootstock evaluations, spacing trials, machine testing, fertilizer and pesticide trials). This type of research is an invaluable and an indispensable aspect of meeting our horticultural mission. However, this kind of study is not fully embraced, judging from the name of our Society or its stated mission and goals. For the past 30-40 years, we have spent the majority of our research time in scientific research to increase knowledge and understanding of fruit and nut tree cropping systems by studying subjects like photosynthesis; carbohydrate and nitrogen distribution in trees; understanding fruit, shoot and tree development and growth; rootstock size-controlling mechanisms; and understanding how trees work (for example, see https://dejong.ucdavis.edu/). However, in spite of all the progress that has been made scientifically, the findings that farmers and growers most valued were new applications of technology or orchard practice. While people in the scientific community value advancements in knowledge and understanding, growers and public clientele generally value horticultural technologies and practices that are developed and appropriately tested more than advancements in scientific knowledge. Technology advancements benefit their profitability

■ Table 1. Examples of scientific vs. empirical research publication by the authors.

Scientific research	Empirical research
Bestfleisch, M., Luderer-Pflimpfl, M., Höfer, M., Schulte, E., Wünsche, J.N., Hanke, M.-V., and Flachowsky, H. (2014). Evaluation of strawberry (*Fragaria* L.) genetic resources for resistance to *Botrytis cinerea*. Plant Physiology *64*, 396–405.	Day, K.R., DeJong, T.M., and Hewitt, A.A. (1989). Postharvest and preharvest summer pruning of 'Firebrite' nectarine trees. HortScience *24* (2), 238–240.
Davidson, A., Da Silva, D., and DeJong, T.M. (2017). The phyllochron of well-watered and water deficit mature peach trees varies with shoot type and vigour. AoB PLANTS *9*, plx042 https://doi.org/10.1093/aobpla/plx042.	DeJong, T.M., Day, K.R., Doyle, J.F., and Johnson, R.S. (1994). The Kearney Agricultural Center Perpendicular "V" (KAC-V) orchard system for peaches and nectarine. HortTechnology *4* (4), 362–367.
Negron, C., Contador, L., Lampinen, B.D., Metcalf, S.G., Guedon, Y., Costes, E., and DeJong, T.M. (2015). How different pruning severities alter shoot structure: a modelling approach in young 'Nonpareil' almond trees. Functional Plant Biology *42*, 325–335.	DeJong, T.M., Tsuji, W., Doyle, J.F., and Grossman, Y.L. (1999). Comparative economic efficiency of four peach product systems in California. HortScience *34*, 73–78.
Pope, K.S., Dose, V., Da Silva, D., Brown, P.H., and DeJong, T.M. (2015). Nut crop yield records show bud-break based chilling requirements may not reflect yield decline chill thresholds. International Journal of Biometeorology *59*, 707–715.	Hagemann, M.H., Roemer, M.G., Kofler, J., Hegele, M., and Wünsche, J.N. (2014). A new approach for analyzing and interpreting data on fruit drop in mango. HortScience *49* (*12*),1498–1505.
Snowball, A.M., Halligan, E.A., Warrington, I.J., and Mullins, M.G. (1994). Phase changes in citrus seedlings from thirteen genetically diverse seedling families. J. Hort. Sci. *69*, 141–148.	Southwick, S.M., Rupert, M.E., Yeager, J.T., Lampinen, B.D., DeJong, T.M., and Weis, K.G. (1999). Effects of nitrogen fertigation on fruit yield and quality of young 'French' prune trees. Journal of Horticultural Science & Biotechnology *74* (*2*), 187–195.
Tombesi, S., Day, K.R., Johnson, R.S., Phene, R., and DeJong, T.M. (2014). Vigour reduction in girdled peach trees is related to lower midday stem water potentials. Functional Plant Biology *41*, 1336–1341.	Tustin, D.S., Hirst, P.M., Cashmore, W.M., Warrington, I.J., and Stanley, C.J. (1990). The principles and practices of training Slender Pyramid trees for high intensity production. Compact Fruit Tree *23*, 83–92.
Tustin, D.S., Hirst, P.M., and Warrington, I.J. (1988). Influence of orientation and position of fruiting laterals on canopy light penetration, yield, and fruit quality of 'Granny Smith' apple. J. Amer. Soc. Hort. Sci. *113*, 693–699.	Warrington, I.J., Dixon, T., Robotham, R.W., and Rook, D.A. (1978). Lighting systems in major New Zealand controlled environment facilities. J. Agric. Engng. Res. *23*, 23–36.
Van Hooijdonk, B.M., Woolley, D.J., Warrington, I.J., and Tustin, D.S. (2009). Initial alteration of scion architecture by dwarfing apple rootstocks may involve shoot/root/shoot signalling sequences by auxin, gibberellin and cytokinin. J. Hort. Sci. Biotechnol. *85*, 59–65.	Warrington, I.J., Stanley, C.J., Julian, J.F., Tustin, D.S., Hirst, P.M., and Cashmore, W.M. (1995). Pruning strategies for restructuring top-dominant central leader 'Granny Smith' apple trees. N.Z. J. Crop Hort. Sci. *23*, 315–322.
Warrington, I.J., and Norton, R.A. (1991). An evaluation of plant growth and development under different daily quantum integrals. J. Amer. Soc. Hort. Sci. *116*, 544–551.	Warrington, I.J., Stanley, C.J., Volz, R., and Morgan, D.C. (1984). Effects of summer pruning on Gala apple quality. The Orchardist of N.Z. *57*, 518–522.
Winterhagen, P., Hagemann, M.H., and Wünsche, J.N. (2016). Expression and interaction of the mango ethylene receptor MiETR1and different receptor versions of MiERS1. Plant Science *246*, 26–36.	Wünsche, J.N., and Heyn, C.S. (2015). Consumer responses to fruit quality of 'Jonagold' apples treated with postharvest application of 1-methylcycloprope (1-MCP) under air and controlled atmosphere storage conditions. European Journal of Horticultural Science *80*, 3–10.
Wünsche, J.N., Greer, D.H., Laing, W.A., and Palmer, J.W. (2005). Physiological and biochemical leaf and tree responses to crop load in apple. Tree Physiology *25*, 1253–1263.	Wünsche, J.N., and Palmer, J.W. (1997). Portable through-flow cuvette system for measuring whole-canopy gas exchange of apple trees in the field. HortScience *32*, 653–658.
Wünsche, J.N., Lakso, A.N., Robinson, T.L., Lenz, F., and Denning, S.S. (1996). The bases of productivity in apple production systems: the role of light interception by different shoot types. Journal of the American Society for Horticultural Science *121*, 886–893.	Wünsche, J.N., Lakso, A.N., and Robinson, T.L. (1995). Comparison of four methods for estimating total light interception by apple trees of varying forms. HortScience *30*, 272–276.

more directly than advancements in scientific knowledge.

Thus, our professional Society should embrace the development and testing of new technologies and practices as an integral and critical part of our mission. This can best be done by clearly recognizing and embracing the two types of research we engage in, scientific and empirical (or technology development), and not blur the differences between them. Furthermore, we should teach our students the difference between these two types of horticultural research so that they can have a better understanding of the types of journals that are most appropriate for publishing their research. Most of us have experienced rejection of our manuscripts because the work was too "descriptive". We need to train our students to avoid this confusion.

ISHS's leading horticultural journal recognizes this dichotomy and states that *eJHS* publishes 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. On the other hand, *Fruits, The International Journal of Tropical and Subtropical Horticulture* states that it is "a leading scientific journal" without mentioning research related to technologies or methodologies. This journal publishes original articles and reviews on tropical and subtropical horticultural crops but leaves the impression that it primarily reports scientific research, whereas the actual

content indicates otherwise. *Acta Horticulturae* is neutral on this topic and is described as a peer-reviewed series, mainly composed of the proceedings of ISHS Symposia and the International Horticultural Congresses. However, because ISHS is a "scientific" society, a novice to the Society likely expects that most of the papers published in the *Acta* report on scientific research, when the opposite is generally the case.

Why does any of this matter? Recent experience with the students in the summer school as well as the majority of graduate students that we have taught in graduate classes in the past 30 years have expressed confusion about scientific research and empirical research primarily directed toward testing a technology or method. While both types of research are important and have value in addressing horticultural problems, it is important to recognize that both types of research are not equally valued in the scientific communities in which most of us work. When students complete a piece of work, they frequently ask what journal might accept their manuscript. Most often they are really asking if their work is appropriate for a journal that has a "high impact factor." Invariably journals with high impact factors are journals that are primarily focused on science that poses and tests creative hypotheses that are of broad conceptual interest or on research that significantly advances scientific understanding. If research is primarily empirical and reporting the effect of some technology or method and has a relatively narrow audience, it would be more appropriate for lower impact journals focused on applications-oriented research. Students and young staff are often disappointed with such answers. We believe that students must recognize this difference before they do their research rather than afterwards. Understanding the details of what constitutes a good scientific manuscript can't be left to chance or to the hope that informal "diffusion" of knowledge from supervisors/advisors will suffice in this highly important area of professional development.

Judging from the quality and content of many of the manuscripts that are submitted to refereeing, universities need to give greater emphasis to such professional training.

The irony of the "scientific impact factor" is that this assessment has been designed to gauge the impact of published research on the scientific community, i.e., how many times the scientific community cites a paper. The scientific impact factors do not gauge the actual impact of research on society or horticultural practices. Much of the empirical testing that we do has a greater immediate impact on agriculture than does basic, scientific research. Furthermore, students need to realize that the "scientific impact factor" is biased by the size of the scientific community interested in the field of research. The small size of the horticultural research community internationally, together with the fragmentation of research activities across many different crops and production systems will always result in low impact numbers – hence the need to only compare impact ratings within and not between disciplines.

Students also need to recognize that the types of research that they do can have large effects on what type of job they can get after they complete their studies. We have often served on faculty search committees and have seen candidates passed over because, while they may have numerous publications, the title of the majority of papers that they have published have been "effect of" papers reporting tests of various treatments or technologies without posing or testing a conceptual hypothesis. Students need to recognize that the "scientific" community does discriminate between scientific and empirical research and does not value the two types of research equally.

As much as we may try, we can't get away from the fact that the classic definition of "horticulture" is "the art or practice of garden cultivation and management." In academic settings many horticulturists have felt a sense of discrimination by "more scientifically" oriented colleagues because we have tried to play by their rules and have attempted to blur the lines between scientific and empirical, technology development research. Rather than recognize, defend and promote the latter as an integral part of what horticulture is, and what is needed to serve our clientele, we often tend to downplay it. We believe strongly that our Society should be more inclusive and overt in recognizing, embracing and promoting the value of both scientific and empirical research. In summary, we make the following recommendations:

- ISHS Board and Council should consider changing its mission statement to explicitly acknowledge the difference between, and value of, both types of research so there is less confusion about whether it is solely a science-based organization or whether both aspects of research are valued. Something like "*ISHS's mission is to nurture and deploy scientific and empirical research toward the development and distribution of technologies to enhance the environmental and economic sustainability of worldwide horticultural practices*" might be more representative of what we actually do.
- ISHS editorial boards should redefine the summary statements for *Fruits* and *Acta Horticulturae*. Clarification about what types of research are valued by our Society is needed.
- ISHS Board and Council should provide specifically-targeted learning opportunities for young scientists (and others wishing to expand their understanding) by offering a short course on scientific working and writing as part of its scientific symposia program – perhaps focused primarily on being an integral part of the regional congresses.
- The ISHS Board should evaluate opportunities for shifting from an entirely inward-looking focus to devoting more resources into promoting and celebrating both the scientific discoveries and empirical advances that are being achieved by its members.

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› Ian J. Warrington

› Jens N. Wünsche

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Spotlight on Honoured ISHS Members

› Robert Bogers

Position or previous position

Retired; last position was director of Frontis – Wageningen International Nucleus for Strategic Expertise

ISHS honour

ISHS Honorary Member

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

I was born in June 1946, in the city of Rotterdam. As a child I was intrigued by all the construction works that were going on to build a completely new city centre after the old one had gone up in flames in the early days of the second World War. My father, having been educated as a furniture maker, had been active in the resistance, and after the war had worked for the government during the trials against war criminals. In 1949, he started his own business making ladders and scaffolding equipment. As was usual in those days, my mother stayed at home to look after my younger brother and me.

After primary school, I was admitted to one of the oldest grammar schools in the Netherlands, founded in Rotterdam in 1328. In particular during the first years, the focus was on both classical and modern languages. Science was an important part of the curriculum in the following years. It was then that I became interested in chemistry, encouraged by an enthusiastic teacher. With a friend, I performed many experiments at home, which was not always appreciated by my mother. It sometimes resulted in foul smells and small explosions in the kitchen! A more biological hobby was my aquarium with tropical fish.

Since 1999, my wife, Anita, and I have lived in the village of Bennekom, close to Wageningen. Unfortunately, Anita's health made it necessary for her to move to a nursing home last year, where I visit her every day. Our two children, Roderik and Enide, and five grandchildren are not far away.

In Wageningen, I joined a group of people who successfully worked to maintain the Belmonte Arboretum after the University had decided that it was no longer necessary for research and education. Also, I became involved in the work of the Passiflorahoeve, a care farm where people who have suffered a psychic trauma help to keep large collections of *Passiflora* and *Aristolochia*, as well as five beautiful butterfly gardens, including breeding facilities, and, recently, also a butterfly museum in good condition.

› Rob and Jozef were given a big boar's head as a present to take to the ISHS office when visiting Michurinsk (Russia) to celebrate Russia's renewed ISHS membership in 2009.

› Robert Bogers, Jozef Van Assche and Jules Janick at the opening of the IV Balkan Symposium on Vegetables and Potatoes in Plovdiv, Bulgaria, 2008.

With a number of colleagues from various countries I started the Rubicon (RUral development and BIodiversity CONservation) Foundation, which supports the conservation of threatened species and key sites for biodiversity through capacity building, project and programme development, and fundraising. Rubicon participates in projects in the Mediterranean area, Turkey, South-West Asia and Africa.

One other aspect of my life: I should not forget to mention my interest in classic British cars.

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

Horticulture was not something my family was particularly interested in, but during one or two years at primary school, I had a small allotment garden where I grew some vegetables, potatoes and flowers. However, it soon became clear that I did not have the same "green thumb" as some of my classmates. Nevertheless, when I went to Leiden University, the example of my biology teacher, Dr. Adriaan Fuchs, who combined teaching in Rotterdam with biochemical research at Delft University of Technology, made me decide to combine my study of chemistry with plant science and microbiology. As a result I was invited to do my PhD research in the Department of Botany, working on the molecular basis of hormone action.

I stayed at Leiden University until 1981. Then, I thought it was time for "something completely different" and found a very interesting job in the Department of International Scientific Cooperation of the Ministry of Education and Science in The Hague. I had to go to many international meetings, e.g., in Brussels (EU,

› Board meeting at ISHS Headquarters in Korbeek-Lo, Belgium, 2010.

COST), Paris (OECD) and Geneva (UN), was sent on a fact-finding mission to Upper Volta (now Burkina Faso) and learned a lot about international negotiations and diplomacy.
My time as a civil servant came to an unexpected end within two years, when there was a vacancy for director of the Bulb Research Centre in Lisse. This was not far from Leiden University, and contacts between the two had always been close. Kees Libbenga, my professor at Leiden University, had told me that he, too, was sometimes thinking of a change, and I advised him to apply for the job at Lisse. After a few days he called me and said: "why don't you apply for that job yourself?" I did not think I would qualify for it, but he insisted. We made a bet: if I did not "survive" the first round of interviews he would give me a bottle of Scotch; if I did, I would owe him one. To my surprise I got the job and lost a bottle of whisky. That's how I started my career in horticultural science.

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

As a student at Leiden University, in the Botanical Laboratory I studied the induction of cell divisions in pea root explants by micro-injection of plant hormones into the root cortex, mimicking the action of *Rhizobium* bacteria. Later I worked in the Biochemical Laboratory, investigating the way *Agrobacterium* infects *Kalanchoe* stems. My PhD study was a cooperative project of the two laboratories, which had formed the Department of Plant Molecular Biology, where I worked on the molecular basis of the hormonal induction of dedifferentiation in plant tissues, with tobacco pith explants as a model system.

As director of the Bulb Research Centre at Lisse, I was responsible for the overall research programme in the departments of physiology, phytopathology, culture techniques and economics, as well as the management of personnel and finance. Here I had to interact with breeders, growers and traders, which to me was a new but very rewarding experience. Of course we also maintained close contacts with fundamental research. We were among the initiators of an exchange programme with INRA (France) and of the Laboratory for Monoclonal Antibodies at Wageningen, and built the Central Reseach Laboratory for Tissue Culture of Horticultural Crops. At the occasion of the 75th anniversary in 1992, we invited flowerbulb researchers from Central and Eastern European countries to come to Lisse for a symposium devoted to bulb culture in these countries.
After ten years at Lisse, the Ministry of Agriculture appointed me director of the research stations for Floriculture at Aalsmeer and Glasshouse Crops at Naaldwijk. My main job was to merge these two into one governmental organisation, and to merge their seven regional experimental gardens into one private organisation, closing five of them. At the same time the research programme had to go on without interruption, while the way it was financed changed considerably. This whole process took almost six years, after which I moved to Wageningen to become director of the national institute for food safety research, RIKILT. Here my chemical background was very useful in discussions with the staff. Soon after I had begun working there we were confronted with heavy dioxin contamination in various food products, which kept us busy 24/7 for a couple of months.

My final job at Wageningen was rather different. In collaboration with the rector of the university I founded a bureau called Frontis – Wageningen International Nucleus for Strategic Expertise, aimed at giving an impulse to scientific progress by bringing together scientists in the fields of agricultural, environmental and related sciences. I invited top scientists from all parts of the world to come to Wageningen for some time to help develop new areas of research, give courses and participate in workshops. In a few years, I organised 26 workshops and symposia and edited 25 books resulting from these events. All these books were published by Springer and are freely available on https://library.wur.nl/frontis/.

4. What do you consider were your greatest achievements?

The manuscript of my first publication in an international journal (Planta) was returned by the editor, professor Anton Lang, with a long hand-written letter in which he commented on almost every paragraph. I was very disappointed but my professor at Leiden University was very enthusiastic: that a famous scientist like professor Lang took the trouble to do this meant that he thought my paper was worth it. I followed Lang's advice to shorten the paper drastically, included his comments in the second version and sent it back. It was accepted at once.
In the spring of 1989, I attended a symposium in Irvine, California, where, unexpectedly, representatives from British and American nature conservation organisations fiercely attacked Dutch flowerbulb traders for selling as "product of Holland" bulbs that had been taken from wild populations in Turkey. They threatened to start an international boycot of all Dutch bulbs if this was not stopped. Back in the Netherlands I contacted the exporters' organisation and advised them to take action. Although these wild-collected bulbs only constituted less than 0.5% of Dutch bulb exports, a boycot of all bulbs would be very damaging. The exporters reacted immediately. Together we invited the British and American critics, Turkish bulb collectors and traders, and both Dutch and Turkish government representatives for a meeting in Lisse. This was followed by a meeting in Ankara and resulted in an agreement whereby all consumer packages of Dutch bulbs would be labelled as either "bulbs grown from cultivated stock" or "bulbs from wild source". Also, Turkey joined the CITES agreement and drastically reduced the amount of bulbs that farmers were allowed to collect from the wild. We invited a Turkish scientist to work at Lisse to learn how to grow and multiply wild-collected bulbs. Later she started a successful project to do so together with villag-

ers in Turkey. I still think this was an important achievement. The Rubicon Foundation I mentioned earlier is a direct offspring of my involvement in this kind of work.
That the merger of the research stations of Aalsmeer and Naaldwijk and the closure of five experimental gardens, which involved a number of job changes and transfers of staff, succeeded with full cooperation of trade unions and without a single protest or court case is something I look back upon with some satisfaction.
And, of course, being given the Honorary Membership of ISHS, is something I am proud of.

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

Nobody's career goes without any problems/difficulty. As a scientist in fundamental research, I had scientific difficulties to deal with and as a civil servant in an international surrounding, I faced other kinds of problems. They were only part of the job and made life interesting. Being an optimist who does not panic very quickly I usually saw problems as a challenge to be inventive and find a solution. It always gave me a good feeling if my colleagues and I had been able to find solutions, sometimes in a quite unexpected direction. As a research manager I had to think about the effect my decisions would have on other people, organisations, etc. This made solving problems more complicated, in particular when large amounts of money or people's jobs were at stake. Then it was good to have a critical staff I could trust and rely upon.
The greatest difficulty I encountered happened when I was director of RIKILT. Soon after I had been appointed the chairman of the Board of Wageningen UR announced ideas and plans which to me and my staff were a total surprise and which we found very hard to defend. Although I tried, the chairman was not satisfied and without further discussion appointed another director. After an uncertain time I started Frontis, which turned out to be a very satisfying job that gave me a lot of pleasure. My advice would therefore be: in case of trouble, stop worrying and "always look on the bright side of life".

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

I can mention more than one.
When at Lisse I had to go to Raleigh, North Carolina, once a year to discuss the flowerbulb programme at North Carolina State University with professor Gus De Hertogh, who sadly passed away last October. Gus was a great lover of Dutch "jenever", and I usually gave him a bottle of that drink. One year I decided to buy him a bottle of Laphroaig, a peated malt whisky, instead. He opened the bottle, gave me a glass of it, took one himself and stored the bottle. A year later I came back to his house and Gus said: "I've got a very peculiar Scotch. It tastes like a medicine. Some fool thought I would like it. Maybe you do", and there was the Laphroaig, untouched for a whole year.
At Lisse we used to keep a number of rabbits that were injected with a flowerbulb virus in order to produce antibodies that could be used to detect the virus in bulbs. One night all the rabbits were stolen and set free in the surrounding fields, where most of them did not survive long. A few days later I was informed that a bus with activists from the Animal Liberation Front was on its way to our institute. A group of people, accompanied by a local journalist, arrived with hammers, pickaxes, spades, planks, etc., and said they wanted to make a definitive end to our rabbit

› Rob and his family at their 40th wedding anniversary.

› Former treasurers Georg Noga and Robert Bogers, flanked by Jozef Van Assche, with their toys: 1999 Mercedes, 1962 Jaguar and 1972 Mercedes, respectively.

work by making the building where the rabbits had been kept unfit for use. They were met by our garden workers, also armed with spades and pickaxes, and I feared an unpleasant confrontation. The two local policemen were not able to do much to prevent a fight and asked me to negotiate. I sent away the garden workers and talked to the activists. In the end we agreed that they would smash one small window, block the entrance by nailing a plank on the door and remove a few bricks from the pavement. If this all was filmed and broadcast by the regional television they were happy. The damage was repaired the same day and I was quite relieved that it ended this way!

Even more exciting was what happened shortly after the symposium in Irvine I spoke about. To save money, I shared a room with the staff member who searched all over the world for "unknown" bulbs that might be interesting to Dutch breeders. Every night he told me about his great concern for his wife's health. For a couple of months she had been complaining about headaches, digestion problems, loss of weight, etc. He was very worried, the more so because doctors could not find the cause of her problems. A few weeks after our return from California she was in a coma and again a few weeks later he was arrested. It turned out that, after he had met a Chilean girl and made her pregnant, he wanted to get rid of his wife and had started to poison her slowly by injecting her food with parathion he had stolen from the institute. This story appeared great in the press and was even part of a book about remarkable murders.

The "dioxin crisis" I was confronted with as director of RIKILT had started with contamination of chicken feed in Belgium but had implications also for other countries. As a result I was interviewed by newspaper journalists (who did not always give an accurate report of what I had told them!) and by French television, and together with one of my staff I was invited to appear before a parliamentary investigation committee in Brussels. The high degree of knowledge of the members of this committee was a pleasant surprise. A Flemish political scientist and journalist wrote a very informative and comprehensive book about this subject.

As ISHS Board member I had a funny experience in Russia. Together with Jozef Van Assche, I visited Michurinsk to celebrate Russia's renewed ISHS membership. I was asked to lay flowers at Michurin's statue. A cameraman filmed it and the next morning I was congratulated by our hosts. What had happened? I had appeared in the regional TV news as the opening item, even before President Medvedev or Prime Minister Putin! An even bigger surprise was the farewell present Jozef and I were given: a huge boar's head, mounted on a heavy wooden plank. It was impossible to take with us on the plane, so we asked our hosts to send it to the Belgian embassy in Moscow.

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?

When I became director of the Bulb Research Centre in May 1983, one of the first things I was expected to do was to be co-convener of the IV International Symposium on Flower Bulbs in 1985. This gave me the opportunity to get to know many of the people working in bulb research worldwide. At the end of this symposium, I was asked to start a Working Group on Flower Bulbs within the ISHS Section Ornamental Plants. Since then I have been actively involved in ISHS, later as chairman of this Section, as scientific secretary of the XXV IHC (Brussels, 1998), and from 2002 till 2010 as Board member (treasurer). Now I am finishing my active ISHS time as internal auditor and Council member. Thus, ISHS has for more than 35 years played an important role, not only in my professional life but also as a source of long-lasting friendships. By attending symposia and other meetings, I have learned a lot about horticulture in various parts of the world, what it means to people's lives and what horticultural science can contribute to their well-being.

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

Fortunately the number of students in horticulture, which reached a low in the "Western" world in the first years of this century, has grown in recent years, also because of a continuous and increasing interest by students from other parts of the world. I would advise young people not to be discouraged by those who say that horticulture is only about dirty hands and does not offer interesting career opportunities. One of the big challenges of our time is to develop methods to feed the growing world population in a healthy and sustainable way, and horticultural scientists are necessary to find a way to do so. Also a pleasant living environment (house plants and flowers, gardens, parks and sports grounds) requires the input of horticultural scientists. Moreover, horticulture does not only involve all fields of plant science, but also includes soil science, water management, food science, human health, gardening, economics, social sciences, logistics, greenhouse technology, computer science and many more aspects. In all these fields you will find rewarding jobs. So, if you are interested in a career in horticulture or horticultural science, do not hesitate to follow your heart. You will not be disappointed.

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

I can only endorse what Georg Noga and Dino Keatinge have said in this "Spotlight" series. Fruit and vegetables play an increasingly important role in people's lives, both to fight undernourishment and malnutrition and to prevent obesitas. Producing high-quality fruit and vegetables (and let us not forget ornamental plants) in sufficient quantities in a sustainable way is a great challenge we are facing. The dramatic decline of insect populations in some European countries and the loss of biodiversity all over the world are a source of great concern also for horticulture. Problems caused by pollution, soil degradation and salinisation, the shortage of water in some parts of the world and high rainfall in other parts cannot be solved without scientific input. New ways of crop production (precision farming, use of information technology), packaging, transport and waste processing, require inventive scientists to tackle them. For horticultural scientists there will be enough problems to solve and new methods to develop.

Detecting Wisconsin's wild cranberries from space

Anastasia Kunz, Vanesa Martín, Nicole Pepper, Eli Simonson, Nick Young and Paul Evangelista

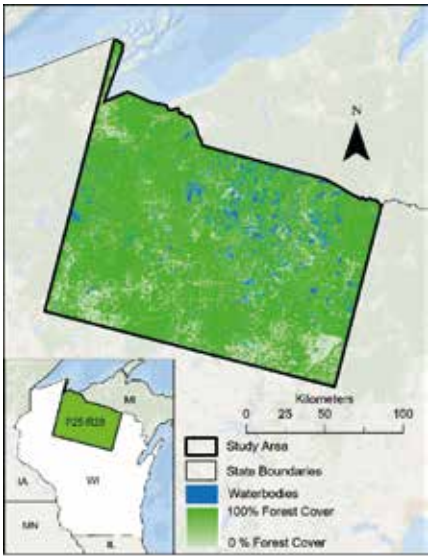

Figure 1. Study area extent in north central Wisconsin.

Crop wild relatives are plants that are genetically related to cultivated crops and function as repositories for genetic diversity (USDA Forest Service, 2014). The conservation of crop wild relatives, both in their natural habitat (in situ) and in seed banks (ex situ), is critical to safeguard genetic diversity and prevent species loss, especially for staple crops. Domestication of plants contributes to both phenotypic and genetic alteration, where species may lose important traits necessary for survival in their natural habitat (Suszkiw, 2014). Conserving crop wild relatives in situ allows for them to continue to change and adapt in their environment. Their unique genetic traits can then be reintroduced to bolster the resilience, yield, and nutritional value of domesticated crops (Khoury, 2013).

Given the critical role that crop wild relatives can play in the realm of food security, the United States Department of Agriculture, Agricultural Research Service (USDA ARS) National Plant Germplasm System (NPGS) is tasked with conserving them both in their natural habitats and in gene banks. Consequently, researchers at the NPGS in Fort Collins, CO partnered with Colorado State University and the NASA DEVELOP Program to determine whether satellites can be used to monitor and map crop wild relatives more efficiently than standard field methods alone. DEVELOP, a program under NASA's Applied Sciences Program, addresses environmental issues through interdisciplinary research projects that apply satellite technology to community concerns around the globe. The collaboration between DEVELOP and the NPGS aimed to experiment with the mapping of different types of crop wild relatives, in the hope of producing an operational method to accurately monitor crop wild relatives on a national scale.

This study analyzed the feasibility of integrating satellite imagery to enhance habitat distribution models of the littleleaf cranberry (*Vaccinium oxycoccos*) and the largeleaf cranberry (*Vaccinium macrocarpon*). Both species occur co-dominantly, forming large stands where it is often difficult to distinguish between the two species. The cranberry stands are found in acidic peat bogs, pH range 2.9-4.7, with high moisture content (Matthews, 2018). These shade-intolerant, perennial shrubs occupy unique niche habitats with low nutrient levels, forming dense contiguous patches in open areas. Although they are commonly found adjacent to many different forest types, they do not typically form large colonies below tree cover (Matthews, 2018). Additional species in the *Vaccinium* genus, as well as sphagnum mosses, are found in these bog habitats with both the largeleaf and littleleaf cranberries. Both focal species flower in the spring and fruit in the fall, with an accompanying foliage transition from green to red (Matthews, 2018).

Our study area was in north central Wisconsin (Figure 1). The landscape is home to a wide variety of geographical features including fertile plains, sand and acidic peat bogs, and mixed wetland forests (Wisconsin Historical Society, 2018). The unique wetland and bog habitats across the study area create ideal growing conditions for cranberry populations, making Wisconsin the nation's leading producer of cranberries (USDA NASS, 2017). To assess current distributions of cranberry crop wild relatives in Wisconsin, the study period covered the year of 2017.

Currently, the NPGS utilizes a spatial modeling approach to predict suitable habitat distributions for crop wild relatives (Merow et al., 2013). This predictive modeling is a critical tool that the NPGS relies on when sending researchers into the field to carry out their conservation efforts; however, it exclusively incorporates bioclimatic variables (i.e. temperature, precipitation) to predict suitable habitat of the focal species (Bradley et al., 2012). This strictly bioclimatic approach overlooks finer-scaled landscape and phenological features that relate to vegetation and land cover. As a result, these models only allow for broad predictions of where the species may be found based on generalized environmental conditions.

Satellites and multi-spectral sensors, such as NASA's Landsat 8 Operational Land Imager (OLI) (United States Geological Survey Earth Resources Observation and Science Center,

Figure 2. Cranberry bog from a field perspective (left) and high resolution NAIP imagery of wild cranberry habitat with database-derived (yellow) and user-generated presence (green) points (right). Source: USDA Farm Service Agency, National Agriculture Imagery Program (NAIP), retrieved from https://code.earthengine.google.com/.

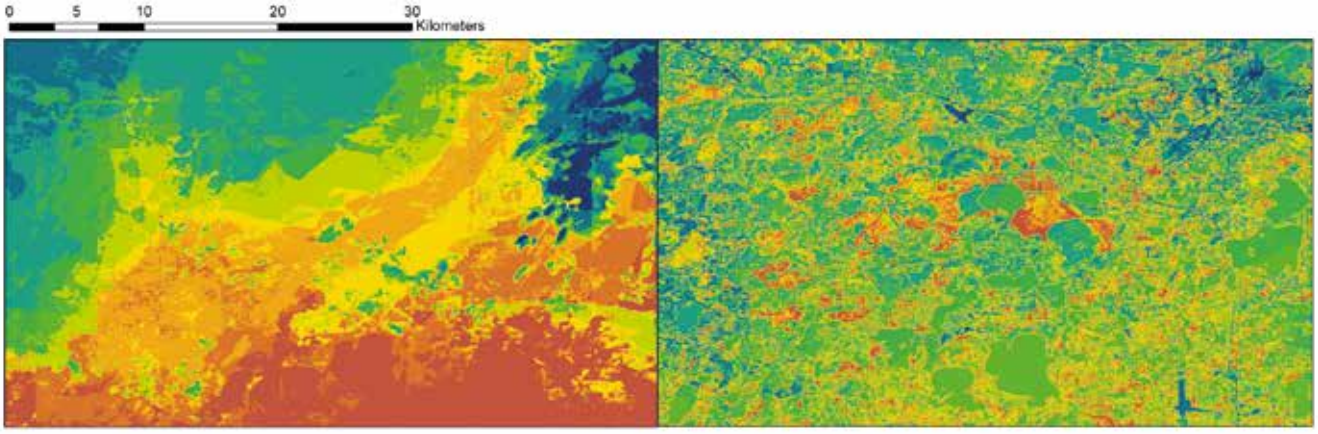

Figure 3. A comparison of habitat distribution models using bioclimatic variables (left) and high resolution satellite imagery (right). Both images span the same extent.

2014), provided our team with aerial images at a 30-m² pixel resolution that were used to distinguish features on the Earth's surface. Each pixel in an image has a unique response across the electromagnetic spectrum. These spectral signatures are a representation of the way light interacts with different surfaces on the Earth, including wavelengths that span beyond the visible spectrum, such as near-infrared and short-wave infrared. We can use these signatures to identify wild cranberries from space because this electromagnetic information can give us insight about characteristics like moisture and chlorophyll content that is difficult to detect in the visible spectrum. With this highly specific data, it is possible to distinguish monotypic stands of cranberries from their surrounding landscapes. For this reason, we incorporated satellite data into the current NPGS methodology to improve model accuracy and efficiency (Kerr and Ostrovsky, 2003).

Reliable species presence data is a critical component of habitat distribution modeling in predicting where else species may occur. For this reason, we tested two different approaches to our presence data input variable. The first approach used in-field presence data for largeleaf and littleleaf cranberry from the Global Biodiversity Information Facility (GBIF) and the USGS Biodiversity Information Serving Our Nation (BISON) databases; researchers at the University of Wisconsin and the NPGS provided additional presence data. These presence locations were collected in field surveys that were not specifically conducted for remote sensing purposes, meaning that the scale at which these presence data are collected often does not translate to spatial scales that align with the pixels in satellite images (30 m²). This can negatively impact the reliability of a distribution model with a satellite-derived component. To avoid this discrepancy, we employed a technique known as Digital Ocular Sampling. This process consisted of using the in-field data to guide where we manually placed presence points to fit the 30-m² spatial resolution (Figure 2). These user-generated cranberry presence data were validated through discussion with project partners and field experts. We ran separate model iterations using these points as the input presence data.

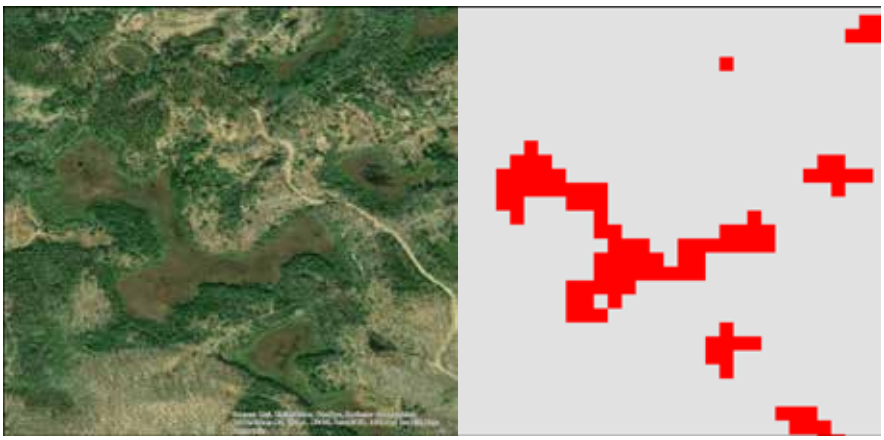

Figure 4. Example of NAIP imagery (left) and detected landscape features that are characteristic of cranberry habitat (right). In this case, red represents cranberry presence and gray represents cran berry absence. Source: USDA Farm Service Agency, National Agriculture Imagery Program (NAIP), retrieved from https://code.earthengine.google.com/.

The incorporation of satellite data into our models resulted in spatial outputs with greater detail than those produced with bioclimatic variables alone (Figure 3). Our final model showed that the detected cranberry habitat aligned well with wetland bogs that are characteristic of viable cranberry habitat (Figure 4). We performed an independent data validation to assess the reliability of our cranberry habitat models. To do this, we overlaid the habitat suitability model with the boundaries of commercial cranberry bogs from the Wisconsin Department of Natural Resources. Our maps agreed with the locations of these commercial cranberry crops despite the fact that we did not use any commercial cranberry presence points to train our models (Figure 5). With this assurance in hand, we were able to produce more confident maps for our field partners and experts.

We found two principal implications associated with this assessment. The first is related to geographic scope, namely the fact that the climatic range across our study site had relatively low variation. As such, the combination of a limited geographic scale and the relatively coarse spatial resolution of bioclimatic variables may have resulted in models that relied disproportionately on satellite-derived variables to predict cranberry habitat. When compared to bioclimatic variables, variation in spectral reflectance can be relatively substantial from pixel to pixel across a small area and is likely due to more abrupt variations in land cover. Therefore, future work should investigate how the explanatory power of satellite-derived variables translates when applied to a larger extent that is matched with a more diversified range of climatic variables.

Furthermore, it is important to recognize that the cranberry habitat detected by our models inevitably included co-occurring species given the 30-m² resolution of the satel-

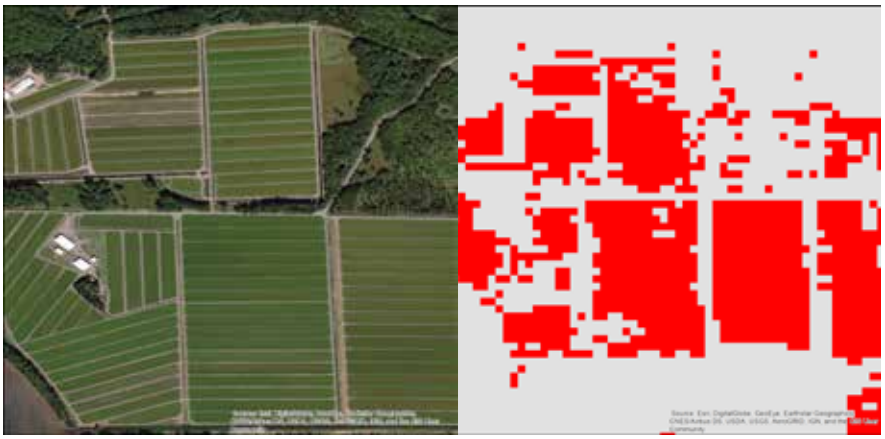

Figure 5. Example of NAIP imagery (left) over commercial cranberry bogs, as defined by the Wisconsin Department of Natural Resources, and detected commercial cranberry bogs (right). Source: USDA Farm Service Agency, National Agriculture Imagery Program (NAIP), retrieved from https://code.earthengine.google.com/.

lite data we employed. Through a discussion with partners at the USFS Chequamegon-Nicolet National Forest and the University of Wisconsin-Madison, we determined that the other detected vegetation could include sphagnum moss and other members of the *Vaccinium* genus.

Satellite data derived from NASA Earth observations were successfully utilized to detect the habitat of our focal cranberry species (Figure 6). In the study area extent, satellite-derived predictor variables provided higher explanatory power in habitat distribution models than standard bioclimatic variables of the same resolution (30 m^2). Additionally, we found that user-generated presence points consistently outperformed database-derived presence points in model outputs. This can largely be attributed to the reality that existing species presence data are not always optimal for remote sensing purposes, specifically in capturing the unique spectral signature of the focal species.

We hope to be able to continue working with our partners in the near future with the aim of conducting in-field verification of our maps. For now, it is apparent that satellite-derived data can positively influence the research efforts of our partners at the NPGS, and their larger goals of improved conservations efforts for future food security and biodiversity.

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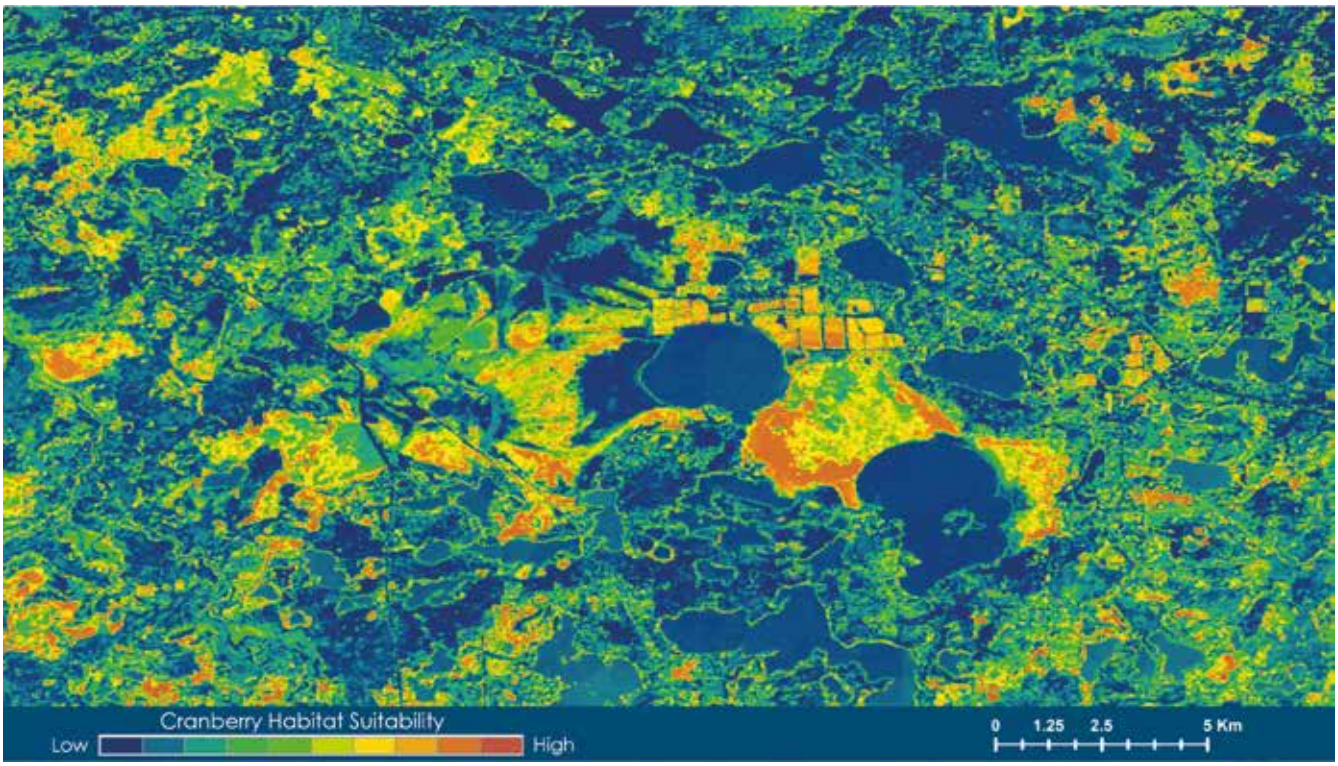

Figure 6. Suitable habitat prediction from 0-100% for cranberry focal species (*Vaccinium oxycoccos* and *macrocarpon*). Probabilistic surface of cranberry habitat ranges from blue (0%) to red (100%), where highly suitable habitats are concentrated in bog wetlands.

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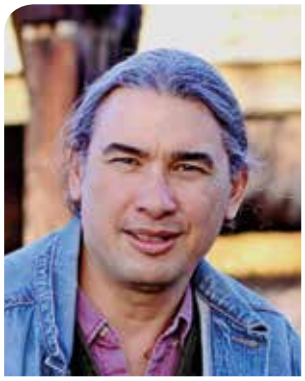

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References

Bradley, B.A., Olsson, A.D., Wang, O., Dickson, B.G., Pelech, L., Sesnie, S.E., and Zachmann, L.J. (2012). Species detection vs. habitat suitability: are we biasing habitat suitability models with remotely sensed data? Ecological Modelling *244*, 57–64.

Kerr, J.T., and Ostrovsky, M. (2003). From space to species: ecological applications for remote sensing. Trends in Ecology & Evolution *18* (6), 299–305.

Khoury, C. (2013). An inventory of crop wild relatives of the United States. Crop Science *53*,1496–1508 https://doi.org/10.2135/cropsci2012.10.0585.

Matthews, R. (2018). *Vaccinium oxycoccos*. In Fire Effects Information System [Online] (U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer)), https://www.fs.fed.us/database/feis/plants/shrub/vacoxy/all.html (accessed November 13, 2018).

Merow, C., Smith, M.J., and Silander Jr, J.A. (2013). A practical guide to MaxEnt for modeling species' distributions: what it does, and why inputs and settings matter. Ecography *36* (10), 1058–1069.

Suszkiw, J. (2014). National inventory takes stock of crops' wild relatives. Agricultural Research Magazine.

United States Department of Agriculture Forest Service. (2014). USDA Forest Service and Agricultural Research Service Crop Wild Relatives Partnership Projects: the Importance of Research Natural Areas, Wilderness Areas, and More.

United States Department of Agriculture National Agricultural Statistics Service (NASS). (2017). Cranberry Report.

United States Geological Survey Earth Resources Observation and Science Center. (2014). Landsat 8 OLI Level-2 Surface Reflectance (SR) Science Product [Data set]. U.S. Geological Survey. https://doi.org/10.5066/f78s4mzj.

Wisconsin Historical Society. (2018). https://www.wisconsinhistory.org/Records/Article/CS387.

Japan Prize of Agricultural Science for 2019 awarded to Professor Dr. Ryutaro Tao

On 5 April 2019, Professor Dr. Ryutaro Tao, International Society of Horticultural Science Board member from 2014-2018, was awarded the Japan Prize of Agricultural Science for his research on "The discovery of *Prunus*-specific self-incompatibility recognition system and its horticultural applications". The Association of Japanese Agricultural Scientific Societies (AJASS), which includes 52 Japanese scientific societies from diverse agricultural disciplines, presented the award to Dr. Tao. The Japan Prize of Agricultural Science was established in 1926, and is highly regarded as the premier award for agricultural research in Japan.

› Professor Dr. Tao received the award plaque and certificate from Professor Watabe, Vice-President of the Association of Japanese Agricultural Scientific Societies.

› Professor Tao and his colleague researchers celebrating at the award ceremony dinner. Left to right: Professor Kawabata, the Japanese Society for Horticultural Science (JSHS) President, Professor Tao, and Professor Shibata, the former JSHS President.

› 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.

Bud load levels and leaf removal in *Vitis vinifera* L. 'Sultana'

› Turcan Teker

Turcan Teker is a viticulturist who works in the Republic of Turkey Ministry of Agriculture and Forestry, Directorate General of Agricultural Research and Policies, Viticulture Research Institute in Manisa. His research focused on canopy management of grapevines, berry shrivel, grapevine physiology, and optimization of raisin quality and quantity. He graduated with a BS from Ankara University, Faculty of Agriculture, Department of Horticulture (2009). He completed his MS in viticulture science at the Graduate School of Natural and Applied Sciences, Ankara University. He is currently studying for his PhD under the supervision of Prof. Dr. Ahmet Altındişli at the Graduate School of Natural and Applied Sciences, Ege University. Turcan has completed his field research and is focused on completing his thesis.

Berry shrivel is the most economically important and frequent problem in grapes in the Aegean Region. Every year, growers complain about this issue to extension and research institutions. Extreme bud load and leaf removal may cause berry shrivel. The recommendations for 'Sultana' production is to have 15 buds m^{-2} (90 buds on canes) and to remove 25% of the leaves. Yet, some growers leave a larger number of buds (150-180 buds) on the canes to obtain more bunches.

Turcan's research examined the effect of bud load and leaf removal treatments on the physiology of grapevines, yield, berry quality, and the occurrence of berry shrivel. Two different bud load treatments (15 and 30 buds m^{-2}) and two different leaf removal treatments (25 and 50%) were applied to the vines.

Leaf removal treatments were performed as a summer pruning approximately one month before veraison (grape ripening). During harvest, berry samples were taken separately from the upper and lower side of bunches for analysis. Berries from each treatment were analyzed for mineral compounds, yield, and quality. Significant differences in berry quality and other traits between optimum and extreme bud load applications were detected. Over-loaded vines were characterized by small berries, soft berry texture, reduced bud fruitfulness, and crop yields.

There was no significant difference ($p<0.05$) between the yield of the treatments due to the quantity of many clusters in 30 buds m^{-2} treatment. 62.8% more berries per bunch were obtained in 30 buds m^{-2} treatment as compared with the 15 buds m^{-2} treatment. However, bunch weight decreased by 28.7%. The increased number of bunches (almost 75-87 bunches per vine) accelerated the occurrence of shriveled berries. This difficulty was observed in the 30 buds m^{-2} treatment, and both 25 and 50% leaf removal treatments. However, shrivel was not found in the 15 buds m^{-2} treatment. Berry weight decreased as bud load on the grapevine increased, and more leaves were removed (50%) on shoots. Bud load treatments also affected berry width and length values.

Turcan Teker won an ISHS Young Minds Award for the best poster at the International Symposium on Viticulture: Primary Production and Processing at IHC2018 in Turkey in August 2018.

› Contact

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Genetic diversity of *Tulipa suaveolens* in the Crimea based on ISSR data

› Tatyana Kritskaya

Tulipa suaveolens Roth (= *T. schrenkii* Regel) is an ornamental polycarpic species of the *Liliaceae* family, and a suspected ancestor of *T. ×gesneriana* L., the garden tulips. Due to the decline in the size of natural species distribution that resulted from the ploughing of the steppes, the International Union for the Conservation of Nature considers this plant to be on the Red List of threatened plants in Russia, Ukraine, Kazakhstan, and Azerbaijan. By comparison with tulips from other areas of the range, *T. suaveolens* populations of the Crimea and the adjacent territories are highly variable in shape and color of the perianth. Furthermore, mountain populations found at 700 meters above sea level are highly specific in their ecology. The aim of the paper was to conduct inter-simple sequence repeats (ISSR) analysis of intra- and inter-population polymorphism in *T. suaveolens* specimens found in the Crimea and the adjacent territories, and to reveal the dominant geographic trends in the species distribution. Specimens were collected in natural localities of *T. suaveolens* in the Crimea, Krasnodar Region, Rostov Oblast, Volgograd Oblast, and Kalmykia Republic. DNA extraction and ISSR analysis were performed using standard procedures. The analysis gave 153 polymorphous *T. suaveolens* bands. Principal coordinate analysis (PCA) of the matrix in the Paleontological Statistics (PAST) software indicated that the populations from Kalmykia and the Krasnodar Region were genetically isolated, whereas specimens from the remaining populations were mixed. The analysis in the NewHybrids software confirmed the results of the PCA, though in a small number of iterations. In these iterations, the program identified the populations from Kalmykia and the Krasnodar Region as "pure parents", while the remaining specimens were classified as F_2 hybrids. However, in analyses with more iterations, the "parent" status was assigned only to the Kalmykian population, while other specimens fell into the "backcrosses" category, grouping to the second, absent parent. The Bayesian analysis using STRUCTURE software resulted in the separation of the dataset into four groups according to their geographic distribution. Nonetheless, ISSR analysis allowed for only tentative conclusions and needs to be supported by other methods of research.

Tatyana Kritskaya won an ISHS Young Minds Award for the best oral presentation at the VIII International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects) in Yalta, Russia, in October 2018.

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Genotype and harvest time affect the allelopathic activity of *Cynara cardunculus* L. extracts on *Amaranthus retroflexus* L. and *Portulaca oleracea* L.

› Aurelio Scavo

Aurelio Scavo is a PhD Student at the Department of Agriculture, Food and Environment (Di3A) of the University of Catania, Italy. His PhD focused on *Cynara cardunculus* L. allelopathy, with emphasis on sustainable weed control. Allelopathy refers to the ability of some plants to release harmful or beneficial secondary metabolites into the environment. The manipulation of allelopathic mechanisms between plants can produce bioherbicides to promote a chemical-free weed management program. In a first step, the allelopathic effects of leaf aqueous extracts from three *C. cardunculus* botanical varieties (globe artichoke, wild, and cultivated cardoon) were demonstrated on seed germination of six common weeds. Secondly, the procedures to efficiently extract allelochemicals considering costs, yields, and inhibitory activity were determined. Dried leaves proved to be the best extraction plant material, and ethanol and ethyl acetate were the best solvents. In addition, new *C. cardunculus* allelochemicals were found and purified. Thirdly, light stress (by plant shading) in field conditions enhanced the content of *C. cardunculus* allelochemicals and the phytotoxicity. In a three-year field experiment, the monoculture of globe artichoke, and cultivated and wild cardoon were found to reduce the amount of weed seeds in the soil seed bank, compared to a biennial rotation wheat/faba bean, and to improve the soil eubacterial communities. The objective was to evaluate the effect of genotype and harvest time on the phytotoxicity, quantity and composition of *C. cardunculus* allelochemicals. The wild and cultivated cardoon had the highest concentrations of allelochemicals. April was the best harvest time for the artichokes to produce the allelochemicals that inhibit *Amaranthu retroflexus* and *Portulaca oleracea* germination, root and shoot length, thanks to the favorable climatic conditions that stimulated the synthesis of these compounds. These results represent an important advancement in the understanding of *C. cardunculus* inhibitory activity and offer new eco-friendly tools to farmers for weed control.

Aurelio Scavo won an ISHS Young Minds Award for the best oral presentation at the X International Symposium on Artichoke, Cardoon and their Wild Relatives in Spain in March 2019.

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Comparative morphological and transcriptome in two *Lycoris* species

› Ziming Ren

Ms. Ziming Ren is a PhD student at Zhejiang University working in ornamental horticulture. The objective of her thesis is to explore the mechanisms regulating the formation and development of bulblets (vegetative propagation) of *Lycoris* spp. *Lycoris* is a genus of flowering bulbs of high medicinal and ornamental value belonging to the *Amaryllidaceae*. This genus consists of about 20 native species that are distributed in Eastern Asia. *Lycoris* has shade tolerance and a wide range of flower colors, which has recently increased its popularity as flowering ground cover. Wild harvests of these plants have dramatically increased to fill the market demand, and consequently the species has become threatened. Breeding and commercial production of *Lycoris* have been hindered by a long sexual reproduction cycle and low regeneration rate under natural conditions. The objective of this study was to estimate the vegetative propagation from bulb scales by performing morphological and transcriptome evaluation. Flowering-sized bulbs of *Lycoris sprengeri* and *Lycoris aurea* (two major landscaping species used in the Yangtze River region of China) were selected and their sizes were measured. Under containerized conditions, with no growth regulators, *L. sprengeri* showed a greater ability to form bulblets (ca. 1-5 bulblets/bulb section) than *L. aurea* (ca. 1-2 bulblets/bulb section). Axillary meristems on the abaxial side of the scale base were initiated during the early stages of vegetative reproduction. Many small cells with dense cytoplasm were observed in the rapidly growing meristems, which give rise to the axillary buds. Basal scale tissues connecting to the plate were collected for transcriptome analysis from the beginning of the multiplication process (0 h, 6 h, 48 h, 6 d, 15 d, 27 d and 36 d). Most of the differentially expressed genes (DEGs) were gathered in the very early stage (6 h from the excision of the bulb scale) for both species. For *L. sprengeri*, a higher number of ethylene-related DEGs were found compared to the value recorded for *L. aurea*. This is consistent with previous findings in *Lilium* where the number of adventitious buds formed on bulb scale explants increased with the application of ethylene. Ethylene might integrate the signals of wounding and changes in polar auxin transport. Thus, our studies led us to determine that the vegetative propagation depends on the number of newly formed meristems on the explant. Their outgrowth enables the formation of a new axillary bud. Our results suggested that ethylene plays a part during axillary meristems development in *Lycoris*. From these promising results, we hope to enhance the multiplication efficiency in *Lycoris*.

Ms. Ziming Ren won an ISHS Young Minds Award for the best oral presentation at the XIII International Symposium on Flower Bulbs and Herbaceous Perennials in Korea in May 2019.

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Using magnesium nanomaterial as a novel alternative to pesticides

› Ying-Yu Liao

Ying-Yu Liao is a PhD student in Plant Pathology, University of Florida, USA. She completed her B.S. in Agricultural Chemistry from National Taiwan University, Taiwan R.O.C., in 2013, and attained her M.S. in Plant Pathology from the University of Florida in 2017. Her research projects are focused on: 1) evaluating novel management strategies using nano-materials and 2) the role of the Type VI secretion system in the tomato pathogen, *Xanthomonas* spp. Florida is the largest fresh market tomato producing-state in the U.S. and accounts for 36% of annual production. Bacterial spot disease, caused by *Xanthomonas perforans*, is one of the most critical bacterial diseases in fresh market tomato production. In Florida, there is no effective chemical control strategy because the emergence of copper-tolerant strains has rendered bactericides ineffective. To prevent extensive cost and maintain Florida's tomato industry, successful disease management strategies for bacterial spot are crucial. In recent years, numerous studies have demonstrated the greater antibacterial properties of nanomaterials compared to their bulky counterparts. The reduced-sized particles have antibacterial activity toward some copper-tolerant bacterial strains. Ms. Liao presented "Using magnesium nanomaterial as novel alternative to plant disease management" at the VI International Symposium on Tomato Diseases. Magnesium (Mg) is an important plant micronutrient that is required for several enzymes and ribosomal activity. Over the past decade, micron-sized and nano-sized MgO (Nano-MgO) particles were shown to have antimicrobial activity against several mammalian pathogens. Nano-MgO (20 nm) was evaluated against a Cu-tolerant *X. perforans* strain in vitro and against tomato bacterial spot in the field. Based on preliminary findings, Nano-MgO may be an effective alternative to standard pesticide applications. This is the first study to test the efficacy of magnesium oxide nanomaterials against plant pathogens.

Ying-Yu Liao won an ISHS Young Minds Award for the best oral presentation at the VI International Symposium on Tomato Diseases in Chinese Taipei in May 2019.

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Cytogenetic assessment of *Lilium longiflorum* × *L. hansonii* revealed by genomic in situ hybridization (GISH)

› Mazharul Islam

My name is Mazharul Islam. I am a PhD student at Kyungpook National University, Daegu, Korea. My major research areas are plant genetics and flower breeding. I hope to introduce noble interspecific and intraspecific *Lilium* hybrids and develop cytogenetic assessment techniques to evaluate newly generated hybrids. The objectives of my study were to investigate chromosome behavior and inter-genomic recombination during meiosis of *L. longiflorum* × *L. hansonii* progenies. Interspecific F_1 hybrids (LM) introduced through a cut-style method between two diploid *Lilium longiflorum* and *Lilium hansonii* were evaluated cytogenetically by genomic in situ hybridization (GISH) technique. However, GISH analysis of F_1 interspecific (LM) hybrids showed equal chromosomal contribution from both female *Lilium longiflorum* (LL) and male *Lilium hansonii* (MM). Each of the parents contributed 12 chromosomes except in three crosses: two *L. longiflorum* 'White Tower' × *L. hansonii* (2*x*-1) and a *L. longiflorum* 'Bright Tower' × *L. hansonii* (2*x*-1). Recombinant chromosomes are not usually found in F_1 interspecific lily hybrids. Most often, genomic recombination occurs in crosses between two genetically different parents. Chromosome pairing and cross-over normally occur during meiosis in backcross progenies. However, in this study, genome analysis (GISH) of F_1 hybrids (*L. longiflorum* 'White Tower' × *L. hansonii*) showed four recombinant sites, including two M/L and two L/M recombinant chromosomes, which denotes a high genetic relationship between *L. longiflorum* and *L. hansonii*. Therefore, recombinant and non-recombinant chromosomes can be found in F_1 interspecific *Lilium* hybrids. Both parents contributed equally though the chromosome numbers in F_1 were not always fixed. Molecular cytogenetic assessment in lily breeding, including flow cytometry, especially GISH, has been a useful tool to easily identify genetic recombination. Mazharul Islam won an ISHS Young Minds Award for the best oral presentation at the XIII International Symposium on Flower Bulbs and Herbaceous Perennials in Korea in May 2019.

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The remontant flowering of perennial plants: implications for breeding bearded iris

› Zhuping Fan

Zhuping Fan is a candidate for an MS degree at Beijing Forestry University, China. She is studying repeat blooming or remontant flowering of bearded iris (*Iris germanica*). She is also evaluating *Iris* through traditional hybridization and molecular breeding methods. Bearded iris appears to have a thick and bushy "beard" on its colorful falls. This flower annually blooms in May in Beijing, China. However, some cultivars bloom twice each year, in May and October. This reblooming enhances the popularity of this flower and adds commercial value to this crop. Repeat blooming types can spontaneously appear in a population, but individuals with this trait can be bred and selected. For this study, specific repeat blooming cultivars were chosen as parents. These selections will be used in future hybridizations to produce improved reblooming bearded iris. In addition, the molecular mechanism of reblooming is under investigation. Currently, the transcriptome profiles of rebloomers and once-bloomers are being determined. Differentially expressed genes have been identified. After the quantitative real-time polymerase chain reaction (qRT-PCR) and other molecular validation, the key genes for reblooming will be determined. This research will be useful in understanding aspects related to flowering control in perennial ornamentals.

Zhuping Fan won an ISHS Young Minds Award for the best oral presentation at the XIII International Symposium on Flower Bulbs and Herbaceous Perennials in Korea in May 2019.

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Identification of the *UPSTREAM OF FLOWERING LOCUS C (UFC)* gene in gladiolus as a marker for the flowering control gene *FLOWERING LOCUS C (FLC)*

› Jaser A. Aljaser

Jaser A. Aljaser is Ph.D. candidate in Applied Plant Science in Horticulture at the University of Minnesota Twin Cities, USA. He received his M.Sc. in Horticulture and Agronomy from the University of California Davis (UCD), USA, in 2015, and received his B.Sc. in Botany from Kuwait University (KU), Kuwait, in 2008. His Ph.D. research topic is gladiolus breeding for rapid generation cycling to produce seed propagated "annual" gladiolus from original perennial species and identification of flowering genes. He is currently Teaching Assistant at KU and pursuing his Ph.D. Upon graduation, he will be appointed as an Assistant Professor in Horticulture with emphasis on floriculture at KU.

The objectives of the poster presented at the XIII International Symposium on Flower Bulbs and Herbaceous Perennials were to identify the presence of the *UPSTREAM OF FLOWERING LOCUS C* (*UFC*) gene in gladiolus and to test the possibility of identifying *FLOWERING LOCUS C (FLC)* from the generated scaffolds. Gladiolus (*Gladiolus* × *hybridus*) is a geophytic ornamental garden plant as well as a cut flower. It is ranked in the top 10 of cut flowers for floral design. In ornamental plants, flowering is a crucial step for the success of cut flower production. Therefore, understanding the flowering pathway and gene expression is important for efficient selective breeding. In this geophyte, the flowering pathway is poorly understood. *FLC* is a major flowering repressor found in *Arabidopsis* and many dicot species. *FLC* plays a vital role in the control of flower initiation. However, in monocot species *FLC* was not identified. The lack of identifying *FLC* in monocot species and discovery of another mechanism of flowering in monocots, such as vernalization in wheat and plant age in both maize and rice, led to our hypothesis that monocot geophytes may also be *FLC*-independent for flower initiation. To determine if *FLC* is present in gladiolus, we searched for genes linked with *FLC*. In *Arabidopsis*, *FLC* is closely linked to two genes, *UFC* and DOWNSTREAM of the FLOWERING LOCUS *C* (*DFC*). The genes are hypothesized to be associated with *FLC*, as *UFC* expression is downregulated upon vernalization similar to *FLC*, although the clear function of *UFC* has not been determined. Designing *UFC* primer, sequencing and analyzing the sequences in multialignment showed two exons of the *UFC* gene with over 80% pairwise of monocot species such as date palm and asparagus. Also, exon gene prediction and protein BLASTs confirmed the presence of the *UFC* gene. The results also confirmed the presence of another exon for *FLOWERING LOCUS C EXPRESSOR* (*FLX*) that upregulates *FRIDGA* (*FRI*) and mediates *FLC* expression. In conclusion, the identification of *UFC* in gladiolus is a crucial step to test if *FLC* is present. The identification of *UFC* will help as a marker to locate *FLC* exons. In addition, the discovery of *FLX* exons, which is *FRI*-mediated for the *FLC* activation gene, supports the hypothesis that monocots evolved away from the *FLC* dependent pathway into being *FLC*-independent species, and the *FLC* gene may not be found as a whole gene but rather a remnant exon.

Jaser A. Aljaser won an ISHS Young Minds Award for the best poster presentation at the XIII International Symposium on Flower Bulbs and Herbaceous Perennials in Korea in May 2019.

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Horticulture in Thailand & the III Asian Horticultural Congress – AHC2020

Ananta Dalodom

The total area of Thailand is about 320 million rai or 51.3 million ha. About 23.9 million ha, or 46.5%, are in agricultural use. Only 2.1 million ha, or 8.8%, are in horticultural production. Horticultural crops are diverse, including subtropical and tropical fruit, vegetables, flowers, ornamentals, industrial fruit, spices, and medicinal plants. Thanks to suitable topographical and climatic conditions, Thailand can produce a variety of horticultural crops throughout the year. The tropical Thai fruits are well recognized for their exotic, delicious, and juicy taste. Some favorites are: durian, mango, mangosteen, longan, and rambutan. Different kinds of vegetables, spices, and medicinal plants are used as ingredient of genuine Thai cuisine. Cut orchids are very popular among the Thai people and are a valuable commodity that is shipped overseas.

Our commercial fruit production area is about 1.2 million ha. Our major crops include mango, longan, durian, mangosteen, longkong, rambutan, and litchi. The production areas for these fruits are in the central, northeastern, eastern, southern and northern regions. About 70% of the fruit production is sold wholesale or to local markets for domestic consumption. The remaining 30% is exported throughout the world. China is the largest importer of Thai fruits. In 2018, the export value of Thai fresh and processed fruit was about 2.37 billion USD. However, Thailand also imports several kinds of temperate fruits from abroad.

Vegetables are grown on about 232,000 ha. The major crops are chili, sweet corn, baby corn, garlic, yard long bean, shallot, water morning glory, Chinese kale, cabbage, and bok choy. The production areas are in the central, northeastern, and northern regions. About 90% of the produce is for domestic consumption, while the remaining 10% is for export of fresh, chilled, and processed vegetables. The exported commodities can earn foreign incomes of about 1.1 billion USD (2018). Some kinds of vegetables such as carrot, potato, garlic, shallot are also imported. About 24% of the carrots consumed in Thailand are imported from China.

Flower and ornamental plants grow on about 11,200 ha. Of that, 3,325 ha are used for cut-tropical orchids, primarily *Dendrobium*. Other flower crops include marigold, ornamental plants, roses, jasmine, lotus, chrysanthemums, cut-leaves, curcuma, and anthurium. Major production areas are in the central region, especially for orchids, and the north and east. Several wholesale and retail markets are located in Bangkok and nearby provinces. In 2018, the overall export value of floricultural products was 136.3 million USD. Thai orchid cut-flowers shared 52.6% of total floricultural export value and ranked second for quantity after the Netherlands. The United States is the major importing country, followed by Japan, Vietnam, China, and Italy. Thailand also imports cut-flowers such as carnation, rose, and lily from China.

Thailand is well aware of product safety and standards. Therefore, an emphasis has been placed on the adoption of good agricultural practice (GAP), and the compliance with national setting standards and international standards.

In 2020, the III Asian Horticultural Congress (AHC), represented by leading horticultural science societies in Asia, will be back again after the previous congress in Chengdu, the People's Republic of China in 2016. Thailand is honored to be the host for the III AHC or AHC2020, which will be held on 7-9 May 2020 at Bangkok International Trade and Exhibition Centre (BITEC), Bangkok under the theme "Asian Horticulture for a Sustainable World". The congress is organized by the Horticultural Science Society of Thailand (HSST), the International Society for Horticultural Science (ISHS), Department of

› Examples of Thai horticultural products: A) durian, B) Thai vegetables, and C) *Vanda* orchid.

› Horti ASIA 2018 International Forum on Horticultural Product Quality (A) and trade exhibition (B).

› Ananta Dalodom, President of HSST, at the plenary session of the II Asian Horticultural Congress (AHC2016).

Agriculture, and Department of Agricultural Extension. The AHC2020 will provide a forum to keep pace with the latest knowledge and innovations in horticultural science and related industries. Horti ASIA organizer, VNU Exhibitions Asia Pacific, will be co-hosting the congress at the heart of the trade fair and international conferences.

Ananta Dalodom, President of HSST, said that AHC2020 will be a platform aimed at sharing recent research and development findings and innovation in various fields of horticulture. It will create the opportunity for a network of technical cooperation among Asian horticulturists and relevant parties. The two-day scientific program will be the featured draw for the congress. In addition, a one-day professional excursion will be arranged for participants to visit various horticultural production areas and industries. The participants can attend Horti ASIA 2020, the international tradeshow for horticultural and floricultural production and processing technology, which will take place in parallel with the AHC2020.

We cordially welcome researchers, professors, students, government agencies, associations, growers, entrepreneurs, and other professionals with an interest in horticulture to attend the AHC2020. You will not only meet your friends in the horticultural sphere, but will also experience the hospitality of the Thai people in the land of smiles.

The main topics of the scientific meetings of the AHC2020 will include production and marketing, genetic resources and breeding, biotechnology, cultural practices and physiology, plant protection, postharvest technology, processing and processed products. All abstracts and full text articles must be submitted using the Responsive Online System for *Acta Horticulturae* submission and review (ROSA).

Please remember the following **important dates:**

Abstracts/Full papers	
Submission of abstracts	1 June – 31 October 2019
Notification of acceptance	30 November 2019
Deadline for submission of full papers	31 March 2020
Registration	
Deadline for early bird registration	31 December 2019
Deadline for online registration	30 April 2020

› Ananta Dalodom

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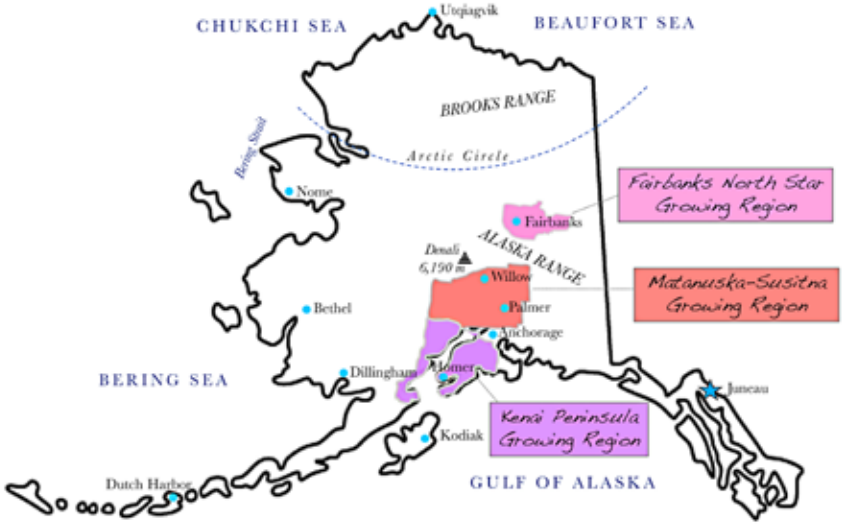
For more information, kindly visit our website: www.ahc2020.org

Peonies as field grown cut flowers in Alaska

Patricia Holloway

Alaska is known more for its oil, fisheries, and tourism industries rather than horticulture. Our tiny population of 740,000 people scattered over nearly 172 million ha of land, yields a patchwork of small farms, market gardens and greenhouses whose markets are mostly local sales, farmers markets, and limited sales to grocery stores and restaurants. However, since 2004, Alaskans have joined the ranks of horticultural exporters based on a most unlikely crop for a subarctic climate – peonies as fresh cut flowers! Here is our story.



› Alaska peony growing regions. Source: Alaska Department of Natural Resources, Division of Agriculture.

The industry

Peonies have been grown as a garden flower in Alaska since the early 1900s, after the Klondike and Alaska Gold Rush brought thousands of people North to seek their fortunes. Peonies were planted occasionally in home gardens, but the roots were difficult to keep alive during transport to Alaska. Once planted, they often were killed by lack of snow cover, severe cold, winter freeze-thaw cycles, and soils that sometimes remained permanently frozen year-round.

Not until the 1970s were formal ornamental research trials conducted at the Fairbanks Agricultural and Forestry Experiment Station, University of Alaska Fairbanks (UAF), to identify hardy species and cultivars as home landscape plants. *Paeonia tenuifolia, P. anomala* and cultivars mostly in the Lactiflora Group were found to be hardy, at least with snow cover. The early trials showed that species peonies bloomed in late May and early June, but many of the Lactiflora and Herbaceous hybrids did not bloom until July and August. In the Alaskan cool southern coastal regions, bloom season extended into late September.

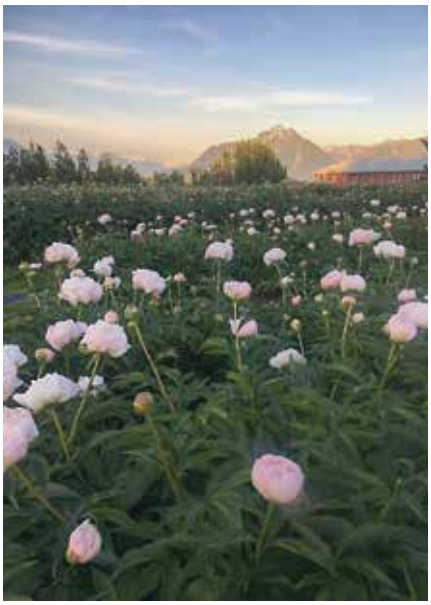
Because Alaska had no horticultural exports of any kind, researchers and growers were unaware of the unique bloom time of peonies and how it might be used to support an industry. Only after Oregon peony grower and cut flower exporter, Mr. Paul Sansone, visited Alaska in the mid 1990s, did we learn of this unique, potentially rich niche market for Alaska growers. In 2001, our first research plots were planted at the UAF Agricultural and Forestry Experiment Station to learn if peonies could be grown as cut flowers, discover how to grow them, explore potential markets, and help develop the infrastructure for Alaska's first horticultural export crop.

Early field studies were promising, so much so that orders for peony stems began to arrive even before there were farmers to fill them. One buyer in London offered to purchase 100,000 stems per week for the entire summer season, only to find out peonies existed solely in research plots at UAF. Alaskan growers were skeptical about trying peonies, because no one had experience in an export flower market, and startup costs to establish a peony farm in Alaska were substantial (root prices alone averaged $3.00 per plant with desirable cultivars listed at $10-25 wholesale). Growers and researchers alike needed to learn how to grow peonies as cut flowers, identify locations in the state where they might grow, and which environmental and economic parameters might challenge the success of this industry.

In 2004, four growers planted the first trial gardens. Based upon their success, interest

› Interior Region – Far North Flowers, Fairbanks, Alaska. Submitted by Nate & Krista Heeringa.

› Kenai Peninsula Region – Frosty Acres Peonies, Homer, Alaska. Submitted by Robert Klemke.



› South Central Region – Wasilla Lights Farm, Wasilla, Alaska. Submitted by Kelly Dellar.

expanded, and new growers organized the Alaska Peony Growers Association to share successes and failures. Early communication among researchers and growers provided a critical link to success especially considering the size of the State and the distances among farms. The number of farms steadily grew, and currently, there are 136 peony farms in Alaska. They range in size from 0.10 to 6 ha.

Farm locations

Farms are located primarily in three regions: Fairbanks (64.8378°N, -147.7164°W) and vicinity in the Interior Region; the South Central Region near Palmer (61.5997°N, -149.1128°W); and the Kenai Peninsula Region with the southernmost farms located in Homer (59.6425°N, -151.5483°W). The major population centers of Anchorage and Fairbanks occur within these regions, and are the center for ground, air and rail transportation. They are connected to the third largest air transport hub in the world through Anchorage, which provides easy access to world markets in Europe, the Middle East and Asia.
Cut flower production ranges from 100 to 70,000 harvestable stems per farm. Growers must wait 2-5 years after planting before harvesting their first crop, and many growers are still in the early stages of field establishment. Other farms are expanding slowly after early successes. In 2018, 350,000 fresh cut stems were sold. In 2023, predicted sales will approach 2 million stems. Although tiny compared to well established agricultural regions of the U.S., Alaska is poised to become a major player in the multi-billion-dollar fresh cut flower industry. The industry has overcome major obstacles in growing a commercial crop where none had existed previously. Progress has been slow and steady as growers identify field management practices appropriate for Alaska, work to identify disease, weed and insect pest pressures, develop marketing plans and educate buyers of this new availability. Alaska already has earned a reputation for high quality, huge flower buds with a superior vase life.

Production

Climate and weather

The three peony producing regions are composed of distinct climate zones. The Interior Region is continental: warm and dry in summer with long, cold winters (average temperature 12.7°C, May-September, -10.7°C in winter). Summer high temperatures often reach into the 20 to 30°C range, while winter temperatures occasionally drop into the -40 to -50°C range. Peony production is possible only with ample snow cover (average annual snowfall, 1.65 m) or other winter protection such as straw mulch. In the past 40 years, 100% of peony roots were killed twice at UAF due to a combined lack of snow and very cold temperatures. Growing seasons are dry (average annual precipitation, 276.8 mm with 180.3 mm summer rainfall) necessitating season-long irrigation.
The Kenai Peninsula Region is a maritime climate: cool in summer and moderately cold in winter (average temperature 9.6°C, May-September, -1.7°C in winter). Summer high temperatures reach into the 15 to 25°C range in Homer. Snowfall can be heavy (average annual snowfall, 1.2 m) but also periods of freezing and thawing in winter can cause problems with peony production especially if the soils are too wet. Site selection in this region is critical to prevent winter kill from root rot. Soils often freeze, but a mid-winter warm spell can cause surface soils to thaw with saturated soils above a layer of ice. Roots in the upper layers will rot in winter. Repeated freeze-thaw actions also cause frost heaving of roots. Most precipitation occurs during the winter months (average annual precipitation, 645 mm with 233 mm average rainfall in summer). Like other regions, all fields are irrigated.
The South Central Region has a cold, temperate climate, warmer in summer than the Kenai Peninsula, but cooler than the Interior Region (average temperature 10.9°C, May-September, -5.5°C in winter). Some areas have deep winter snows (average annual snowfall, 1.4 m), whereas others have very strong winds that remove snow cover and desiccate the fields. The same freeze-thaw problems and frost heaving that occur on the Kenai Peninsula are common. Average annual precipitation is 406.6 mm; 286 mm in rainfall in summer. Like the other regions, nearly all peony fields are irrigated at least for the first part of the summer. This region also hosts Alaska's major commercial vegetable production.
The greatest number of peony farms is in the Interior Region, in part because of the availability of farmland. The Kenai Peninsula Region has the oldest peony farm, but appropriate land for peony farming is limited, and they tend to be quite small in size. In the early years, cut flower harvest began in the warm Interior Region (late June – mid July) followed by South Central Region (early July – mid August) and the Kenai Peninsula (mid July – September) with slight overlap among the regions. More recently, summer conditions have been unpredictable with the Kenai Peninsula showing warmer, drier con-

ditions and a greater overlap with Interior cutting seasons.

Production systems

Most peony roots are imported from the Netherlands or from distributors, growers and breeders in the contiguous United States. Some root suppliers in the U.S. purchase starter roots from the Netherlands, grow them two years, then re-sell them to meet the 3- to 5-eye standard for bud quantity.

'Sarah Bernhardt' is the most frequently planted cultivar followed by 'Duchess de Nemours', 'Festiva Maxima', and 'Felix Crouse'. 'Sarah Bernhardt' is one of the few peonies requested by name by florists and other direct consumer outlets. 'Duchess de Nemours' is a standard white cultivar, but it has a very short harvest window once buds begin to soften. They also continue to open easily in cold storage if low temperatures are not maintained. Many other cultivars, particularly full double, semi-double, bomb and Japanese cultivars, are sold in smaller quantities as experiments. Most Intersectional (Itoh) hybrids have a very short vase life and are not grown as cut flowers. Single petaled peonies release copious quantities of pollen in late bloom and are not as desirable as flowers with fewer anthers. Originally, growers believed that the double and semi-double cultivars would have a longer vase life than Japanese or singles, but vase life is more related to cultivar rather than type.

Summer sales volume ranked by color include: white, 'Sarah Bernhardt' pink, red, blush pink, bright pink (fuchsia), cream and coral. Coral-colored peonies would rank higher by volume, but they are susceptible to winterkill in many parts of the State and are grown only in certain geographic locations. Demand for corals far exceeds supply.

Field planting

Peonies are planted in single or double rows with a minimum spacing between plants of 60 cm. Between-row spacings depend on the harvest method. All harvesting is by hand, and growers use everything from garden carts to tractor-pulled trailers to move flowers from the field to cold storage. Growers strive to allow no more than one hour between cutting and placement of flowers into cold storage.

Growers use flat or raised beds (15-25 cm) with sufficient spacing between rows to allow picking from two rows at once. Rows spaced 2 m apart or closer often are trellised to allow easier harvesting especially for the robust 'Sarah Bernhardt'. In large producing regions, rows can be hundreds of meters in length with runners employed to transport hand-held bundles of flowers to waiting trailers and trucks. On small Alaska farms where labor is in short supply, rows often are shortened to 8-10 m sections with aisles bisecting the rows. A single harvester can cut and hold a bundle of flowers the length of these short rows, then place the flowers in carts at the end of the short rows, thus eliminating runners.

Many organic farms use woven or spun-bonded landscape fabric to cover rows for weed control. Irrigation is accomplished with trickle tape placed beneath the fabric or larger emitters spaced at each planting hole. The tapes can last for years, but can be destroyed by vole chewing the tapes or moose stepping on them any time of year. Plants up to five years of age do not often show water stress except in very dry years or on sandy soils. As the plants mature and increase in size, water deficiencies in the form of stunted stem growth and curled leaves (lengthwise with the midrib) become common especially in the Interior Region. Summer irrigation significantly increases stem length, but has no effect on eventual vase life.

Soils in all regions vary significantly in pH and many require additions of agricultural lime before planting and occasionally thereafter. Fields are fertilized once in early summer and again only if the plants show deficiency symptoms. Most Alaska soils are infertile and require complete fertilizers for optimum production. Dr. Mingchu Zhang (Soil scientist, University of Alaska Fairbanks, Fairbanks, AK) has developed tissue diagnostic tests for evaluating the health of peony plants.

Growth and harvesting

Peony growth is quite rapid depending on the air and soil temperatures. In the Interior Region, flowers reach harvest date approximately 30 days after buds emerge from the soil. The season is longer in coastal areas with a cooler climate. Besides hand or chemical weeding, the first important labor demand is disbudding. Many cultivars of peonies produce a single large terminal bud, but the majority of cultivars also produce two or more lateral buds. Some growers are experimenting with leaving the side buds in place, but most side buds are removed as soon as they can be reached and before they leave an unsightly stub.

Peonies are harvested by hand using knives or clippers. With a few exceptions, stems exceed 60 cm in length at harvest. Depending on the vigor of the plant, up to two-thirds of the stems with buds are cut from each plant. Removing too many stems, especially on cultivars that produce fewer than 10 stems per plant, can lead to a reduction in yield in subsequent years.

The most challenging part of harvesting peonies is learning the correct stage for each cultivar. Most references describe cutting at the "marshmallow" stage, which is not a very helpful description. Two things determine proper cutting stage: cultivar and market. Harvest flowers too early when sepals completely cover the petals, and the flower will not open. Wait until the petals have begun to separate, and buds may blow open in cold storage, and vase life may be shortened. Growers identify stages based upon environmental conditions at their farm as well as the cultivar, then test the stages by performing vase life evaluations to make sure they cut at the optimum stage. Red cultivars usually have softer buds than pink or white cultivars. Some cultivars such as 'Ann Cousins' are notorious for being difficult to harvest, relying on slight color changes and softening of the petals.

In general, when sepals separate, peony petals show true color, and the buds begin to soften, harvest begins. In the North, where daylight can reach nearly 24 hours, harvesting occurs nonstop for 12-14 hours per day. If the markets are wholesale distributors or if they require long distance transport, buds

› Alaska's oldest peony farm, Alaska Perfect Peonies. Submitted by Rita Jo Shoultz.

› Peonies from Pioneer Peonies, Wasilla, Alaska. Top to bottom, right: 'Dr. Alexander Fleming', 'Boule de Neige' and 'Sarah Bernhardt'. Submitted by Denise Bowlan.

are harvested tighter than if sold to local farmers markets.

Peonies should never be sold in full bloom even for local markets because vase life will be very short.

Diseases, insects and other challenges

In other parts of the world, peony fields remain productive for ten or more years. The oldest fields at the University of Alaska are 18 years old and continue to yield well. As fields become established, several pests and diseases emerge even in areas where agricultural crops have never been grown before. The most significant problem is *Botrytis* gray mold diseases that impact young emerging shoots, maturing foliage and flower buds, as well as cut flowers in cold storage. Early assessments identified *B. paeoniae*, *B. cinerea*, and *B. pseudocinerea* as common disease-causing species, but recent research by Drs. Gary Chastagner and Andrea Garfinkel (Plant pathologists, Washington State University, Puyallup, WA) revealed an amazing genetic diversity including up to 16 phylogenetic species in the Pacific Northwest alone. The pathogenicity of these species as well as the efficacy of current control measures are being studied.

Control measures include fungicides, wide plant spacings to promote air circulation and reduce leaf wetness, and field sanitation. One often overlooked method of transmission of *Botrytis* in a field is during petal fall. If old flowers are not removed, petals landing on leaves can provide food for germinating spores that can, in turn, infect the leaves. Fields are also cleaned of all foliage and stems at the end of the season, and stubble is often burned to prevent disease resting structures from persisting in the field over winter.

Tobacco rattle virus (TRV), also known as peony ringspot or peony mosaic, appeared early in Alaska peony fields – imported on infected rootstock. The brilliant yellow rings, spots and chevron-type patterns that show up on the leaves usually appear seasonally after harvest. Depending on the air temperature, they can appear early and significantly impact cut flower quality. Cool air temperatures promote the symptoms. Plants are not inspected for TRV, and there is no existing quarantine. In some commercial fields, up to 50% of the roots imported to Alaska have shown TRV depending on the root supplier. Some TRV isolates are transmitted by nematodes that are not known to survive in Alaska. However, TRV persists in the plant. Besides striking color patterns in the leaves, nothing is known about TRV effects on yield or plant longevity. Dr. Chastagner found that TRV did not affect vase life of 'Sara Bernhardt' peonies.

The only management is to rogue out the affected plants.

Three other fungal pathogens were found by Drs. Chastagner and Garfinkel in Alaska, but they are not as common or as widespread as *Botrytis* and TRV: red spot or licorice spot disease, *Mycocentrospora acerina*, white mold or leaf spot, *Sclerotinia sclerotiorum*, and *Phoma* sp. Very little information is available regarding the biology, spread, and management of these pathogen on peonies. They are managed with fungicides and sanitation.

Peonies and nectar flow

Approximately two weeks before anthesis, nectar flow begins on peony buds. There are no well-defined extra-floral nectaries on peonies, but the sugary exudate oozes from the red edges of the sepals. The nectar beads up along the edges of the sepals, spills out over the buds, covering all surfaces and collects at the base of the sepals. In seasons with no rainfall, the buds can become so sticky, they make harvesting very difficult. Even walking through the closely-spaced field can be a challenge. The nectar also attracts a variety of insects including ants, honey bees, bumble bees, wasps, hornets and aphids. Most do no harm to the peonies but can be a nuisance for workers.

In humid and rainy parts of Alaska, a black, sooty mold fungus grows on the nectar, especially the quantities that collect at the base of the flower bud. The buds must be pre-treated with a fungicide or individually washed after harvest to remove this mold before sale. Some growers include honey bee hives in their peony fields, and they are very efficient at collecting the nectar and minimizing the mold problem. Sooty mold is a problem in the South Central and Kenai Peninsula Regions, but not Interior Region.

Occasionally, aphids will appear on peonies but mostly in fields surrounded by birch trees (*Betula alaskana*). Two significant insect pests are thrips and lygus bugs. Thrips cause bud distortion, bud abortion, flower drop and bruising on petals. Up to 12 species of thrips have been identified including western flower thrips that can cause flowers to be rejected during inspections for foreign shipments. Dr. Beverly Gerdeman (Entomologist, Washington State University, Mt Vernon, WA) has shown

› Peonies in on-farm refrigerator. Fox Hollow Peonies, Nenana, Alaska. Submitted by Wanda Haken.

that thrips migrate from weedy areas at the edges of the fields beginning in mid-May when plants are only 7-10 cm tall. Thrips first settle between the bracts and sepals or between sepals and petals of early stage buds. From these protected locations, thrips lay eggs and progressively move further into the bud as the bud slowly opens. Damage is early in the life of the flower and internal making control very difficult. Although the damage to peonies is most visible on white-flowered cultivars because of the bruising and scarring caused on petals, thrips do not discriminate based on color.

Lygus bugs appear in early May, but the greatest infestations begin in June. They have piercing, sucking mouth parts that can cause bud deformities and bud abortion. Both thrips and lygus bugs are managed with insecticides, weed control, use of fabric weed barriers and field sanitation.

Other losses to fresh cut peonies may be caused by hail especially during end-stage bud development, crooked stems due to weak or rapid shoot elongation; and a physiological disorder called cabbage heads where the guard petals are shorter than normal and flowers are flattened. The cause of cabbage heads is unknown, although cultivars vary in susceptibility.

Storage and postharvest handling

Peonies are harvested and immediately placed into cool rooms (approximately 10°C) to remove field heat. As soon as possible, stems are cut to length depending on the buyer (~60 cm) and graded according to bud size (AAA: 45 mm, AA: 40 mm or A: 35 mm diameter). The lower two or three leaves are removed. Stems are stored dry in buckets or crates or stacked on shelves in cold rooms (0.5-1.0°C; >80% relative humidity). Cut stems stored in water will continue to open in the cold room. Herbaceous peonies do not release large quantities of ethylene, and chemical preservatives such as sucrose, citric acid, do not extend vase life.

They can be stored up to four weeks without losing flower quality, although leaves will dehydrate even at high humidity. Research with controlled atmosphere storage is occurring in France, the Netherlands and the United States to learn if longer term storage is possible.

Prior to shipment, stems are re-hydrated in warm water for 15-30 minutes. Stems may be bundled into sets of five, or held in large upright bundles for transport depending on market demand. Flowers are packed into boxes lined with newsprint or dacron® sheets. Ice packs are often included, but temperature effects only last a maximum of 10 hours in transit.

› Peony field with landscape fabric for weed control. Funny River Peonies, Soldotna, Alaska. Submitted by Denise Carey.

Peony markets

Fresh cut peonies in Alaska sell for $1.00 to $7.00 per stem depending on the market. The highest dollar value is for coral colored peonies. Alaska growers either work independently or sell as part of a pack house or cooperative. Pack houses have a single owner who may or may not be a grower. The owner buys directly from nearby farms to increase volume, but sales are from the owner's company. Cooperatives are collectively owned by member farms, and they work together to sell, pack and distribute flowers. There are six pack houses/cooperatives in Alaska with five to 20 participants in each.

The markets are diverse and include farmers markets, direct sales to consumers, florists and funeral planners, bulk sales through grocery stores, regional wholesale houses, floral distributors, and event planners. Some growers work with a single buyer, however most work with a mixture of buyers such as local farmers markets, floral distributors and florists. Although an export is most commonly considered a foreign market, Alaska distinguishes foreign and domestic exports to other regions of the United States, because the distribution and handling are often similar. With the exception of California, Alaska peonies move freely among States with no inspection or permit requirements. Like many cut flower growers worldwide, a major concern is maintaining a cold chain from field to buyer. Shipping peonies during the hottest part of the summer with carriers that don't always respect the perishability of cut flowers, is always a challenge.

Both domestic and foreign exports are critical to the continued growth of this industry because Alaska's population and local markets are very small. Presently, all domestic and foreign exports are carried by air transport. As the volume of flowers increases, growers will employ barge shipments with refrigerated vans from Anchorage as well as refrigerated truck shipments through Canada. The grower's biggest challenge is educating domestic and world markets that field grown, fresh cut peonies from Alaska truly are available in July, August and September.

In 2018, Dutch sales exceeded 78 million peony stems, and Alaska sales have not reached one million. There is definitely room to grow!

› Patricia Holloway

› About the author

Patricia Holloway is Professor Emerita of Horticulture at the University of Alaska Fairbanks. She conducted horticultural research in Fairbanks for more than 30 years on a diversity of crops, especially Alaska wild berries. Her research with peonies was instrumental in providing the foundation for the cut flower industry in Alaska. Presently, she is a horticultural consultant for the peony industry and book publisher through her company, A.F. Farmer, LLC. E-mail: psholloway@alaska.edu

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Book reviews

Sansavini, S., Costa, G., Gucci, R., Inglese, P., Ramina, A., Xiloyannis, C., and Desjardins, Y., eds. (2019). Principles of Modern Fruit Science (Leuven, Belgium: ISHS), pp.421. ISBN 978-94-6261-204-4 (paperback). €80. www.ishs.org/principles-modern-fruit-science

This book is a translation of a previous Italian version of a book called "Arboricoltura Generale". It is a book edited by Dr. Silviero Sansavini and several other Italian co-editors with contributed chapters by numerous well-known Italian pomologists. In addition to being an exhaustive treatise on almost all aspects of pomology, the book is a testament to the concentration of Italian pomological expertise that has evolved over recent decades. The book aims to be a pomology textbook that can be used selectively to support instruction in pomology at introductory or advanced levels. It attempts to achieve this by providing the overarching concepts involved in various aspects of fruit tree development, growth, physiology and management as well as providing detailed information about these topics by citing numerous examples of research results on individual species.

The book begins by covering botanical and physiological topics related to fruit tree structure, growth and development, and tree function and then proceeds to cover the more practical aspects of pomology involving development of cultivars and tree and orchard management. Organization of the book in this way results in some minor redundancies in the presentation of some topics, such as characteristics of root growth that are covered in the initial section on roots in the Tree Structure chapter and the sections in the Tree Functions chapter where aspects of roots are discussed again. Similarly, details of carbohydrate transport are presented in the carbohydrate transport and allocation section of the Tree Functions chapter and again in fruit growth discussion in the Tree Ontogenesis chapter. However, these redundancies do not significantly detract from the information conveyed and students likely will find that it reinforces certain topics.

This book has a strong emphasis on the description of the involvement of plant hormones in almost all aspects of fruit tree development and growth and tends to infer that hormones are causal agents behind many phenomena. Thus, the book appears to have a bias toward explaining things via hormone action. It is very instructive to have the various aspects of hormonal research related to numerous areas of pomology inserted in this text and readily available for students to read. However, it may be a bit misleading to assert that hormone presence explains a lot of what goes on in fruit trees because hormones are primarily signaling compounds and the ultimate question is usually about what generates the signals. Much of hormone theory involves correlations between hormone concentrations in various tissues and some cellular, tissue or organ activity or response. For instance, in the root-canopy relationships discussion (Box 4.2) all root-canopy growth relationships are discussed in the context of root-shoot hormonal transport to the exclusion of other theories. It is widely reported that differences in rootstock hydraulic conductance and relative differences in root and canopy water potential can explain many root-shoot interactions while tree and vine canopy manipulation strategies built on hormonal theories (such as partial root zone deficit irrigation) don't work in practice.

The inclusion of chapters on tree breeding and biotechnologies applicable to pomology are great additions to this pomology text. The breeding of fruit tree and vine crops presents unique challenges to overall advancements in pomology and it is important that students of pomology understand these challenges. These chapters introduce the topics in enough detail to convey the uniqueness and some of the difficulties of breeding and developing perennial fruit crops without getting into excess detail.

The subsequent chapters on the practical aspects of pomology such as propagation, nursery production, and orchard establishment are excellent and provide practical knowledge as well as the scientific concepts on which these practices are based. The chapter on planting and training systems, pruning and fruiting control is a comprehensive treatise on these subjects, as should be expected, since Italian pomologists have been leaders in these aspects of pomology for decades. The pictures and diagrams of different tree structures and branch bearing habits of various species as well as the special section on the training and pruning of specific species are particularly informative.

It is interesting that the chapters on tree water relations and irrigation as well as mineral nutrition appear towards the end of the book when many aspects of these topics are related to the Tree Functions chapter towards the beginning of the book. It is apparent that this placement in the book is because both of these chapters emphasize aspects of tree management. However, these chapters also provide fundamental information about tree function. It is a bit awkward that water stress in fruit trees is briefly covered in the stress physiology/photosynthesis section of the Tree Functions chapter but the more thorough introduction to the principles of water relations doesn't appear until the irrigation chapter. These are minor organizational issues and the important thing is that, taken together, this book is certainly the most thorough scholarly treatment of modern fruit science available.

In conclusion, I would highly recommend this book for any serious student of pomology. It covers multiple disciplinary topics involved in the study of fruit science as well as the most important management practices (and the science on which they are based) pertaining to establishing and managing fruit tree orchards.

Reviewed by Ted DeJong,
Chair of ISHS Division Temperate Tree Fruits, USA

› XIII International Symposium on Flower Bulbs and Herbaceous Perennials

Division Ornamental Plants #ishs_dorn
Division Protected Cultivation and Soilless Culture #ishs_dpro

The XIII International Symposium on Flower Bulbs and Herbaceous Perennials (XIII ISFBHP2019), with the theme "Blooming the world with flower bulbs and herbaceous perennials", was held at the Grand Ambassador, Seoul, Republic of Korea, from 1-3 May 2019. The symposium was hosted by the Korean Society for Floriculture Science and the Korean Society for Horticultural Science in partnership with the International Society for Horticultural Science. The event was organized by the Korean Association for Flower Industry Development, the Korean Institute of Horticultural and Herbal Science (RDA) and the Korean National Arboretum. More than 140 participants from 16 different countries contributed to the success of the symposium. Their contribution included 18 oral presentations and more than 80 posters. The scientific plenary sessions were conducted on the first and third day of the symposium. The first day concentrated on production and physiology topics. Four technical sessions were conducted on the first day, as well as a special session in memory of the late August (Gus) De Hertogh. Dr. De Hertogh was considered one of the primary experts on flower bulbs. He published books related to flower bulbs and provided systematic developments for its popularity, understanding, and research for its commercialization. His contribution to this field has become an inspiration to the current students, researchers, and colleagues who continue the path that he started. The third day of the symposium was devoted to technical sessions and oral presentations that were centered on plant breeding and molecular research for flower bulbs and herbaceous perennials. A technical tour was organized for the attendees of the symposium.

Flowering bulbs and herbaceous perennials are a high volume, high value horticultural crop. These cut flowers and potted plants are exported from Korea and other producing countries to major ports worldwide. With that in mind, this symposium aimed to update the knowledge and share research developments of breeders and scientists for this horticultural community. The participants were warmly welcomed by the symposium convener, Dr. Ki-Byung Lim from Kyungpook National University, Republic of Korea. He expressed his appreciation for all the collaborative efforts of the organizing committee members for the realization of the event. Likewise, he also emphasized that this was one of the opportunities not only to share research developments and ideas but also to build professional links and connections. The symposium organizers featured an amazing display of Korean flowering bulbs and herbaceous perennials throughout the meeting venue. The first oral session promoted plants in the Korean peninsula. Keynote speakers introduced the flower bulbs and herbaceous perennials in Korea with varying aspects. Dr. Oh Geum Kwon from the National Institute of Horticultural Herbal Science (RDA) described the breeding research done for lily, freesia, and chrysanthemum. Dr. Sang Yong Kim from the Korean National Arboretum shared their project developments on the commercialization of native wild flowers present in their establishment.

Flower bulbs and herbaceous perennials production and physiology research were also presented through the keynote speakers who shared scientific studies for *Ranunculus asiaticus* (Dr. Margherita Beruto from the Regional Institute for Floriculture, Italy), dahlia (Dr. Chad Miller from Kansas State University, USA) and tulips (Dr. William Miller from Cornell University, USA). Dr. Rina Kamenetsky (Institute of Plant Science, ARO, Israel) discussed climate change effects on the flowering, bulbing and production of geophytes. Likewise, integrated disease and pest management, research, and challenges involving ornamental geophytes were summarized by Dr. Gary Chastagner (Washington State University, USA).

› Guests, keynote speakers, students and participants during the opening ceremony of the symposium.

› Dr. Ki-Byung Lim, Dr. Margherita Beruto and Dr. Gary Chastagner presenting the ISHS Young Minds Awards for the best oral presentation to Ms. Ziming Ren (second from left), Ms. Zhuping Fan (third from right) and Mr. Md. Mazharul Islam (second from right).

› Dr. Gary Chastagner, Dr. Margherita Beruto, Dr. Ki-Byung Lim and Dr. William Miller presenting the ISHS Young Minds Award for the best poster to Mr. Jaser Aljaser.

› Participants at the Korean Flower Park (A) enjoying one of the world's major tulip flower festivals at Taean, South Korea (B).

The technical tour for the second day of the symposium featured three excursions. The tours included beautiful and interesting horticultural areas in South Korea, which included the world famous Tulip Festival and Chollipo Arboretum, Korean modern flower production and native plants, and the beautiful Morning Calm Garden and the Korean National Arboretum.

Various breeding programs and research studies for flowering bulbs and herbaceous plants were considered on the third and last day of the symposium. Due to urbanization, more people are living in the cities with a lesser amount of space as well as for transportation and storage efficiency. The popularization of breeding compact plants was introduced and Dr. Johan Van Huylenbroeck from ILVO, Belgium, shared his research for breeding compact growing ornamentals. Dr. Keith Funnell from the New Zealand Institute of Plant and Food Research also shared his tools and strategies on germplasm diversification, which involves natural breeding and tissue culture to produce new hybrids. An insightful presentation was given by Dr. Neil Anderson from the University of Minnesota, USA, wherein selection tools were discussed on how to reduce generation time of geophytic herbaceous perennials, which usually takes more than two years from seed to flowering. Innovative research for breeding blue chrysanthemum through genetic engineering was presented by Dr. Naonobu Noda from the National Agricultural Food and Research Organization in Japan, including the application or the modification of anthocyanin biosynthesis. Likewise, Dr. Fangyun Chen from Beijing Forestry University, China, presented the studies and advances in the breeding of inter-sectional hybrids of peony in China.

Within each technical session, two-hour sessions were designated for poster presentations and the afternoon sessions were assigned for oral presentations. During the symposium, the Scientific Committee selected the winners to receive the ISHS Young Minds Awards. They awarded the best poster presenter to Mr. Jaser Aljaser (University of Minnesota, USA) with the study entitled "Identification of the upstream of flowering locus C (UFC) gene in gladiolus as a marker for the flowering control gene flowering locus C (FLC)". There was a three-way tie for the award for the best oral presenter. The co-awards were given to Ms. Ziming Ren with her study entitled "Comparative morphological transcriptome study of vegetative propagation in two *Lycoris* species", Ms. Zhuping Fan with her study entitled "The remontant flowering of perennial plants: implications for breeding reblooming bearded iris", and Mr. Md. Mazharul Islam with his study entitled "Cytogenetic assessment of *Lilium longiflorum* × *Lilium hansonii* revealed by genomic in situ hybridization (GISH)."

With the organization and outcome of this symposium, the objectives were sufficiently met through the collaborative effort of the organizers, staff, students, researchers, and stakeholders. During the business meeting, it was agreed that the next International Symposium on Flower Bulbs and Herbaceous Perennials will be in Chile in 2023, and Dr. Ki-Byung Lim (Korea) was elected as the new Chair of ISHS Working Group Flower Bulbs and Herbaceous Perennials. The symposium proceedings were published as *Acta Horticulturae* 1237 prior to the symposium.

Ki-Byung Lim

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VIII International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects)

Division Plant Genetic Resources and Biotechnology #ishs_dbio

On 1-5 October 2018, the VIII International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects) was held. This conference, also known as YaltaBiotech2018, occurred in the Federal State Funded Institution of Science "The Labor Red Banner Order Nikita Botanical Gardens – National Scientific Center of the Russian Academy of Science" (FSFIS "NBG-NSC"), Yalta, Russian Federation, under the auspices of the International Society for Horticultural Science (ISHS).

Prof. Dr. Sci. Irina Mitrofanova, Head of Plant Developmental Biology, Biotechnology and Biosafety Department of FSFIS "NBG-NSC" was the convener of the conference. The Organizing Committee included international researchers from many fields of biotechnology. FSFIS "NBG-NSC" is one of the oldest botanical gardens and scientific organizations in the world, and in 2018, it celebrated its 206th anniversary.

More than 100 specialists from 68 scientific and academic institutions of Russia, Belarus, Kazakhstan, Brazil, Germany, Israel, Italy, Iran, Costa Rica, Portugal, Croatia, Czech Republic and Finland took part in the conference. In addition, the works of scientists from 80 scientific organizations and universities of Russia were published in the book of abstracts.

The intensive development and widespread introduction of methods of biotechnology, molecular and cell biology, biochemistry, physiology and certain aspects of plant reproductive biology were described. Solutions for topical issues of study, including conservation and expansion of plant genetic diversity, were specified. This conference summarized a comprehensive discussion of the results of work in the field of plant biotechnology. The issues of ex situ and in situ conservation of biodiversity were discussed. The conference determined that the urgency of biotechnology development is needed to:

- improve scientific collaboration and concentrate efforts on effective solutions to prioritize scientific and technological challenges;
- implement coordinated scientific-technological and innovative policy in the field of plant biotechnology to ensure competitiveness in the world market;
- harmonize legal and regulatory framework for scientific investigation;
- conduct coordinated activities to standardize, certify, and protect intellectual property for plant biotechnology;
- efficiently use the existing and newly created production and technical information database;
- coordinate the relationship of biotechnology development and the manufacture of bio-products.

Special attention was paid to the cooperation of scientists in biotechnology, molecular biology, biochemistry, physiology, and reproductive plant biology. This will open up new opportunities for the exchange of scientific experience, access to information databases, development of new methods and technologies, and realization of joint projects in each of the countries of the conference participants. Therefore, it is necessary to concentrate scientific potential on priority areas, harmonization of the legal and regulatory framework, and exchange of information.

During the conference, 6 plenary and 44 sectional reports were heard. Scientists presented 56 posters. Particular attention was paid

› Participants of YaltaBiotech2018 at the main conference hall of the Nikita Botanical Gardens.

to the results of research obtained under the grant of the Russian Science Foundation No. 14-50-00079. The full papers will be published in the *Acta Horticulturae* conference proceedings. The participants of the conference summarized the following next steps for the development of modern plant biotechnology:

- development of a resource base of biotechnologies of participating institutions (national collections of plant cell and tissue cultures, viral isolates, and genetic engineering);
- creation of a unified database of national collections of plant cell and tissue cultures;
- development of technologies for obtaining cellular biomass and the use of quantitative and qualitative analysis methods to evaluate the content of biologically active substances in intact plants, callus and suspension cultures;
- development and improvement of DNA technology (molecular genetic monitoring of plant collections ex situ and the formation of the core-collections, genetic certification of collections, development and implementation of methods of molecular genetic diagnosis of phytopathogens, development and implementation of methods of marker-mediated plant breeding, molecular-genetic monitoring of populations of rare and endangered plants, the creation of cultivars with bioengineered methods);
- development of biotechnology of woody plants;
- adoption of new biotechnologies and products on the basis of partnership and within the framework of scientific and production associations.

The participants noted their mutual interest and complementarity approaches to understand tasks in the field of biotechnology; in light of this, it is advisable to expand the following activities:

- create and develop national collection of plant cell cultures and tissues, as well as common databases of these collections;
- harmonize rules for deposit, access and transfer of cell cultures in accordance with international agreements and standards;
- implement the search and screening of chromosomal and molecular genetic certification of new genetic resources;
- registration of results of scientific research presented during the conference in the form of further joint projects, grants, cooperation agreements.

› Prof. Maria Antonietta Germanà (left), Chair of ISHS Working Group Citrus Biotechnology, presenting ISHS Medal Award to Prof. Irina Mitrofanova (right), Conference Convener.

ISHS Young Minds Awards were obtained by two participants: Tatyana Kritskaya (PhD) from Chernyshevsky Saratov State University, Saratov, Russia, for the best oral presentation entitled "Genetic diversity of *Tulipa suaveolens* in the Crimea based on ISSR data" and Ekaterina Vasileva from FSBSI All-Russian Research Institute for Agricultural Microbiology (ARRIAM), Pushkin, Saint Petersburg, Russia, for the best poster presentation entitled "Investigation of antimicrobial activity of pea (*P. sativum* L.) NCR peptides towards plant endophytic bacteria *Bacillus* sp. and *Rahnella* sp.".

The scientific and cultural programme included some very nice excursions:

- Parks of the oldest Russian Botanical Garden – The Nikita Botanical Gardens – National Scientific Center;
- Scientific-technological Center "BIOTRON" and "Genomics";
- Jeep tour to the ancient cave cities of Crimea Mountains: Esci-Kermen and Mangup Kale;
- Livadia and Alupka Palaces and other

› Organizing Committee of YaltaBiotech2018.

› Prof. Patrícia Paiva (right), ISHS Board Member Responsible for Young Minds, presenting ISHS Young Minds Award for best oral presentation to Tatyana Kritskaya (left).

› Prof. Renato Paiva (right), Chair of ISHS Working Group Quality Management in Plant Propagation, presenting ISHS Young Minds Award for best poster to Ekaterina Vasileva (left).

› From left to right: Prof. Maria Antonietta Germanà, Chair of ISHS Working Group Citrus Biotechnology; Prof. Irina Mitrofanova, Conference Convener; Dr. Claudia Ruta, invited speaker from Bari University (Italy); and Iva Prgomet, young scientist from Portugal at the BIOTRON (Biotechnology Center) of the Nikita Botanical Gardens – National Scientific Center of the RAS.

historical places of the South Coast of Crimea.

Evening parties were organized at the beginning and at the end of the scientific meeting on the territory of the Arboretum, where participants were able to communicate in an informal setting and discuss questions of the day.

The conference participants adopted (unanimously) the following resolutions:

- The participants agreed that the conference was very successful;
- The conference provided the opportunity to develop a plan for complex research in a number of areas, such as biotechnology, biochemistry, physiology, reproductive biology and molecular genetics of plants, proposed during the conference and aimed at preserving plant biodiversity. This was considered the most important challenge for the next period;
- To broaden participation in the conference to botanical gardens, which are the centers of biodiversity conservation of plant life. The Organizing Committee of the conference will involve the leading botanical gardens to the organization of the conference, which will greatly support the scientific activities and the role of botanical gardens;
- To organize and hold training for young scientists. To initiate participation in the conference for teachers, students, and postgraduates of federal universities and biological institutions;
- To honor the excellent work of the Organizing Committee;
- To express gratitude to the administration of FSFIS “NBG-NSC” for the assistance and support provided to the conference;
- To express gratitude to the main sponsors of the conference;
- We propose to hold the next conference in December 2020, at Mahidol University in Bangkok (Thailand) to be convened by Prof. Dr. Kanchit Thammasiri.

Irina Mitrofanova

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› Conference delegates during plant biodiversity jeep tour on the top of the mountain Eski-Kermen.

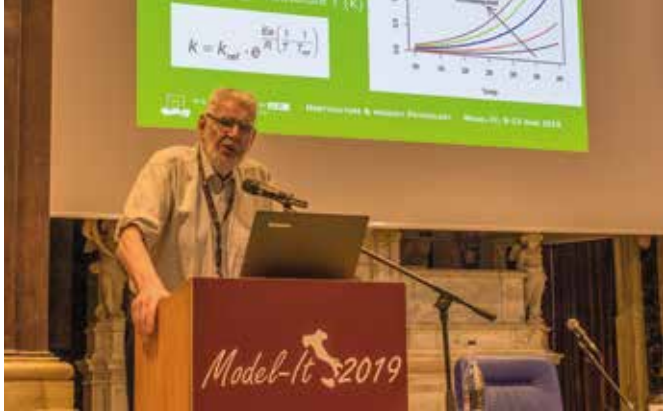
› Model-IT 2019 – VI International Symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain

Division Postharvest and Quality Assurance **#ishs_dphq**

› Participants of the symposium.

The VI International Symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain (Model-IT 2019) was successfully held in Molfetta, Italy, from 9 to 12 June 2019. Molfetta is in the Apulia region, which has horticultural production with a total cultivated surface of 1.2 ha. This represents 10% of the total Italian cultivated land. The main crops are olives, table and wine grapes, tomatoes, winter vegetables, and other fruits such as peaches and apricots. The symposium topics included the application of mathematical models for the whole horticultural value chain, from production in greenhouses or open fields to marketing and distribution, including postharvest handling and food processing. The symposium was opened with two very distinguished invited speakers and was composed of eight sessions, with a total of 52 oral presentations, introduced by five keynote lectures. Professor Harald Martens, adjunct professor of the Norwegian University of Science and Technology (NTNU) and research leader of Idletechs AS, Trondheim, Norway, opened the first session on "Produce quality and shelf-life". He gave a lecture entitled "Measurements and models in the biosciences: an integrative perspective", speaking about the possibility of building a bridge between the field of biology and the field of mathematics. The second lecture, given by Professor Pol Tijskens, Emeritus at the University of Wageningen, The Netherlands, was entitled "What I always wanted to know about kinetic modelling, but…". This was a very exhaustive overview of all the possible variables affecting enzymatic reactions, giving examples of how to include their effect in differential equation models. The other scientific sessions covered non-destructive applications for fruit physiology and quality, non-destructive applications for fruit postharvest physiology, models to improve the horticultural chain, postharvest physiology, plant physiology and environmental conditions, process control, and plant responses to agronomic conditions. Finally, a special session was dedicated to the output of a relevant European project called "Agrifood value chain modelling as a tool to face uncertainities". This symposium series provided a unique opportunity for the interaction and insight of people from different research

› Dr. Harald Martens (Norwegian University of Science and Technology, Norway) opening the scientific sessions.



› Dr. Pol Tijskens (Horticulture and Product Physiology, Wageningen University and Research, The Netherlands), invited speaker at Model-IT 2019.

fields throughout the supply chain. Moreover, there were many opportunities for the exchange of ideas and solutions. Not only theoretical approaches, but also performances of applications already present on the market or in the final phase of development, were discussed, improving the transfer of knowledge between research and industry. As for industry participation, some of the sponsors such as Raytec vision, Blueleaf and SAIM IMPIANTI, also presented information on their recent research and development efforts. This demonstrated that industry's choice to support this event was stimulated by their research interests. Moreover, networking was encouraged thanks to the energizing time in coffee and lunch breaks, and because of the nice location, in an ancient Jesuit monastery, now a Bishop seminary, which provided open air spaces and pleasant summer temperatures.

Symposium participation was very high in comparison with previous times. More than 130 people from 18 countries attended the symposium. Conveners, Giancarlo Colelli and Maria Luisa Amodio from the University of Foggia, Italy, were very satisfied with the quality of scientific reports and the depth of coverage. Among the participants, 22 scientists competed for the ISHS Young Minds Awards. One award was given to Phuc Le Ho, KU Leuven, Belgium, for the best oral presentation entitled "Modelling respiration rate of dragon fruit as a function of O_2, CO_2 and temperature." The second award was presented to Massimiliano Varani, Università di Bologna, Italy, for the best poster entitled "Performance evaluation of a non-chemical weed control machine for vineyards and orchards operating with high pressure cold water." Overall the most important result of this symposium was to have strengthened this symposium series, showing the need to share advances of the research on modelling as applied to the horticultural supply chain.

Maria Luisa Amodio and Giancarlo Colelli

› Maria Luisa Amodio and Giancarlo Colelli (Università di Foggia, Italy), conveners of Model-IT 2019.

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› Winners of the ISHS Young Minds Awards: A) Phuc Le Ho – best oral presentation, B) Massimiliano Varani – best poster.

› GreenSys2019 – International Symposium on Advanced Technologies and Management for Innovative Greenhouses

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

The GreenSys 2019 - International Symposium on Advanced Technologies and Management for Innovative Greenhouses was held from 16-20 June 2019, at the Convention Center in Angers, France. GreenSys first symposium was organized in 2004 in Belgium, and held every other year since 2007 (Italy, Canada, Greece, South Korea, Portugal and China). GreenSys is coordinated under the aegis of the International Society for Horticultural Science (ISHS). The symposium is co-endorsed by ISHS Divisions Precision Horticulture and Engineering, and Protected Cultivation and Soilless Culture.

GreenSys2019 was co-organized by Agrocampus Ouest, Centre Technique Interprofessionnel des Fruits et Légumes (CTIFL) and the Institut National de la Recherche Agronomique (INRA), with the support of Angers Loire Métropole, the city of Angers, the District Council of Maine-et-Loire, the Region Pays de la Loire, and the partnership of Végépolys (French competitive cluster). Angers is a vibrant city located in the historical region of Anjou, which is about 300 km southwest of Paris. It has a long tradition in horticulture starting in the 15th century with the reign of King René. He encouraged development of the production techniques of ornamental plants, vegetables, fruit, and grapes. Today, Anjou is the most horticulturally productive area in France, with more than 4,000 companies and 30,000 jobs. Anjou is in the heart of the Loire Valley, classified by Unesco as World Heritage.

This event was an opportunity to bring together researchers, technicians, and other professionals to present their research innovations in greenhouse horticulture and plant

› GreenSys2019 participants.

factory, to share ideas and knowledge and discuss state-of-the-art and future perspectives for the protected crops sector. About 600 participants attended this symposium, including 400 scientists and 200 professionals from 40 countries. Scientific sessions were organized, covering 12 topics. The GreenSys2019 edition of the symposium showed the increasing interest in plant factories (3 sessions), and lighting technologies (4 sessions). GreenSys initiated a new session on organic greenhouse production. A technical session dedicated to professionals was also organized with 11 synthesis presentations by scientists and two presentations by company representatives.

In the context of global warming, the symposium revealed that plastic greenhouses remain of great interest to world food production. These covered production areas are adapted to host specific equipment such as insect-proof, hail-proof, or thermal screens. Performances of covering materials were questioned, diffusive glasses and their interest being analyzed. Photovoltaic glasshouses were also addressed during the symposium. Concerning the use of LED technologies in greenhouses, recent advances were presented, which showed that studies of the light spectrum effect on plant development still remain to be further analyzed to consolidate results.

High-tech semi-closed greenhouses, already used in vegetable production, may be extended to ornamental productions because their performances are promising. In such greenhouses, plants are in the heart of the management process and climate conditions are optimized to respond to plant needs. Modelling is as a good tool to anticipate climate behavior and improve the design of the production systems.

› Closing ceremony with (from left to right) Murat Kacira, Chair of ISHS Division Precision Horticulture and Engineering, Hicham Fatnassi, Pierre-Emmanuel Bournet and Eric Brajeul, Conveners of GreenSys2019, and Stefania De Pascale, Chair of ISHS Division Protected Cultivation and Soilless Culture.

› From left to right: Conveners of GreenSys2021 (I. Lopez Cruz, E. Fitz-Rodríguez), GreenSys2019 (H. Fatnassi, P.E. Bournet, E. Brajeul), GreenSys2017 (Q. Yang), GreenSys2015 (F. Baptista), GreenSys2013 (J.E. Son, I.B. Lee), GreenSys2009 (S. De Pascale), GreenSys2004 (L. Marcelis), S. Sase, and G. Giacomelli.

› Conveners of GreenSys2019 and Stefania De Pascale presenting the ISHS Young Minds Awards to A) Malleshaiah Sharath for the best oral presentation, and B) Pierre-Paul Dion for the best poster.

Robotics were also thoroughly presented at the symposium, showing that automatic mechanical tools connected to artificial intelligence software may be applied for many needs, from phenotyping young plants to the production and harvesting stage. Systems for detecting the sanitary state of plants were also presented; micro-drones could become a tool for pest control in crops. One hundred and twenty-seven oral communications and 215 posters were presented. About 100 PhD students attended the symposium. The ISHS Young Minds Awards were presented to Malleshaiah Sharath from the University of Wageningen, the Netherlands, for the best oral presentation entitled “Far red during daytime impedes flowering in chrysanthemum under blue extended long day” and to Pierre-Paul Dion from the University of Laval, Canada, for the best poster entitled “Organic nitrogen uptake by cucumber plants grown in organic greenhouses”.

Two thematic workshops were also organized: the first one by the working group on Greenhouse Crops of the European Vegetables Research Institutes Network (EUVRIN), and the second one on computational fluid dynamics (CFD).

Two hundred participants attended the technical tours: visiting SCEA Cheminant (cucumber and tomato production) and the CTIFL Research Center in Nantes Region, as well as the greenhouse manufacturer (Richel) and the ornamental plant production of Maison Barrault in Angers Region.

About 30 partners including private sponsors, as well as public and local authorities supported the symposium.

The next GreenSys 2021 (International Symposium on New Technologies for Sustainable Greenhouse Systems) will be held on 24-28 October 2021, in Cancun, Mexico, with the conveners Dr. Irineo Lopez Cruz and Dr. Efrén Fitz-Rodríguez, University of Chapingo, Mexico.

Pierre-Emmanuel Bournet

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› XV EUCARPIA Symposium on Fruit Breeding and Genetics

Division Temperate Tree Fruits **#ishs_dfru**

Division Plant Genetic Resources and Biotechnology **#ishs_dbio**

› Participants of the symposium.

The XV EUCARPIA Symposium on Fruit Breeding and Genetics was organized on 3-7 June 2019, in Prague, Czech Republic, by the Research and Breeding Institute of Pomology Holovousy Ltd. (RBIP) and the Czech University of Life Sciences Prague (CULS) in cooperation with the European Association for Research on Plant Breeding (EUCARPIA), and the International Society for Horticultural Science (ISHS). According to the latest world trends, the recently modernized lecture hall in the campus of the Czech University of Life Sciences in Prague was selected as the symposium venue.

The organization of this symposium in the Czech Republic was made to honor the lifelong work of Mr. and Mrs. Blazek. These long-time employees of RBIP are recognized experts in the field of fruit breeding. Their work is constantly being followed by scientific and breeding workplaces around the world.

One hundred and fifty scientists and experts from 30 countries across five continents took part in the event. During the three-day lecture block, which was opened by the CULS vice-rector Prof. Lošťák, the research of 40 scientific projects were presented as oral presentations. In addition, 110 projects were placed in two poster sections. Oral and poster presentations related the latest world trends in fruit breeding programmes, maintenance and diversity of fruit gene banks, the use of molecular genetics in fruit breeding, and the description of fruit genetic resources.

Oral presentations of the XV EUCARPIA Symposium on Fruit Breeding and Genetics were grouped into five sessions: fruit breeding, molecular genetics and biotechnology, biodiversity and genetic resources, resistance to biotic and abiotic stress, and fruit safety and quality.

Modern fruit growing must adapt to a changing climate while maintaining/improving yield and quality, and decreasing inputs. In this context, the symposium highlighted the most recent scientific progress aimed at the genetic improvement of major fruit crops like apple, pear, sweet cherry, plum, and peach.

The lectures and posters presented during the symposium clearly showed recent developments and changes, especially in the field of molecular genetics (genotyping-by-sequencing, microsatellite-analysis, next generation sequencing (NGS), SSR-markers), and its use in advanced fruit breeding.

In addition to the scientific reports, the symposium participants visited the most famous historical parts of Prague, and were invited to two social events. They also participated in a tour of modern premises of the Czech University of Life Sciences. During the symposium, the possibilities of future cooperation, internships or excursions were widely discussed among participants.

› Dr. Jiří Sedlák (center) presenting the ISHS Young Minds Awards to Arnau Fiol Garvi (right) for the best oral presentation and to Ms. Giulia Pasqualetto (left) for the best poster.

The technical tour to sweet cherry and apple plantations occurred on the last day of the symposium. The newly constructed laboratories of RBIP Holovousy Ltd., and commercial orchards of fruit growing company Sady Český ráj s.r.o were visited.

A special committee, set up by the ISHS representative Dr. François Laurens and the symposium convener Dr. Jiři Sedlák, selected two ISHS Young Minds Awards for junior scientists. The award was presented to Arnau Fiol Garvi from the Center for Research in Agricultural Genomics (CRAG), Spain, for the best oral presentation entitled "Development of molecular markers for fruit skin color in Japanese plum (*Prunus salicina* Lindl.)", and to Ms. Giulia Pasqualetto from the University of Udine, Italy, for the best poster presentation entitled "Confirmation of intergeneric hybrids between apple and pear".

During a business meeting of EUCARPIA and ISHS on the last day of the symposium, Julius Kühn Institute in Dresden, Germany, was elected as the organizer of next XVI EUCARPIA Symposium on Fruit Breeding and Genetics in 2023. Dr. Henryk Flachowsky will be the convener. Based on the voting at the business meeting, Dr. Jiří Sedlák from RBIP in Holovousy was elected as the new chairman for the EUCARPIA fruit section. He replaced Prof. Stefano Tartarini from the University of Bologna.

Jiři Sedlák

› Visit of sweet cherry plantations at the Research and Breeding Institute of Pomology Holovousy Ltd.

› Contact

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› VI International Symposium on Lychee, Longan and Other *Sapindaceae* Fruits

Division Tropical and Subtropical Fruit and Nuts #ishs_dtro

The VI International Symposium on Lychee, Longan and Other *Sapindaceae* Fruits was organized by the Fruit and Vegetable Research Institute (FAVRI) on 7-11 June 2019, in Hanoi, Vietnam. The symposium was held under the aegis of the International Society for Horticultural Science (ISHS), with the support of the Ministry of Agriculture and Rural Development of Vietnam (MARD).

Over 130 scientists and delegates from 10 countries, including China, India, Thailand, South Africa, Australia, Israel, USA, Japan, Italy, and Vietnam, were welcomed to the symposium. With 55 oral and poster presentations in total, the symposium offered one plenary session with invited keynote presentations, one poster session, and six technical sessions for discussions on current issues of *Sapindaceae* fruit production and development.

The plenary session provided an overview of the current development of *Sapindaceae* fruits and research and development achievements in the producing countries. The session attracted attention of the delegates to the world production scenario, the systematic research and vigorous development promotion strategies for lychee in China, and the successful off-season longan production in Thailand. Pointing out limitations of the production, Professor Dr. Sisir Kumar Mitra, Board member of ISHS and Co-Chairman of the session, emphasized that cooperation in exchange of cultivars and technologies and trade is the key to reduce the gap between potential and actual yields, to improve the productivity and economics of the growing countries.

A closer look at the trends and issues of lychee and longan production and trade in Vietnam, India, and China was provided in technical session 1, including a comprehensive review on technologies to enhance bearing potential and fruit quality of the lychee.

› Participants of the symposium.

Through evaluating diversity of the valuable genetic germplasm and discussing the potential effective propagation techniques, presentations in technical session 2 described the breeding new cultivars with favorable traits as one of the key strategies to promote production and consumption of *Sapindaceae* fruit products.

Technical session 3 described new biological approaches to resolve production issues. This session included compelling studies of the genomic size of *Sapindaceae* species, eradicating fruit browning process through gene editing, inducing flowers through the control of gene expression, and the mechanism of lychee fruit cracking.

Technical session 4 had the most presentations. This session was devoted to a discussion of cultural techniques, including canopy management and flower induction, with the application of physical and chemical aids for productivity improvement in the main season and off-season production.

A successful example of integrated pest management on lychee in the Bac Giang Province, Vietnam, was presented in technical session 5, on pest and disease management. Efforts of Indian and Thailand scientists in maintaining sustainable production as influenced by disadvantageous climatic conditions, specifically in the context of climate change, were also addressed in this session.

› Dr. Karin Hannweg (right), Chair of ISHS Division Tropical and Subtropical Fruit and Nuts, presenting the ISHS Medal Award to Ms. Le Thi Ha (left), Symposium Convener.

› HE. Le Quoc Doanh, Deputy Minister of Agriculture and Rural Development of Vietnam, delivering opening remarks at the inaugural session.

Technical session 6 discussed postharvest management, with the major attention on reducing sulfur dioxide residue on fresh fruit after cold storage for better fruit quality.

At the end of the symposium, the Working Group business meeting was held. Professor Dr. Xuming Huang from the College of Horticulture, South China Agricultural University, was formally elected as the next Chair of ISHS Working Group Lychee, Longan and other *Sapindaceae* Fruits. Based on the specific criteria for ISHS Young Mind Awards, Ms. Nareenart Traisuwan, an undergraduate student from Mahidol University, Thailand, was selected as giving the best oral report. Her presentation was entitled "Effect of hot wind on annual growth in longan (*Dimocarpus longan* Lour)". In addition, the ISHS medal was awarded to Ms. Le Thi Ha from FAVRI in recognition of her

› Keynote speakers at Q&A of the plenary session. From left to right: Professor Dr. Tran Van Hau – Can Tho University, Vietnam; Dr. Nguyen Van Phong – Southern Horticultural Research Institute, Vietnam; Dr. Theeranuch Jaroenkit – Maejo University, Thailand; Professor Dr. Chengming Liu – South China Agricultural University, China; Dr. Xiang Xu – Guangdong Academy of Agricultural Science, China; Professor Dr. Sisir Kumar Mitra – ISHS Board member, India).

› Ms. Nareenart Traisuwan (third from left), winner of the ISHS Young Minds Award for the best oral presentation, with other delegates from Thailand.

commendable service as Convener of the symposium.

After the symposium, a one-day field trip was organized to visit the Luc Ngan District, Bac Giang Province, which includes the largest lychee production area in Vietnam. The delegates interacted with local growers on various aspects of lychee production. During the trip, the delegates also visited an innovative Juran Sulfur-free lychee treatment system that enables the preservation of the fruit's natural red color and delicious flavor for up to 4-5 weeks.

The VII International Symposium on Lychee, Longan and Other *Sapindaceae* Fruits will be held in China. Prof. Dr. Xuming Huang from the College of Horticulture, South China Agricultural University will be the symposium convener.

Doan Thu Huong and Le Thi Ha

› Display of *Sapindaceae* fresh fruits and products at the symposium.

› Contact

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› X International Symposium on Artichoke, Cardoon, and their Wild Relatives

Division Vegetables, Roots and Tubers #ishs_dveg

The X International Symposium on Artichoke, Cardoon, and their Wild Relatives was held from 12 to 15 March 2019 in Orihuela, (Alicante), Spain. The symposium was organized by the University Miguel Hernández (UMH) in collaboration with the Spanish Association of Artichoke (Alcachofa de España) and the Local Association of Artichoke (Alcachofa Vega Baja) under the aegis of the ISHS. The convener was Daniel Valero and the President of the Scientific Committee was Maria Serrano, both members of the Postharvest Group of Fruit and Vegetables (UMH). Orihuela is the capital of the region of Vega Baja. It was the birthplace of the poet Miguel Hernandez, and nowadays it is one of the main tourist destinations in Valencia.

More than 120 participants (including students), from 10 countries, took part in the symposium, which included an invited opening lecture, six keynotes, 22 oral presentations and 34 posters.

The symposium was structured in six technical sessions dedicated to: 1) Biodiversity and management of genetic resources, 2) Production, multiplication and seed production, 3) Growth conditions, water and nutrients, 4) Pest management, 5) Postharvest, processing, and produce quality, and 6) Bioactive compounds.

› Participants of the symposium.

› Opening ceremony. From left to right: Ms. Mercedes Alonso, Deputy of the local government of Alicante, Ms. María T. Cháfer, Director of Rural Development and Common Agricultural Policy, Regional Government, Mr. Emilio Bascuñana, Mayor of Orihuela, Dr. Juan J. Ruíz, Rector of the University Miguel Hernández, Ms. Asunción Sánchez, Senator of the Government of Spain, Dr. Daniel Leskovar, Chair ISHS Division Vegetables, Roots and Tubers, Dr. María Serrano, President of the Scientific Committee and Professor at the University Miguel Hernández.

› A) Dr. Gaetano Pandino from the University of Catania (Italy) talking about "Globe artichoke and cardoon forms between traditional and modern uses" in the opening lecture. B) Dr. Daniel Leskovar talking about "Environmental stress and management strategies for artichoke: review, analysis and trends".

In the opening lecture, Dr. Gaetano Pandino from the University of Catania, Italy, discussed "Globe artichoke and cardoon forms between traditional and modern uses". His recent research demonstrated that artichoke seeds can produce bio-diesel. For this, specific high yielding cultivars are needed to produce the seeds which are the raw material for bio-diesel. Thus, artichoke cultivation could be expanded more globally, with other applications than food.

In session 1, Dr. Mario Pagnotta from the University of Tuscia, Italy, offered a review of the recent published results of *Cynara* germplasm. Genetic diversity of artichokes and thistles from different collections has been evaluated through several molecular markers.

In session 2, Dr. Carlos Baixauli, President of the Spanish Society of Horticulture (SECH), presented the main methods of artichoke multiplication and the role of multiplication of seeds. In Spain, the main cultivar is 'Blanca de Tudela', which is usually multiplicated vegetatively, using cuttings, stumps or tails.

In session 3, dedicated to growth conditions, water and nutrients, Dr. Daniel Leskovar, Texas A&M University, USA, gave details on recent environmental stresses to which artichoke-growing regions are subjected. His presentation described these stresses in many areas of the world. He also summarized the best management strategies.

The next day, in session 4, Dr. Josep Armengol, from the Mediterranean Agroforest Institute, Valencia, Spain, talked about the importance of using disinfected plant material and keeping the soils disinfected.

In session 5, dedicated to postharvest, processing, and produce quality, Dr. Pedro Zapata (UMH) presented data on how an irrigation system can improve the health properties of artichoke. He demonstrated that irrigation by flooding (the traditional irrigation in the area of Vega Baja) can increase the content of bioactive compounds of artichoke by 15% as compared to plants that have undergone local irrigation.

In session 5, Dr. María Serrano talked about bioactive compounds and presented a review about the tools and strategies to increase phytonutrients. She explained that the use of elicitors, such as salicylic acid derivatives and methyl jasmonate applied as preharvest treatments, can increase yield, quality and time of harvest, with a net increase in bioactive compounds and antioxidant activity.

One full day was dedicated to visit fields and companies related to artichoke production and processing. First, the participants visited the Experimental Station of Nunhems-BASF located in Torre-Pacheco (Murcia), which showed the various processes carried out by this company, from the research and trials with varieties until they become commercial cultivars. After that, participants visited the Olé! company, the largest exporters of artichoke from Spain, in the municipality of Almoradí (in the Alicante Region of the Vega Baja). Participants were able to verify the characteristics of the crop, the cultivars, and the irrigation and harvest systems. The artichoke process was completed with a visit to the auction La Redonda de Orihuela. There scientists and professionals saw the typical artichoke from the area and its marketing. First a price is fixed, which decreases until the buyers, who are usually company marketers, exporters and the canning industry, stop the auction at the level that they have deemed appropriate, choose the artichokes they want, and the quantity of the purchase.

The last day was dedicated to a technical workshop at the High Polytechnic School of Orihuela (UMH). The main topics included integrated management of microorganisms, the cultivation of artichoke developed by the company Symborg, the health properties of artichoke and finally a round table.

Dr. Aurelio Scavo from the University of Catania, Italy, received the ISHS Young Minds Award for the best oral presentation entitled "Effect of genotype and harvest time on the weed phytotoxicity of *Cynara cardunculus* L. leaf extracts".

During the ISHS business meeting, Prof. Giancarlo Colelli was elected to organize the next International Symposium on Artichoke, Cardoon, and their Wild Relatives in April 2022 in Italy.

Daniel Valero and Maria Serrano

› Contact

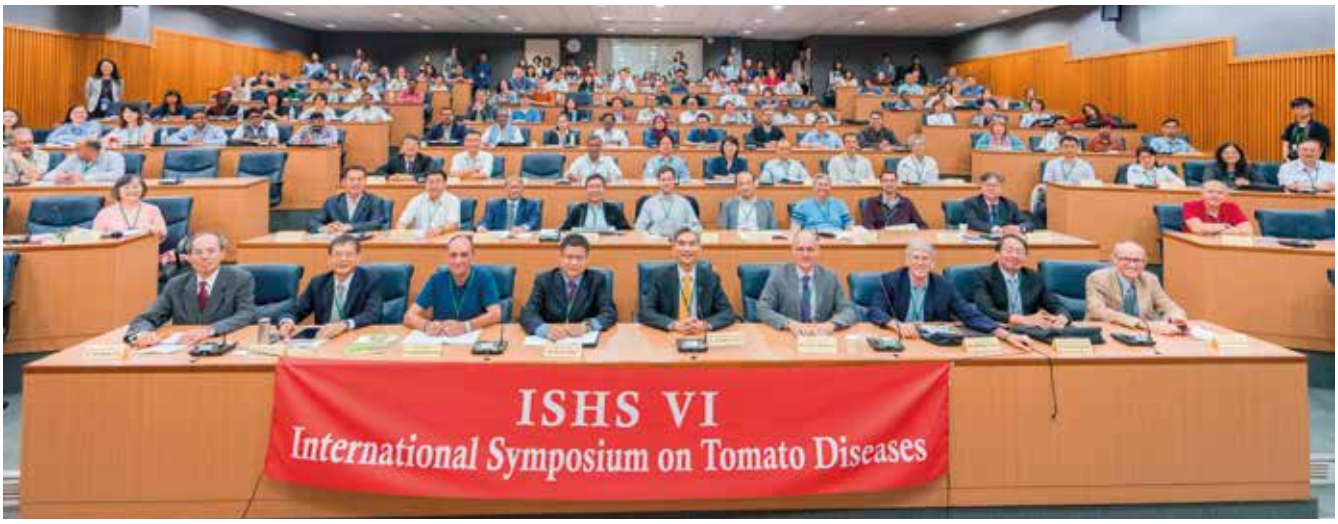
Prof. Dr. Daniel Valero and Prof. Dr. Maria Serrano, University Miguel Hernández, Ctra. Beniel Km. 3,2, 3312 Orihuela, Alicante, Spain, e-mail: daniel.valero@umh.es and m.serrano@umh.es

› Oral presentation by Dr. Aurelio Scavo, winner of the ISHS Young Minds Award.

› Visit to artichoke fields sponsored by Olé!, one of the most important exporters of artichoke.

VI International Symposium on Tomato Diseases

Division Vegetables, Roots and Tubers #ishs_dveg

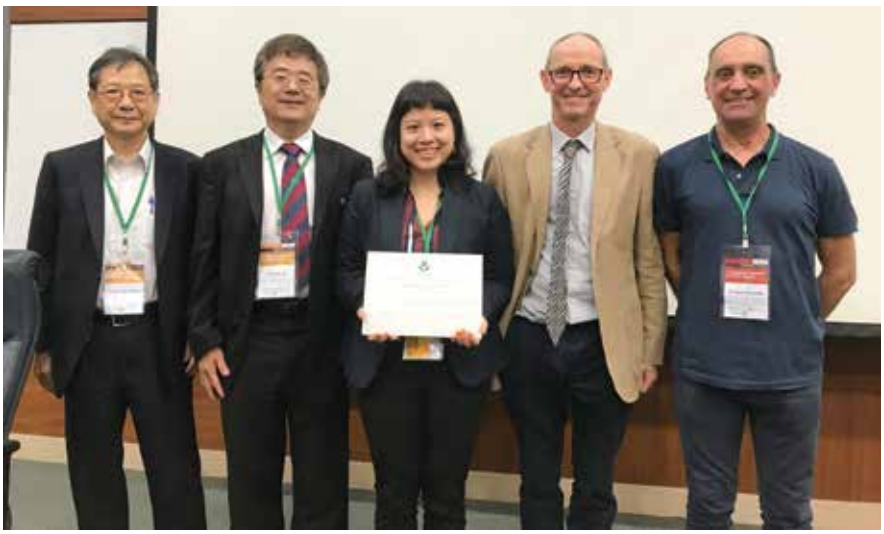


› The full auditorium at NCHU during the opening of the symposium.

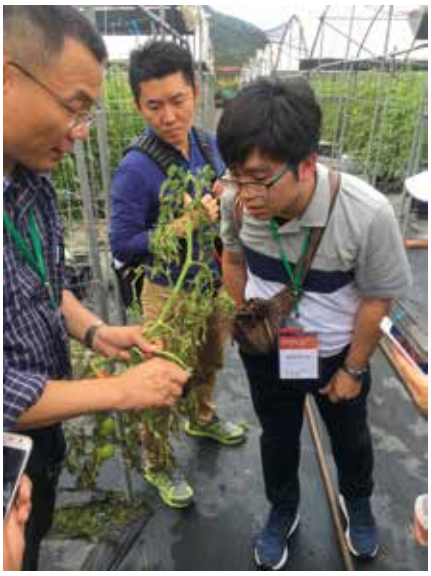
More than 144 people from at least 17 different countries participated in the VI International Symposium on Tomato Diseases (6-9 May 2019). The main theme was "Managing Tomato Diseases in the Face of Globalization and Climate Change". It was convened by the World Vegetable Center (WorldVeg), the National Chung Hsing University (NCHU), and the Taiwan Agricultural Research Institute (TARI) under the aegis of the ISHS and was held in the International Conference Facility of the Agricultural & Environmental Sciences Building, NCHU, Taichung campus, Taiwan.

The presentations on the first day discussed resistance to diseases and alternative approaches to identifying and deploying different types of resistance. However, a reoccurring topic throughout the symposium was the rapid rate of evolution and emergence (perhaps associated with globalization and climate change) of new, more virulent and aggressive species and strains of pathogens, and the difficulty in finding durable resistance against these. Prof. William (Bill) Fry, keynote, Cornell University, USA, illustrated this by reference to the regular breakdown of resistance to the late blight pathogen *Phytophthora infestans*. Late blight sporangia produced on agar medium carry a very different suite of RxLR effectors (important in pathogenicity) and are in a very different physiological state than sporangia from leaflet lesions. It would thus seem prudent to screen for resistance using such natural leaflet sporangia rather than sporangia from agar cultures. Prof. David Francis, keynote, The Ohio State University, USA, cited the bacterial spot pathogen (*Xanthomonas* spp.) and the early blight pathogen (*Alternaria* spp.) as other examples where there have been rapid shifts in race and species, and the emergence of populations with increased aggressiveness and fungicide tolerance. He also pointed to mining historical introgressions and previously identified tomato wild relative sources of resistance, identification of coupling phase recombination to create resistance cassettes, genomic selection, and background genome selection, as successful approaches in identification of resistance and in countering the emergence of new species and races of pathogens.

Prof. Shyi Dong Yeh, local keynote, NCHU, described transgenic approaches to deliver broad-spectrum resistance to tospoviruses and begomoviruses through inducing both transcriptional gene silencing and post-transcriptional gene silencing (PTGS) of viral gene sequences, respectively in the nucleus and cytoplasm of plant host cells. Prof. Hiroshi Ezura, Tsukuba Plant Innovation Research Center, Japan, gave a presentation spon-



› Ms. Ying-Yu Liao (University of Florida) showing her ISHS Young Minds Award certificate for the best oral presentation (flanked from left to right by Dr. Ray Chang [convener, TARI], Prof. Fuh-Jyh Jan [convener, NCHU], Dr. Lawrence Kenyon [convener, WorldVeg] and Prof. Enrique Moriones [outgoing Chair ISHS Working Group Tomato Diseases, IHSM-UMA-CSIC, Spain]).



› Examining a wilted tomato plant during the TARI field visit.

sored by CropLife-Taiwan describing how CRISPR-Cas9 gene editing is used to enhance nutritional traits in tomato and how the same techniques could be used to enhance some tomato disease resistance traits. In this context, there was a poster presentation from Prof. Fuh-Jyh Jan, symposium co-convener, NCHU, on progress in testing multiplex CRISPR/Cas9 constructs targeting the intragenic region and sites in the C2C3 and C1 genes of the *Tomato yellow leaf curl Thailand virus* to improve resistance to Begomoviruses.

Bacterial wilt, caused by *Ralstonia solanacearum* species complex (RSSC), featured prominently during the second day, which was almost entirely devoted to bacterial diseases. Dr. Nemo Peters, keynote, LIPM INRA-CNRS, France, described his team's work using the RSSC type III effectors as bait to identify candidate tomato proteins, including susceptibility gene products, involved in the pathogen-plant interaction, and how these could be targeted in breeding for increased RSSC resistance. The recent shifts in strain or species of *Xanthomonas* responsible for bacterial spot in several areas, including Taiwan, meant there was also considerable interest in this pathogen at the symposium. Ms. Ying-Yu Liao, University of Florida, USA, received the ISHS Young Minds Award for her robust oral presentation of work from her PhD studies on using magnesium oxide nanomaterials as alternative for managing bacterial spot of tomato.

Opening the session on virus genetics and survey on the third morning, Dr. Moshe Lapidot, keynote, The Volcani Center, Israel, discussed the emergence and rapid spread of *Tomato brown rugose fruit virus* (ToBRFV; a Tobamovirus that is seed-borne and overcomes the *Tm-1*, *Tm-2* and *Tm-2*^{2} genes in tomato) and the search for novel sources of resistance to it. The importance of ToBRFV and the urgent search for methods to accurately diagnose and reliably manage it alongside other seed-borne pathogens, were further highlighted by Dr. Kai-Shu Ling, keynote, USDA-ARS, USA, and Dr. Wulf Menzel, Leibniz Institute, DSMZ, Germany, during the session on virus and viroid disease management in the afternoon of the third day.

At the Business meeting of ISHS Working Group Tomato Diseases, Prof. Enrique Moriones, the outgoing Working Group Chair, nominated Dr. Lawrence Kenyon (WorldVeg) to be the new Working Group Chair and Prof. Fuh-Jyh Jan (NCHU) to be the Vice-Chair. The Working Group also agreed to take forward the offer from Prof. Eduardo Mizubuti and Dr. Alice Inoue-Nagata to convene the next symposium in Brazil in May 2022.

On the final day of the symposium, there was the option of a field visit either to TARI and vegetable production facilities around Taichung, or to WorldVeg (Tainan) via the Sheng Shung tomato grafting nursery and Fuchsia Farm cherry tomato production net-houses near Chiayi. At WorldVeg the participants saw at first-hand the severe effect of *Tomato yellow leaf curl Thailand virus* and *Tomato chlorosis virus* infection in the plants carrying little or no resistance in Dr. Peter Hanson's tomato multiple disease resistance trial. The participants also got to see demonstrations of some of the other tomato disease work going on, as well as the WorldVeg demonstration garden, Genebank (one of the world's largest public vegetable germplasm collections with over 8500 tomato accessions listed and over 4500 available for distribution), and the new Phenospex automated field plant phenotyping facility.

Lawrence Kenyon

› Contact

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› After visiting Dr. Peter Hanson's multiple disease resistant tomato evaluation trial during the field visit to WorldVeg.

In memoriam

Charles E. Hess (1931-2019)

Dr. Charles E. Hess died on April 13, 2019, at his home in Davis, California, after a long illness. He was surrounded by his family and beloved wife Eva of 38 years. Known by all as Charley, he had an ebullient spirit, a warm, outgoing personality, and a brilliant analytical mind. He influenced the lives of many; including students, colleagues, farmers, friends, and family.

Charley was born on December 20, 1931, in New Jersey. His father owned an ornamentals nursery and Charley grew up with a deep interest and love of plants. He had a brilliant career in horticulture research, university administration, and state, national, and international agricultural leadership.

Charley received his BS degree at Rutgers in 1953, and was awarded membership in Phi Beta Kappa. He received MS (1954) and PhD (1957) degrees at Cornell University in horticulture and plant physiology. From 1956 to 1958, he served as First Lieutenant and Project leader in the Crops Division, U.S. Army Biological Laboratories. He joined the Purdue Horticulture Department in 1958, as Assistant Professor and rose to the rank of Professor. He was well known for his research in rooting, rooting cofactors, and the development of the mungbean assay to evaluate rooting substances. In 1966, he returned to Rutgers as Research Professor and Chair of the Department of Horticulture, moved to higher administration, and in 1972 became the Founding Dean of Cook College, known today as the School of Environmental and Biological Sciences. In 1975, he accepted the position of Dean of the College of Agriculture of the University of California - Davis with a faculty appointment in the Department of Environmental Horticulture. In 1989, he was appointed by President George H.W. Bush and confirmed by the Senate, to be the Assistant Secretary for Science and Education in the United States Department of Agriculture where he served with distinction until 1991. He was appointed by President Ronald Reagan to the National Science Board of the National Science Foundation where he promoted the funding of biotechnology research and its application to improve horticultural crops. He chaired the National Academy of Science committee to develop a national strategy for biotechnology in agriculture. He returned to U.C. Davis as Director of International Programs and continued to hold positions as Chair of the Department of Nutrition and Vice Chancellor of Research.

Charley had a strong affiliation with two horticultural societies. He served as President of the American Society for Horticultural Science in 1973, and received the Society's highest honor as member of the Hall of Fame in 2013. He served as Editor and President of the International Plant Propagator's Society. He was awarded an honorary doctorate from Purdue in 1986.

Charles Hess has long been a major spokesperson for horticultural and agricultural science. He traveled widely with major efforts in Egypt and China. As a member of the Task force on Polar issues of the National Science Board he visited the Vanda Station in Antarctica where he was initiated in the Royal Lake Vanda Swim Club with a skinny dip! He was the father of five overachieving children and five beautiful grandchildren. He will be long remembered and missed.

Jules Janick, Purdue University, USA

New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Argentina: Sandra Bucci; **Australia:** Dr. Stephen Burgess, Prof. Roderick Dewar, Nha K. Huynh, Dr. Belinda Kerridge, Mr. Marc Percival, Ms. Harriet Walker; **Austria:** Franz Reitbauer; **Belgium:** Dr. Roberto L. Salomon, Minette Testor, Ms. Yasmin vanbrabant; **Bosnia and Herzegovina:** Assist. Prof. Miro Barbaric; **Brazil:** Ms. Miriam Corona, Alvaro De Araujo; **Bulgaria:** Mr. Mladen Petrov, Assoc. Prof. Milena Petrova-Dimova; **Canada:** Ms. Lorena Balducci, Ms. Alanna Bodo, Ms. Charlotte Giard-Laliberté, Mr. Bram Hadiwijaya, Mr. George Kanellos, Magali Nehemy; **Chile:** Mr. Carlos Bopp, Ms. Paulina Howard; **China:** Prof. Dr. Zhiyong Guan, Dr. Xin Guo, Zhou Jiahua, Assoc. Prof. Li Li, Dr. Qingqing Li, Dr. Wei Liang, xia Liu, Prof. Dr. Huiqin Ma, Dr. Ting Min, Jiping Sheng, Dr. Zhaosheng Wang, Chen Wei, Prof. Liyi Yang, Ms. Li Yanhua, Jinglin Zhang, Prof. Shufang Zheng; **Chinese Taipei:** Ms. Guan Ping Lin; **Croatia:** Prof. Dr. Branka Levaj; **Czech Republic:** Ina Kyselova, Lukas Vagner, Tereza Zunová; **Denmark:** Ms. Carolina Falcato Fialho Palma; **Dominican Republic:** Mr. Richard Gonzalez; **Egypt:** Assoc. Prof. Yahia Mohamed; **Estonia:** Dr. Toivo Univer; **Ethiopia:** Mr. Diriba Bane Nemera; **Finland:** Pille Mänd, Aleksanteri Mauranen, Kaisa Rissanen, Dr. Pauliina Schiestl-Aalto, Yu Tang; **France:** Ms. Clarisse Auvinet, Yohann Fare, Dr. Nathalie Leduc, Dr. Davide Tarsitano; **Germany:** Mr. Hans Bethge, Ms. Magali Blank, Dr. Andreas Borrmann, Dr. Michael Goisser, Mr. Simon Haberstroh, Lucian Kaack, Dr. Sascha Reth; **Ghana:** Mr. Andy Agble; **Guadeloupe:** Mr. christian Bebin; **Honduras:** Nelson Miguel Domínguez Vasquez; **Hungary:** Dr. Ildikó Király; **India:** Dr. Bhagwat Saran Asati; **Israel:** Dr. Nirit Bernstein, Prof. Hanan

Eizenberg, Mr. Kumar Lama, Mr. Gal Mat, Mr. Yoel Messika, Prof. Michal Oren-Shamir, Dr. Reut Peer, Dr. Ben Rimon; **Italy:** Dr. Vincenzo Alagna, Dr. Gianluca Allegro, Davide Bianchi, Dr. Lucio Brancadoro, Dr. Kushtrim Bresilla, Monica Canton, Dr. Paolo Carnevali, Dr. Elisabetta Gargani, Ms. Giuseppe Gianguzzi, Prof. Silvia Guidoni, Maria Carla Napoli, Mr. Nikolaus Obojes, Prof. Michele Perniola, Prof. Giovanni Quaranta, Dr. Riccardo Russo, Dr. Daniele Sarri, Dr. Guido Schillaci, Dr. Maurizio Tartarini, Dr. Stefania Toscano, Prof. Riccardo Valentini; **Japan:** Dr. Toshikazu Asakura, Wakana Azuma, Dr. Takanori Horibe, Assist. Prof. Kenta Katayama, Dr. Masayuki Kita, Ms. Kano Yamada; **Korea (Republic of):** Mr. Young Su Hyun, Dr. Song Hyung Keun, Mr. Hyeon Woo Jeong, Dr. Kevin Kim, Dr. Soo-Jin Kwon, Prof. Junghoon Lee, Ms. Kyungdeok Noh; **Latvia:** Prof. Dr. Biruta Bankina, Ilze Gravite; **Lithuania:** Jurga Miliauskiene; **Mauritius:** Lutchoomun Satyabhama; **Mexico:** Dr. Gregorio Arellano, Hugo Abelardo Arroyo-Martínez, Dr. Verónica Cepeda-Cornejo, Karla Gonzalez-García, Mr. Adolfo Minero-Amador, Dr. Mark Olson, Dr. Ramon Paz-Vega, Ilse Iliana Pérez, Dr. Edith Villavicencio; **Namibia:** Prof. Habauka Kwaambwa; **Netherlands:** Prof. Dr. Yuling Bai, Mr. Michele Butturini, Ms. Martina Lazzarin, Henry Lommerse, Mr. Davy Meijer, Mr. Alejandro Thérèse Navarro, Dr. Giorgio Tumino, Evelien van Tongerlo, Lisa Zamparo; **New Zealand:** Dr. Jonghyun Choi, Dr. Keith Sharrock, Ms. Gina Sopha, Mr. Kevin Teahen; **Nigeria:** Mr. Simon Alpeus, Dr. Hadiza Yaro; **Pakistan:** Dr. Shahbaz Khan; **Philippines:** Ms. Jan Pauline Gabriel, Prof. Ricardo Patricio; **Poland:** Ms. Monika Cioc, Ms. Paulina Dukat, Dr. Anna Kolton; **Portugal:** João Cruz, Dr. Maria Paula Simes; **Romania:** Dr. Mirela Florina Calinescu, Dr. Alina Florea, Dr. Cristina Zlati; **Russian Federation:** Mr. Vlad Beresnev, Elena Khaylenko, Dr. Nina Klimenko; **Saudi Arabia:** Dr. Saud I Albalawi, Prof. Nora AlFaris; **Slovak Republic:** Prof. Dr. Viera Paganová; **South Africa:** Ms. Sutapa Adhikari, Mamoun Arabi, Mr. Jan Hendrik Avenant, Ms. Gloria Baah, Dr. Jeanne Brand, Ms. Elmien Coetser, Mr. Zane Coles, Ms. Helene Fotouo, Mr. Stephan Le Roux, Ms. Mittah Malebo Magodielo, Mr. Lavhelesani R Managa, Mr. Chuene Mashamaite, Ms. Carren Mncube, Dr. Salmina NS Mokgehle, Ms. patricia Fanele Msezane, Dr. Nomali Ngobese; **Spain:** Dr. Maria José Aranzana, Prof. Dr. Ana María De León Hernández, Dr. Antonio Diaz Espejo, Ana Isabel Galván Romero, Mr. F. Javier López moreno, Javier Marrufo, Jordi Oliver; **Spain - Canary Islands:** Dr. Juan Felipe Pérez-Francés; **Sri Lanka:** Chandika Gunathilake; **Swaziland:** Ms. Swazi Dube; **Sweden:** Mr. Camilo Chiang, Annie Drottberger, Fred Hagwall; **Switzerland:** Sabine Vollenweider, Dr. Roman Zweifel; **Tajikistan:** Umed Sharipov; **Thailand:** Dr. Supanath Kanjanawattanawong, Ms. Chawisarat Koolprueksee, Assist. Prof. Sarunyaporn Maksup, Ms. Thanachporn Paising, Ms. Nutchari Phramnak, Mr. Wuttichai Sareeyuvaratch, Dr. Pronsawan Sutthinon, Ms. Supakon Thaboran; **Turkey:** Dr. Ayca Akca Uckun, Mr. Abdullah Erdogan, Ms. Merve Kara; **United Kingdom:** Mr. Piers Lavan, Mr. Ian Michell; **United States of America:** Mr. Christopher Adkison, Jonathan Allred, Assist. Prof. Luca Brillante, Prof. Anne Britt, Rebekah Carlson, Ms. Miriam Morua Catalan, Sander Denham, Mr. Antoine Desjonqueres, Mr. Michael Eaton, Mr. Marc Fishman, Dr. Deborah Golino, Assist. Prof. Celina Gomez, Luis Gracia, Daniel Grambihler, David Harry, David Hawley, Dr. Fei Jia, Mr. Aji John, Dr. Sara Kuwahara, Ms. Sherie Long, Dr. Erico Mattos, Juan Montalvo, Mr. David Moore, Prof. Chishimba Mowa, Makrand Naravane, Dr. Cherie Ochsenfeld, Dr. Andrew Oishi, Clarence Pippin, Joel Reiner, Dr. Zilfina Rubio Ames, Mr. Lonny Smith, Mr. Anthony Soster, Dr. Xiaoqing Xie, Angela Xu, Assist. Prof. Changmou Xu, Kevin Xu; Vietnam: Mr. Le Phuc Ho

› Calendar of ISHS events

For updates and extra information go to www.ishs.org and check out the calendar of events. Alternatively use the "science" option from the website navigation menu for a comprehensive list of meetings for each Division or Working Group.
To claim reduced registration for ISHS members your personal membership number is required when registering - ensure your ISHS membership is current before registering. When in doubt sign in to your membership account and check/renew your membership status first: www.actahort.org or www.ishs.org

Year 2019

- September 1-4, 2019, Erfurt (Germany): **XXVI International Eucarpia Symposium Section Ornamentals: Editing Novelty.** Info: Prof. Dr. Philipp Franken, Erfurt Research Centre for Horticultural, Crops, University of Applied Sciences, Erfurt, Kühnhäuserstraße 101, 99090 Erfurt, Germany. E-mail: philipp.franken@fh-erfurt.de Web: https://www.eucarpia-ornamentals2018.org/
- September 2-5, 2019, Rovinj (Croatia): **VI International Symposium on Fig.** 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 or Zeljko Prgomet, Collegium Fluminense Polytechnic of Rijeka, Trpimirova 2/V, HR-52210 Rijeka, Croatia. Phone: (385)98255791, E-mail: skink@pu.t-com.hr E-mail symposium: fig2019@iptpo.hr Web: http://fig2019.iptpo.hr
- September 14-18, 2019, Istanbul (Turkey): **IV Balkan Symposium on Fruit Growing.** Info: Prof. Dr. Sezai Ercisli, Ataturk University Agricultural Faculty, Department of Horticulture, 25240 Erzurum, Turkey. Phone: (90) 442-2312599, Fax: (90) 442 2360958, E-mail: sercisli@atauni.edu.tr Web: http://www.balkanfruit2019.org
- September 30 - October 3, 2019, Guadalajara (Mexico): **IX International Symposium on New Ornamental Crops.** Info: Dr. Rodrigo Barba Gonzalez, CIATEJ a.c., Av. Normalistas # 800, Colinas de la Normal, Guadalajara Jalisco CP 44270, Mexico. Phone: (52)3333455200, Fax: (52)3333455245, E-mail: rbarba@ciatej.mx Web: http://www.newornamentalcrops.com
- October 7-11, 2019, Palermo (Italy): **International Symposium on Precision Management of Orchards and Vineyards.** Info: Dr. Riccardo Lo Bianco, Università degli Studi di Palermo, Dipartimento SAAF, Viale delle Scienze, Ed 4, 90128 Palermo, Italy. Phone: (39) 09123896097, Fax: (39) 09123860813, E-mail: riccardo.lobianco@unipa.it or Dr. Antonino Pisciotta, viale delle Scienze, 11, 90128 Palermo, Italy. E-mail: antonino.pisciotta@unipa.it or Dr. Luigi Manfrini, Università di Bologna, 40127 Bologna, Italy. E-mail: luigi.manfrini@unibo.it E-mail symposium: info@pmov2019.it Web: http://www.pmov2019.it
- October 7-11, 2019, Hyytiälä (Finland): **XI International Workshop on Sap Flow.** Info: Dr. Yann Salmon, P.O.Box 68, Faculty of Science, Department of Physics, FI-00014 University of Helsinki, Finland.

E-mail: yann.salmon@helsinki.fi or Prof. Teemu Hölttä, University of Helsinki, Helsinki, Finland. E-mail: teemu.holtta@helsinki.fi Web: http://www.atm.helsinki.fi/sapflow/

- October 13-15, 2019, Wageningen (Netherlands): **VertiFarm2019: International Workshop on Vertical Farming.** Info: 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 or Dr. Murat Kacira, Dept. of Biosystems Engineering, 1177 East 4th Street, Room 403, Shantz Building, 38, Tucson, AZ 85721-0038, United States of America. Phone: (1) 520-626-4254, Fax: (1) 520-626-1700, E-mail: mkacira@email.arizona.edu or Dr. Francesco Orsini, University of Bologna, Viale fanin, 44, Bologna 40127, Italy. Phone: (39)0512096677, Fax: (39)0512096241, E-mail: f.orsini@unibo.it Web: http://www.wur.eu/vertifarm2019
- November 10-13, 2019, Pretoria (South Africa): **II International Symposium on Moringa.** Info: Dr. Sunette Laurie, ARC - Vegetable and Ornamental Plants, Private Bag x293, 0001 Pretoria, South Africa. Phone: (27)128088000, E-mail: slaurie@arc.agric.za Web: http://www.ism2019.co.za/
- December 2-4, 2019, Bangkok (Thailand): **I International Symposium on Botanical Gardens and Landscapes.** Info: Dr. Kanchit Thammasiri, Department of Plant Science, Faculty of Science, Mahidol University, Rama VI Road, Phyathai, Bangkok 10400, Thailand. Phone: (66)89-132-7015, Fax: (66)2-354-7172, E-mail: kanchitthammasiri@gmail.com E-mail symposium: bgl2019thailand@gmail.com Web: http://www.sc.mahidol.ac.th/scpl/bgl2019

Year 2020

NEW
- January 21-24, 2020, Bagalkot (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: adre.uhsbagalkot@gmail.com 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 Web: http://iststvbagalkot2020.com/
- March 15-19, 2020, 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 24-29, 2020, Brena Baja (La Palma) & La Laguna (Tenerife) (Spain): **XIV International Protea Research Symposium.** Info: 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

NEW
- April 22-26, 2020, Punta Cana (Dominican Republic): **X International Pineapple Symposium**. Info: Mr. Joelin Santos, AsoproPimopla, C/ Altagracia 100, Monte Plata, Dominican Republic. Phone: (829)745-0318, E-mail: j.santos@asopropimopla.org

NEW
- May 2-6, 2020, Rimini (Italy): **IX International Strawberry Symposium.** Info: Prof. Dr. Bruno Mezzetti, Dip.Sci. Agrarie, Alimentari ed Ambientali, Università Politecnica delle Marche, Via Brecce Bianche, Ancona 60100, Italy. Phone: (39)0712204933, Fax: (39)0712204856, E-mail: b.mezzetti@univpm.it or 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@univpm.it or Dr. Gianluca Baruzzi, Council for Agric. Research & Economics, via La Canapona, 1 bis, Magliano, 47100 Forlì, Italy. Phone: (39) 543 89566, Fax: (39) 543 89077, E-mail: gianluca.baruzzi@crea.gov.it Web: https://www.iss2020.com/

NEW
- May 7-9, 2020, Bangkok (Thailand): **III Asian Horticultural Congress - AHC2020.** Info: Mr. Ananta Dalodom, Horticultural Science Society Thailand, Department of Agriculture, 50 Paholyothin Rd., Chatuchak, Bangkok 10900, Thailand. Phone: (66)29406578, Fax: (66)29406579, E-mail: ananta.dalodom@gmail.com E-mail symposium: ahc2020bangkok@gmail.com Web: http://ahc2020.org/
- May 17-20, 2020, Leuven (Belgium): **XIII International Controlled and Modified Atmosphere Research Conference - CaMa2020.** Info: Prof. Bart Nicolai, Flanders Centre for, Postharvest Technology, W. De Croylaan 42, 3001 Heverlee, Belgium. Phone: (32)16322375, Fax: (32)16322955, E-mail: bart.nicolai@biw.kuleuven.be or Dr. Maarten Hertog, BIOSYST-MeBioS, K.U. Leuven, de Croylaan 42 - bus 2428, B-3001 Heverlee, Belgium. Phone: (32)16322376, Fax: (32)16322955, E-mail: maarten.hertog@kuleuven.be Web: https://cama2020.org/

NEW
- May 20-22, 2020, Torino (Italy): **IV International Symposium on Woody Ornamentals of the Temperate Zone.** Info: Prof. Dr. Valentina Scariot, Università degli Studi di Torino, Dept. Agric., Forestry & Food Sci., Largo Paolo Braccini 2, 10095 Grugliasco, Torino, Italy. Phone: (39)0116708932, Fax: (39)0116708798, E-mail: valentina.scariot@unito.it or Prof. Dr. Gabriele Loris Beccaro, Università degli Studi di Torino, Dept. Agric., Forestry & Food Sci., Largo Paolo Braccini 2, 10095 Grugliasco, Torino, Italy. Phone: (39)0116708802, Fax: (39)116708658, E-mail: gabriele.beccaro@unito.it E-mail symposium: woodyornamentals2020@unito.it Web: https://www.woodyornamentals2020.com/

NEW
- June 2-6, 2020, Stuttgart (Germany): **IV International Symposium on Horticulture in Europe - SHE2020.** Info: Prof. Dr. Jens N. Wünsche, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70593 Stuttgart, Germany. Phone: (49)711-459-22368, Fax: (49)711-459-22351, E-mail: jnwuensche@uni-hohenheim.de or Dr. Patrick Winterhagen, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70593 Stuttgart, Germany. or Dr. Michael Helmut Hagemann, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70599 Stuttgart, Germany. Web: https://she-ihs-fav2020.de/

NEW
- June 2-5, 2020, Stuttgart (Germany): **V International Humulus Symposium.** Info: Prof. Dr. Jens N. Wünsche, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70593 Stuttgart, Germany. Phone: (49)711-459-22368, Fax: (49)711-459-22351, E-mail: jnwuensche@uni-hohenheim.de or Dr. Michael Helmut Hagemann, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70599 Stuttgart, Germany. Web: https://https://she-ihs-fav2020.de/

NEW
- June 2-6, 2020, Stuttgart (Germany): **VIII International Symposium on Human Health Effects of Fruits and Vegetables - FAVHEALTH2020.** Info: Prof. Dr. Jens N. Wünsche, University of Hohenheim, Department of Crop Science, Section Crop Physiology of Specialty Crops, Emil-Wolff-Str. 25, 70593 Stuttgart, Germany. Phone: (49)711-459-22368, Fax: (49)711-459-22351, E-mail: jnwuensche@uni-hohenheim.de or Prof. Dr. Bhimanagouda Patil, VFIC, Texas A&M University, Department of Horticulture, 1500 Research Parkway Ste A120, College Station, TX 77845, United States of America. Phone: (1)9794588090, Fax: (1)9798624522, E-mail: b-patil@tamu.edu Web: https://she-ihs-fav2020.de/

- June 7-11, 2020, Moscow (Russian Federation): **XV International Symposium on Virus Diseases of Ornamental Plants.** Info: Dr. Tatiana Mitiouchkina, Branch of Institute of Bioorganic Chemistry, Science av.6, 142290 Moscow region Pushchino, Russian Federation. Phone: (7)4967731779, Fax: (7)4967731779, E-mail: tatiana@planta.bio

NEW
- June 7-11, 2020, Ma'ale HaHamish (Israel): **IX International Symposium on Mineral Nutrition of Fruit Crops.** Info: Dr. Uri Yermiyahu, Gilat Research Center, Soil and Water, Mobile Post Negev 85280, Israel. Phone: (972)89928649, Fax: (972)79926485, E-mail: uri4@agri.gov.il Web: https://www.ortra.com/events/mnutrition2020
- June 8-12, 2020, Malmö (Sweden): **IX International Symposium on Light in Horticulture.** Info: Assist. Prof. Most Tahera Naznin, Department of Biosystems and Technology, Swedish University of Agricultural Sciences, Box 103, 23053 Alnarp, Sweden. Phone: (46)40415019, E-mail: naznin.most.tahera@slu.se or Dr. Maria Karlsson, Växtskyddsvägen 3, skne, Hunnestorpsvägen 29, skne, 23053 BstadAlnarp, Sweden. Phone: (46)40-415370, E-mail: maria.e.karlsson@slu.se or Prof. Dr. Beatrix Waechter Alsanius, Dept. of Biosystems and Technology, SLU, Box 103, 230 53 Alnarp, Sweden. Phone: (46)40415336, E-mail: beatrix.alsanius@slu.se or Dr. Karl-Johan I. Bergstrand, SLU, Department of Horticulture, Box 103, 230 53 Alnarp, Sweden. Phone: (46)040415343, E-mail: karl-johan.bergstrand@slu.se E-mail symposium: ISHSLight2020@slu.se Web: https://www.ishslight2020.se/
- June 21-26, 2020, Coimbra (Portugal): **VIII International Symposium on Production and Establishment of Micropropagated Plants.** Info: Prof. Dr. Jorge Canhoto, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal. Phone: (351)239855210, Fax: (351)239855211, E-mail: jorgecan@ci.uc.pt or 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@ci.uc.pt E-mail symposium: pempishs.coimbra2020@uc.pt

NEW
- July 7-10, 2020, Zlatibor (Serbia): **XII International Symposium on Plum and Prune Genetics, Breeding and Pomology.** Info: Dr. Darko Jevremovic, Kralja Petra I 9, 32000 Cacak, Serbia. Phone: (381)32321375, Fax: (381)32321391, E-mail: darkoj@ftn.kg.ac.rs E-mail symposium: plum2020@institut-cacak.org Web: http://www.plum2020.com
- July 22-24, 2020, Bogor, West Java (Indonesia): **II International Symposium on Tropical and Subtropical Ornamentals.** Info: Dr. Syarifah Iis Aisyah, Dept.of Agronomy and Horticulture, IPB, Jl. Meranti, Kampus IPB Darmaga, 16680 West Java Bogor, Indonesia. Phone: (62)2518629353, E-mail: syarifahiis@yahoo.com or Dr. Dewi Sukma, Department of Agronomy and Horticulture, Bogor Agricultural University, Jl. Meranti Kampus IPB Dramaga, 16680 Bogor, Indonesia. Phone: (62)-251-8629353, Fax: (62)-251-8629353, E-mail: dsukma70@yahoo.com E-mail symposium: tso2020indonesia@gmail.com Web: http://tso2020.ipb.ac.id
- July 26-31, 2020, Wenatchee, WA (United States of America): **XII International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems.** Info: Prof. Stefano Musacchi, Washington State University, TFREC, 1100 N. Western Ave., Wenatchee, WA 98801-1230, United States of America. Phone: (1)509-663-8181, Fax: (1)509-662-8714, E-mail: stefano.musacchi@wsu.edu E-mail symposium: info@2020orchardsystems.com Web: https://2020orchardsystems.com/

NEW
- August 30 - September 3, 2020, Halifax, Nova Scotia and Charlottetown, Prince Edward Island (Canada): **XII International Vaccinium Symposium.** Info: Prof. Dr. David Percival, Dalhousie University, Department of Plant, Food, and Environmental Sciences, PO Box 550, Truro, NS B2N 5E3, Canada. Phone: (1)9028937852, Fax: (1)9028931404, E-mail: david.percival@dal.ca Web: http://www.Dal.ca/ivs
- September 7-10, 2020, Palermo (Italy): **International Symposium on Tropical and Subtropical Horticulture in Mediterranean Climate.** Info: Prof. Vittorio Farina, Università degli Studi di Palermo, Dipartimento Scienze Agrarie, Alimentari e Forestali, viale delle Scienze edif 4 - 90128 Palermo, Italy. Phone: (+39)09123896090, E-mail: vittorio.farina@unipa.it or Dr. Giuseppe Sortino, Department of Agricultural & Forest Science, University of Palermo, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39)09123861234, E-mail: giuseppe.sortino@unipa.it E-mail symposium: info@tropmed2020.it

NEW
- September 14-19, 2020, Hammamet Sud (Tunisia): **X International Congress on Cactus Pear and Cochineal.** Info: Prof. Hichem Ben Salem, IRESA, 30 rue Alain Savary, 1002 Tunis-Belvédère, Tunisia. Phone: (216) 71791670, Fax: (216)71796170, E-mail: bensalem.hichem@iresa.agrinet.tn Web: http://www.cactus2020.agrinet.tn

NEW
- September 21-24, 2020, Palermo (Italy): **II International Symposium on the Role of Plant Genetic Resources in Reclaiming Lands and Environment Deteriorated by Human and Natural Actions.** Info: Prof. Francesco Marra, Department of Agricultural & Forest Science, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39)09123861236, Fax: (39)09123861211, E-mail: francescopaolo.marra@unipa.it or Dr. Emilio Badalamenti, Viale delle Scienze, Palermo, Italy. E-mail: emilio.badalamenti@unipa.it E-mail symposium: info@ispgr-it2020.it Web: http://www.ispgr-it2020.it
- September 24-26, 2020, Ohrid (North Macedonia): **VIII South-Eastern Europe Symposium on Vegetables and Potatoes.** Info: Prof. Dr. Gordana Popsimonova, Debarca 16, 1000 Skopje, North Macedonia. Phone: (389)70255878, E-mail: gpopsimonova@yahoo.com or Skender Kaciu, Univ. of Prishtina-Faculty of Agri., and Veterinary, Boulevar B.Clinton bb, 10000 Prishtina, Kosovo. E-mail: skenderkaciu@yahoo.com E-mail symposium: contact@ishs8.org Web: https://ishs8.org/

NEW
- September 28-30, 2020, Bari (Italy): **I International Symposium on Plant Propagation, Nursery Organization and Management for the Production of Certified Fruit Trees.** Info: Prof. Salvatore Camposeo, Università di Bari, Dipt. di Scienze Agro-Ambientali e Territor, Via Amendola 165/a, 70126 Bari, Italy. Phone: (39)0805442982, Fax: (39)0805442982, E-mail: salvatore.camposeo@uniba.it or Prof. Dr. Tiziano Caruso, Department of Agricultural & Forest Science, University of Palermo, Viale delle Scienze, Edificio 4 ingresso H, 90128 Palermo, Italy. Phone: (39) 09123861207, E-mail: tiziano.caruso@unipa.it or Prof. Vito Nicola Savino, University of Bari - Microbiologia Applic., Dip. Protezione delle Piante, Via Amendola 165a, 70126 Bari, Italy. Phone: (39)0805443069, Fax: (39)0805443608, E-mail: vitonicola.savino@uniba.it E-mail symposium: info@certfruit2020.org Web: http://www.certfruit2020.org

NEW
- October 5-8, 2020, 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: http://www.orghort2020.it/

NEW ■ October 6-9, 2020, Yalova (Turkey): **X International Symposium on Kiwifruit.** Info: Dr. Arif Atak, Horticultural Central Research Institute, Yalova, Turkey. Phone: (90)2268142520, Fax: (90)2268141146, E-mail: atakarif@gmail.com Web: http://www.kiwifruit2020.org/

■ October 11-15, 2020, Nara (Japan): **VII International Symposium on Persimmon.** Info: Prof. Dr. Keizo Yonemori, Faculty of Agriculture, Ryukoku University, 1-5 Yokotani, Seta Oe-cho, Otsu 520-2194, Siga, Japan. Phone: (81)775995695, Fax: (81)775995608, E-mail: keizo@agr.ryukoku.ac.jp E-mail symposium: 2020persimmon@gmail.com Web: http://kaki2020.jshs.jp

NEW ■ October 11-15, 2020, Cape Town (South Africa): **XI International Symposium on Grapevine Physiology and Biotechnology.** Info: Melané 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

■ October 14-17, 2020, Nanjing (China): **V International Symposium on Biotechnology and Molecular Breeding in Horticultural Species.** Info: Jun Wu, Nanjing Agricultural University, College of Horticulture, Nanjing, Jiangsu, 210095, China. E-mail: wujun@njau.edu.cn or Prof. Dr. Shaoling Zhang, Nanjing Agricultural University, 1 Weigang, 210095 Nanjing, China. E-mail: nnzsl@njau.edu.cn

NEW ■ October 19-24, 2020, Kunming (China): **XII International Symposium on Banana.** Info: Dr. Inge Van den Bergh, Bioversity International, C/O KULeuven, W. De Croylaan 42 bus 2455, 3001 Leuven, Belgium. Phone: (32)16377067, E-mail: i.vandenbergh@cgiar.org or Sijun Zheng, Beijing Load 2238, Kunming, Yunnan, 65020, China. E-mail: s.zheng@cgiar.org E-mail symposium: symposium@promusa.org Web: http://www.promusa.org/article159-2020-China

NEW ■ October 25-28, 2020, Seoul (Korea (Republic of)): **III International Symposium on Germplasm of Ornamentals.** Info: Prof. Dr. Byoung Ryong Jeong, Department of Horticulture, 501 Jinju-daero, Gyeongsang National University, Jinju, Gyeongnam 52828, Korea (Republic of). Phone: (82)55-772-1913, Fax: (82)55-757-7542, E-mail: brjeong@gmail.com Web: http://www.isgo2020.org

NEW ■ October 26-30, 2020, Malaga (Spain): **XIII International Mango Symposium.** Info: Dr. J. Ignacio Hormaza, EE. La Mayora - CSIC, 29750 Algarrobo-Costa, Malaga, Spain. Phone: (34)952552656, Fax: (34)952552677, E-mail: ihormaza@eelm.csic.es or Dr. Víctor Galán Sauco, Isaac Albéniz 17, 38208 La Laguna, Tenerife, Canary islands, Spain. Phone: (34)922261647, E-mail: vgalan46@gmail.com E-mail symposium: mango2020@ihsm.uma-csic.es Web: https://en.mango2020.es

NEW ■ November 1-4, 2020, Lemesos (Cyprus): **III International Symposium on Soilless Culture and Hydroponics: Innovation and Advanced Technology for Circular Horticulture.** 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 or Prof. Dr. Silvana Nicola, University of Turin, Dept. of Agric., Forest and Food Sciences, Leonardo Da Vinci 44 (L.Paolo Braccini, 2), 10095 Grugliasco (TO), Italy. Phone: (39)0116708773, Fax: (39)0112368773, E-mail: silvana.nicola@unito.it Web: https://www.hydro2020.com/

NEW ■ November 3-6, 2020, Almeria (Spain): **VI International Symposium on Papaya.** Info: Prof. Dr. Julian Cuevas González, University of Almería, La Cañada de S. Urbano s/n, 04120 Almería, Spain. Phone: (34)950015559, Fax: (34)950015939, E-mail: jcuevas@ual.es Web: http://www2.ual.es/VI-simposium-on-papaya/

NEW ■ November 8-13, 2020, Mersin (Turkey): **XIV International Citrus Congress - ICC2020.** 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.icc2020.org/

■ November 9-13, 2020, Rotorua (New Zealand): **IX International Postharvest Symposium.** Info: Dr. Allan Woolf, Plant and Food Research, Mt Albert Research Centre, 120 Mt Albert Road, Sandringham, 1025, Auck, Private Bag 92169, Auckland, New Zealand. Phone: (64)99257267, Fax: (64)99258628, E-mail: allan.woolf@plantandfood.co.nz or Assoc. Prof. Andrew East, Massey University, Private Bag 11222, Palmerston North, New Zealand. E-mail: a.r.east@massey.ac.nz Web: http://www.postharvest2020.co.nz

■ November 22-25, 2020, Dakar (Senegal): **IV All Africa Horticultural Congress - AAHC2020.** Info: Dr. Moctar Fall, Cluster Horticulture, 2,5 km Route de lAéroport, Immeuble MSA - BP 25 852, Dakar, Senegal. Phone: (221)776389171, E-mail: directeur@agroseed.sn

NEW ■ December 14-16, 2020, Bangkok (Thailand): **IX International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects).** Info: Dr. Kanchit Thammasiri, Department of Plant Science, Faculty of Science, Mahidol University, Rama VI Road, Phyathai, Bangkok 10400, Thailand. Phone: (66)89-132-7015, Fax: (66)2-354-7172, E-mail: kanchitthammasiri@gmail.com, biotech2020thailand@gmail.com Web: http://www.sc.mahidol.ac.th/scpl/Biotech2020

Year 2021

NEW ■ February 16-18, 2021, Catania (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 Francesca Bretzel, CNR, Inst. for Ecosystem Study, Via G. Moruzzi 1, Pisa 56124, Italy. Phone: (39)0503152485, Fax: (39)0503152473, E-mail: francesca.bretzel@ise.cnr.it or Dr. Stefania Toscano, Via Valdisavoia 5, 95123 Catania(CT), Italy. Phone: (39)0954783303, E-mail: stefania.toscano@unict.it

■ April 28 - May 1, 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

■ May 20-25, 2021, Beijing (China): **IX International Cherry Symposium.** Info: Prof. Dr. Kaichun Zhang, Beijing Academy of Forestry & Pomology Sci., Jia 12, Ruiwangfen, Xiangshan Str, Haidian, Beijing, 100093, China. Phone: (86)1082596007, E-mail: kaichunzhang@126.com E-mail symposium: cherrysymposium9@126.com

NEW ■ May 30 - June 3, 2021, 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

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