

*A publication of the International Society for Horticultural Science*

# Chronica Horticulturae



## **Horticultural highlights**

The benefits of ornamental plants on human health in the context of the COVID-19 pandemic • IV Asian Horticultural Congress (AHC2023) in Japan • Conservation techniques for dragon fruit

## **Symposia and workshops**

Cactus Pear and Cochineal • Edible Alliums

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# Chronica Horticulturae



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



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

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Cover photograph: Red dragon fruit also called red pitahaya blanca, *Selenicereus undatus* (Haw.) D. R. Hunt, for purchase at a market in Corvallis, Oregon, USA. Photo credit: Kim E. Hummer. See article p.25.



## > From the cockpit

Peter J. Batt, Editor, *Chronica Horticulturae*



> Peter J. Batt

Welcome to a new year and to a new look for *Chronica Horticulturae*. We were only two weeks into the new year when our President advised me of the need to take the reins for *Chronica Horticulturae*. The appointment was not unexpected, for as the Board member for Communication, it sits well within my portfolio. However, I didn't expect it quite so soon, and while this is my first edition, I must acknowledge the huge amount of work that our past Editor-in-Chief, Kim Hummer, has made in bringing you this edition. Due thanks must also be given to Kelly Van Dijk from ISHS headquarters who will continue to support me in this new role.

A little bit about myself. In a past life, I was Professor of Food and Agribusiness Marketing at Curtin University in Perth, where I established Australia's first Bachelor of Business Horticulture almost 40 years ago. Within ISHS, I've organised around eight symposia and was part of the team that successfully delivered IHC2014 in Brisbane. I've also been Chair of ISHS Commission Economics and Management and more recently, Chair of ISHS Division Horticulture for Development. I joined the Board in 2022 as the representative for Oceania and, by default – as I was the last to speak – inherited the portfolio of Communications.

I'm currently in the process of transitioning to retirement, winding up my international consulting business and finally getting to do some of the things that I never had time to do before. In Perth, Western Australia, we have a wonderful climate for water sports. I'm currently part of a six man crew for a 30 foot racing yacht – we sail twice a week – and I'm seriously into ocean skis, heading 5-6 kms off shore and riding the big swells as they come up the coast. Hence, when I was trying to come up with a name for this column, which will become a regular part of *Chronica Horticulturae*, a nautical theme seemed most appropriate, for it's from the cockpit that we effectively control and coordinate all the activities on the boat.

In accepting the new role, I do want to implement a few changes, and hence, for this first editorial, I'd like to focus on a couple of these. First and foremost, *Chronica Horticulturae* is the principle communication vehicle for ISHS. A View from the Board will become a regular feature, advising you, our members, what we as a Board are doing to address some of the key challenges facing our Society and how we intend to better position the Society going into the future.

Symposia are the core of our business, and as such, I want to give EVERY conve-

ner an opportunity to promote their event. Publication would ideally be three months before the call for abstracts. Conveners are to prepare a brief article that provides:

- some background/overview of the industry sector and its significance (and this is expected to replace some of the current review papers that are too general and too long)
- the aims and objectives of the symposia
- keynote speakers
- venue and duration

For many of the reviews that have been written in the past, the Board feels that these would be better positioned in either our journals or in *Scripta Horticulturae*, and, as a result of the peer review process, authors would be appropriately acknowledged for their effort.

In addition, and there's no change here, all conveners will continue to provide a short report at the conclusion of their event.

For similar reasons, you will also see some changes in the way we promote the International Horticultural Congress and the three other regional congress in Africa, Asia and Europe. ●



## > Did you renew your ISHS membership?

Logon to [www.ishs.org/members](http://www.ishs.org/members)  
and renew online!

# > Exploring ways to enhance membership, corporates, sponsors and partners

François Laurens, President of ISHS, Peter Batt, Lukas Bertschinger, Yao-Chien Alex Chang, Ted DeJong, Moctar Fall, Patricia Paiva, Ryutarō Tao and Peter Vanderborght



> François Laurens

Change is inevitable. Some 2,500 years ago, the Greek philosopher Heraclitus was quoted as saying ‘there is nothing permanent except change’.

In our last editorial, we spoke of our desire to formulate a new strategy for ISHS and to position the Society as ‘the world’s leading independent organization of horticulturalists’. However, since publication, we have received advice that the term horticulturist is probably more appropriate, for horticulture is a noun and horticulturalist is an adjective. As titles like economist, botanist or chemist are based on nouns, not adjectives, our new vision statement has been revised accordingly: “ISHS is the world’s leading independent organisation of horticulturists acting as a globally recognised and sought-after platform for research, science-based information exchange and collaboration in support of sustainable innovation in horticulture”. We extend our thanks to Owen Doyle for pointing this out.

Behind the scenes, this is the first edition of *Chronica Horticulturae* to be prepared by our new Editor-in-Chief, Dr. Peter J. Batt. As the Board member for Communication, this was an obvious choice, and we thank Peter for accepting the position. We are now looking at how we might better utilise *Chronica Horticulturae* to promote the aims and objectives of ISHS and to keep you, our members, better informed.

As Peter takes the reins, this is an opportune time to both acknowledge and to thank our past Editor-in-Chief Dr. Kim Hummer for the many years of dedicated service she has given to the task.

In formulating a strategic plan for the Society, and as reported in the last edition of *Chronica Horticulturae*, we have identified a number of priorities:

- enhancing the role of ISHS as a globally recognized platform for research and science-based information exchange;
- increasing and diversifying our membership;

- a review of ISHS publications;
- a review of the ISHS website;
- the establishment of a Young Minds Committee; and
- an in-depth analysis of the business model.

In the coming months, we will need to prioritize our efforts, as we will experience a significant budget deficit. Unfortunately, as a result of the COVID-19 pandemic, considerably less income was achieved from ISHS symposia and as a consequence, the budget for 2022, as approved by the Council in August, has been significantly reduced. At the Board level, while every effort is being taken to reduce expenditures, our key priority is to explore the various means by which we can enhance our membership base.

By the time this issue of *Chronica Horticulturae* reaches your mailbox, all past and present members of the Society will have received an email from ISHS Headquarters urging you to complete an online membership survey. This will be the first comprehensive survey of our membership since 2012 and much has changed since then.

The survey, which is being administered through Survey Monkey, will survey both past and present members. For past members, we primarily want to know why they have chosen not to renew, which benefits they most valued and what we as a Society need to do to retain or to regain their support.

For current members, our focus is primarily on the benefits membership offers to our members and the extent to which expectations have been met. We are also looking at where we can improve the ways in which our Society operates and members’ level of satisfaction with the various publications and social media platforms maintained by the Society.

In response to questions from the floor at IHC Angers, we also wish to explore member interest in a number of issues such as climate change, the lack of water, biodi-

versity, sustainability, food insecurity, poor nutrition and diet, wellbeing, consumer resistance to new technology, etc. We want to know which of these issues are most important to you and what action/activities ISHS should take in pursuing those issues. Finally, in securing greater support from corporate members, sponsors and partners, and indeed, in reporting to you – our members – we want to know whether we should be reporting our performance annually against a number of environmental, social and governance (ESG) indicators, and potentially what form that might take.

As the results of this survey will inform the Board and directly influence our future strategies and direction, we encourage your participation. And please, always remember, your Board is here to serve you.

In parallel to the membership survey, we will shortly begin interviewing those organisations who sponsored and/or participated in IHC2022 in Angers to explore the extent to which their expectations were met. This information will be instrumental in drawing up a number of new membership categories that we can offer to these and other potential corporate members, sponsors and partners.

As we move forward into the next phase, we will happily accommodate any personal introductions that you may wish to make, for when engaging with the corporate sector, personal relationships are so very important. ●





# > Silvana Nicola

## Position or previous position

Full Professor

Two terms ISHS Board (Vice-President, 2014-2018; Secretary, 2018-2022)

Two terms ISHS Executive Committee, Chair of ISHS Section Vegetables (2006-2010; 2010-2014)

Chair of ISHS Working Group on Fresh Cut Produce (2007-2011)

Convener and co-convener of 9 ISHS meetings/workshops/symposia/summits

## ISHS honour

ISHS Honorary Member

## Tell us a bit about yourself

I was born in Italy, in a very small town on the outskirts of Turin. My family was big: a traditional Italian grower family, composed of parents, brothers and sisters, aunts and cousins. We grew many vegetables, but the pride of the family was sweet pepper production (Figure 1). All of the family helped on the farm, regardless of age, except when we were at school. Agriculture was hard work. Even then I wanted to study agriculture to make working in the sector easier and less stressful. At the same time, I wanted to get away from my home town. At high school, I chose a "Scientific Lyceum", a typical five-year study program dedicated to science. I chose French as a foreign language to avoid studying in my home town, which only offered English as a foreign language. Against the will of my father, who wanted me to study a more "prestigious degree" – either medicine or engineering – I insisted on studying agriculture at university.

In my third year of university, I met my lovely husband Michel. He has always encouraged me to pursue my goals and has followed me all over the world whenever possible. We love to travel and to get acquainted with the culture of other people, wherever they live.

## What got you started in a career in horticultural science?

To graduate I needed to present a thesis and for that, I chose to study the vase life of gerbera. On graduation day, the professor of Olericulture offered me an opportunity to stay at the institution to work on fresh tomato in a protected environment and then seed-

ling development for transplanting. At that time the nursery industry was just emerging and a lot of work was needed to facilitate the production process. Suddenly, I was doing research, but for 'soft' money, and for only six months per year. To make a living I was doing several jobs at once, including working as a horticulturist for a regional organization to implement alert systems for fruit protection. The end of the '80s was the beginning of the digital era, with field detectors for humidity and temperature connected to basic meteorological stations. From a remote computer we were preparing the warning alerts to growers to take immediate actions against the spread of fungal disease.

What changed my life was an opportunity to apply for a Fulbright Scholarship. I was fortunate enough to be accepted and I chose the University of Florida to spend my six months under the guidance of Prof. Dr. Daniel J. Cantliffe, one of the world's most renowned scientists on seed technology and seedling physiology at that time. Working at the University of Florida gave me such a boost in self-confidence and increased my passion for horticulture. My French was of no help, but I quickly learned English. Daniel eventually offered me a position as Research Assistant and a PhD fellowship and we moved to Gainesville, Florida.

## What do you consider to be your greatest achievements?

One of my greatest achievements was being able to help nursery producers in Florida to solve several of the problems they were experiencing in raising transplants. I also learned new techniques to grow transplants that were not common in Italy: sub-irrigation systems, the ebb-and-flow and floating systems, derived from the tobacco transplant industry. When I started a new position at my home university I brought these techniques back with me and expanded them to all sorts of leafy vegetables.

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

After three years at the University of Florida, I got the PhD and came back to Italy, becoming an Assistant, then Associate and then Full Professor. I am passionate about doing research in horticulture, working with growers and their associations, and I draw a great deal of personal satisfaction from mentoring students at all levels. I particularly enjoy hosting PhD students from abroad.



■ Figure 1. I was born in a field of sweet peppers!

I feel my greatest achievement is related to the fact that I have had a career in horticulture at an international level. I have spent several months abroad, working in universities in Spain and Japan. I continue to spend several weeks abroad most years, including giving lectures under the European Erasmus Program. I continue to work with colleagues around the world: I'm now an Extern Examiner in Horticulture at the University College Dublin (Ireland), and will soon commence a five year engagement as a Visiting Professor at the Chinese Academy of Agricultural Science in Beijing.

I am very proud of my activities for and on behalf of ISHS. The first time I participated in a symposium as Chair of ISHS Section Vegetables was at the International Symposium on Vegetable Safety and Human Health, in Beijing, in 2006 (Figure 2). In 2008, I helped organize another symposium in Beijing, the International Symposium on Vegetable Production, Quality and Process Standardization in Chains: a Worldwide Perspective.

As Chair of ISHS Section Vegetables I have felt a great accomplishment in opening new ISHS symposia, especially in new countries or in developing countries. I particularly recall the International Symposium on Tomato in the Tropics, in Colombia, in 2008, or the first Eurasian Symposium on Vegetables and Greens, in Armenia, in 2012.

As a Member of the ISHS Board, specifically as Vice-President and Scientific Coordinator,



■ Figure 2. Silvana Nicola handing out the ISHS Medals to the conveners, Prof. Chen Hang (left) and Prof. Wilfried H. Schnitzler (right), of the International Symposium on Vegetable Safety and Human Health (2006, China).

I felt some accomplishment in restructuring the scientific framework of the Society, along with the help of my fellow Board member Dr. Jill Stanley. Another achievement has been enhancing the “Symposia 2.0 concept”, merging small events into bigger ones, regional or by topics, to make symposia more efficient (Figure 3).

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

My doctoral studies were difficult. My advisor was very demanding and his mentoring philosophy was harsh. Thanks to my husband’s continuous support and my stubborn commitment I finally reached my goal, but it took me some years to realize that my advisor had made me become more self-confident and proud of my achievements. For me it was an honor to be elected for two terms as Chair of ISHS Section Vegetables right after him. Daniel J. Cantliffe has indeed created a legacy at ISHS, for the next Chair of ISHS Section Vegetables, Quality Production Systems, Leafy Green and Non-Root Vegetables was another of his former students and one of my greatest friends, Daniel I. Leskovar (Figure 4).

In the following years, my career path was not so easy. In Italy, after leaving the country to go abroad, there are barriers and constraints. If you stay put your chances of promotion are better, but now things are changing. I turned those difficulties into opportunities, relying on the international scientific community to feel satisfied in my job. It is

with thanks to ISHS that I have had such a rewarding and joyful time, meeting so many wonderful colleagues around the world at symposia or meetings, for international projects or sabbaticals, and during my time as a member of the ISHS Executive Committee and Board.

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

I became member of ISHS because of IHC1990 in Florence. My first international event, right next door, in my own country, gave me the opportunity to get acquainted with the

Society. I soon realized how important the sense of community was and the importance of having a network of colleagues around the world to exchange experiences and knowledge. As I was at a very early stage of my career, just two years after graduation, I did not realize at that time the role of ISHS, but I kept being a member of the Society to enhance my relationships with other scientists. During the highly successful IHC2002 in Toronto, I was a convener at one of the symposia, giving me the chance to appreciate the gathering of scientists and the organization of abstracts, talks and manuscripts. Throughout the following years, either from the USA or from Italy, I increased my appreciation of the international scientific community.

Most of my best friends are from all around the world and it is so nice to see them again at various symposia and to spend free time with them and their family. Our Society is made of us and together we create our network, we disseminate knowledge, we foster our understanding of horticulture, and we pass on our knowledge and our passion to our students. Being an Honorary Member of the Society (Figure 5) gives me even more sense of duty to encourage young people to become members of the Society and to serve our community.

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

Horticultural science is fun. Young people should be passionate about horticulture and be curious to discover new species, new uses for horticultural crops and beverages, and the many ecosystem services provided by plants. The diversity of crops, cropping systems and end products provide plenty of opportunities for young people. Most of the advanced and



■ Figure 3. ISHS Board and Executive Committee meeting (2016, Canada).





■ Figure 4. The last three Chairs of ISHS Section Vegetables, Daniel Cantliffe (right), Silvana Nicola (center), Daniel Leskovar (left), together at the Gala dinner at IHC2014, Brisbane.

innovative production systems are for horticultural species, and companies often look for young scientists with innovative ideas to create new plant-based foods, or new colors of flowers for the market.

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

Horticulture provides the beauty in our landscapes through parks and gardens, in our homes and our work environments through cut flowers and indoor plants, the health giving properties of fruit and vegetables, and through the many spices that we use, the unique flavors that we experience in our food and drinks.

The COVID-19 crisis has exemplified the importance of contact with nature, and of the presence of green spaces in cities and houses. These aspects will help revitalize the ornamental plant sector, and such activities as urban gardening, social horticulture, and therapeutic horticulture. The pandemic has affected the supply of fresh horticultural products. New logistics and production systems




■ Figure 5. Former President of ISHS, Dr. Rod Drew, handing the ISHS Honorary Member certificate to Silvana Nicola, accompanied on stage by her husband, Michel Contini, at IHC2018, in Istanbul.

tems need to be designed to counter the difficulties we have recently observed. More local production will be required to ensure that enough food is produced to feed the population. The climatic changes occurring are forcing us to search for solutions to produce food in adverse situations. Population growth and diminishing resources will drive


us to produce more with less, encouraging research dedicated to more efficient production systems, reducing the use of water and other production inputs. Automation and artificial intelligence can help us to enhance the horticultural sector. The circular bioeconomy is an opportunity to reduce, reuse and recycle plant byproducts. ●

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# ➤ The benefits of ornamental plants on human health in the context of the COVID-19 pandemic

Moumita Malakar and Margherita Beruto

The concept of biophilia defines the human innate need to be near nature. With the advent of urbanization and e-era, we began to affect the balance between humanity and nature. We have forgotten our common roots with nature. The COVID-19 pandemic was an unprecedented event for all mankind. It caused a myriad of irreplaceable losses in the professional as well as the personal domain. The health crisis during this pandemic highlighted how nature-based solutions can help recovery and resilience. Potted plants, cut flowers, and foliage are appreciated for their beauty and fragrance but it becomes more and more evident that they could be considered also for their effects on physiological and psychological human well-being. This review is focused on the role of ornamentals in restoring mental cognition, bringing mental peace and sanity, overcoming mental distress, and other health issues.

## Importance of ornamental flowers in multi-level spheres

Flowers sprinkle color into our life, enlivening our roots in nature (Figure 1). The use of flowers in human life has a long history of use for medical, cultural, social, and religious traditions. Studies have shown that flowers induce creative energy and improve our mood, reducing stress and depression (Xie et al., 2021 and other citations therein). Therefore, flowers and ornamental plants should be considered not only for their decorative use but also for their impact on society well-being.

During the pre-COVID-19 phase, we were not bothered about our “mental health.” Many of us were unfamiliar with this term, but the post-COVID-19 phase has forced us to garner cognitive ideas virtually about this topic. From the literature, the status of mental illness was lower in the pre-pandemic phase compared to the current situation (Figures 2 and 3). Semantically, “mental health” encompasses emotional, psychological, and social well-being (WHO, 2022). In this framework, the peace and sanity of mind aid in strategically handling and coping with diversified

stresses (WHO, 2022). Taking into consideration these statements, the use of ornamentals (flowers and foliage) for natural therapy significantly impacts our health, and can be envisaged for use in clinical psycho-therapies (like counselling, cognitive behavioral therapy [CBT], dialectical behavior therapy [DBT], client-centered therapy) (Békés et al., 2021).

During the COVID-19 pandemic, the forced isolation, refraining from all sorts of social gatherings, endless confinement, and glancing over the deserted areas have caused the onset of mental illness. According to the Kaiser Family Foundation (KFF, an American non-profit organization, <https://www.kff.org/>) statistics during the pandemic indicated that about four out of ten adults in US suffered from depressive anxiety (Panchal et al., 2021a). The COVID-19 caused economic recession and social instability. Consequently, the induced physical and mental fragility influenced some adjunctive habits like aggravated alcohol consumption (12%), and the intake of high dose sleeping pills (Panchal et al., 2021b). In India, COVID-19 triggered a wide age group (people of 18-85 years old) so that one in four people required medical intervention (The Times of India, 2021, <https://timesofindia.indiatimes.com/india/covid-has-changed-world-of-kids/articleshow/87677353.cms>). In addition, mental illness was involved in disturbed sleeping patterns (59% of total Indian population [IP]), and suicidal thoughts (27% of total IP) as reported by The Times of India in 2021 (<https://timesofindia.indiatimes.com/lifestyle/health-fitness/health-news/coronavirus-trouble-sleeping-covid-can-be-one-of-the-many-reasons/photostory/93066794.cms>). As coping measures of several stresses, people rediscovered the importance of staying in close proximity of family and friends (77%), of keeping busy with indoor hobbies and constructive activities (68%), and of dedicating more time to meditation (34%) (The Times of India, 2022, <https://timesofindia.indiatimes.com/world/rest-of-world/covid-has-taken-severe-mental-health-toll-who/articleshow/89951071.cms>).

Given the circumstances, nature is the ultimate resolution to restore stability in life. Medically, it was proven earlier (pre-COVID-19 period) that a broad array of ornamental foliage and flowering plants could positively influence the physiological and psychological well-being (Khan et al., 2016). The post-COVID-19 period corroborated this statement on an experimental basis (Xie et al., 2021). According to Xie et al. (2021) flower colors affect individual mood status and stress level. Adornment of indoor spaces with aromatic plants and fresh cut flowers (e.g., chrysanthemum, rose, heliconia, tulip, peony, tuberose, and carnation) brings positive emotions and energy.

On the one hand, nurturing the gardening passion is a way to ameliorate lifestyle, and on the other hand, this attitude could increase consumer awareness of the value of the ornamental sector. In other words, we face a juncture that could facilitate extensive proliferation of the ornamental sector. Hence, flowers are not merely a piece of décor. Ornamentals in day-to-day life are imperative for good mental and physical health.

## Status of the application of ornamentals worldwide as stress and anxiety buster

As previously mentioned, the COVID-19 pandemic taught us an important lesson on the role of nature and ornamental plants. This role has been forgotten in our hectic life and in our increasingly urbanized cities. Therefore, to improve our lives and to better face the periods of isolation that are imposed by the present pandemic or future events, it is important to raise awareness of the importance of ornamental plants and encourage scientific studies on this topic.

Viewing of multi-hued (like yellow, white, or red) flowers indoors is equal to the visual experience of natural scenery (Xie et al., 2021). In addition, the involvement of flowers on the amelioration of a range of psychological issues can be achieved in several other activities such as growing ornamentals



indoors (viz. hanging basket, balcony boxes, and vertical gardening forms) and outdoors (viz. front or backyard flower beds, or landscaping of large building condominiums) or the creation of floral compositions for special events or anniversaries.

Notwithstanding the impact of flowers on human concentration, memory, happiness, mental cognition, and depression (Texas A&M Agrilife Extension, <https://agrillifeextension.tamu.edu/> and <https://ellisonchair.tamu.edu/health-and-well-being-benefits-of-plants/>), scanty experimental-based literature exists. The bibliographic search results on the various ornamental plants for which benefits on human health have been documented are summarized in Table 1.

The medical and/or physiological aspects of taking care of flowers are fascinating. Different horticultural activities cause implications on human brain electrical impulses (Anupama et al., 2012; Tao et al., 2020). Of five kinds of brain waves, alpha ( $\alpha$ ; at frequency between 8 and 12 Hz) and beta ( $\beta$ ; at frequency between 12 and 30 Hz) waves have been found to occur during relaxation feeling and working or conscious states, respectively (Young et al., 2021). The interaction between flowers and human beings significantly triggers relaxation feelings, unlike what happens when we are busy with a myriad of modern electronic gadgets. According to Loretta Graziano Bruening (2017), much of the enjoyment derived from flowers is related to chemicals in the brain, tied to human evolutionary history. Flowers stimulate the secretion of the so called “happy hormones” (HH), which are dopamine (secretion stimulated by “expectation of a reward”), serotonin (known as “bonding hormone”), and oxytocin (known as an “antidepressant hormone”). As an example, the appeal of bright flower colors is related to our evolutionary status. Indeed, the hungry ancestors were looking at colors as a possibility to get fruit and water. Modern humans no longer search the landscape for food as a matter of survival and don’t consciously link flowers with food, but the blossoming of a flower triggers the sense that something special is coming because it triggers dopamine (Bruening, 2017). Another example given by Bruening is addressed to highlight that oxytocin is the happy brain chemical that can influence social support. Receiving flowers and communicating with flowers enhances the social trust we seek.

The HH concentration can be influenced by the sense of touch and smell we experience when we touch the tender flower petals or we breath the fragrances and aromas originated by some ornamentals. Consequently, a better physiological and psychological well-being is achieved. Therefore, flowers can do magic not only thanks to their dazzling



■ Figure 1. Mini garden using multicolored winter annuals (*Petunia* sp., *Tagetes* sp. [marigold], *Antirrhinum* sp. [snapdragon] and *Celosia* sp.) at the front yard of Circuit house, Midnapore, West Bengal, India. Source: Moumita Malakar, personal collection.

hues but also by their pleasant aroma. The importance of smell has long been known. The pleasant fragrance of ornamentals can cause an overwhelming effect on the human mind. Now, the question is how do we detect the smell? The entire process of receiving a smell is termed an olfactory cycle. Scientifically speaking, the emitted gas molecules from the source first enter our nasal cavity. These gas molecules get dissolved in the mucus fluid while at this stage the stimulus also agitates the olfactory neurons (i.e., sensory cells). This process is known as “chemical stimulation.” Finally, the stimulus is transmitted to the limbic system of the brain via the olfactory bulb and causes the sensation of smell (Acar and Polat, 2019). As previously stated, the pleasant smell sensation influences the HH secretion. These medical explanations on how the intervention of ornamentals could alleviate the COVID-19 induced stresses and anxieties may endorse their extensive application.

Several “abstract therapies” (those that differ from the conventional ones and revolve around something like music, art, or dance) using floral components were conducted recently by several researchers in relation to the recent pandemic induced demand or situation-based need. Tao et al. (2020) used fresh cut rose (*Rosa hybrida*), chrysanthemum (*Chrysanthemum morifolium*), lily

(*Lilium candidum*), and carnation (*Dianthus caryophyllus*) flowers to make electroencephalograms (EEG) and state-trait anxiety inventory (STAI) based evaluations to detect the impact of remaining busy with ornamentals and other “techno sensors” (like computer or mobile phones). In their study, they determined by EEG evaluation that the  $\alpha$  and  $\beta$  brain waves work under both conditions. They obtained the brain wave frequency of 511 Hz, which proved the relaxed and wakefulness conditions of subjects (mean age group  $22.2 \pm 0.9$  years old, mean weight  $52.76 \pm 9.80$  kg, and mean height  $160.68 \pm 5.87$  cm) due to the  $\alpha$ -activity during working with flowers. They also found a lower blood pressure during horticultural activity than during the techno sensor based mental task. Xie et al. (2021) evaluated the impact of unscented cut roses of three different colors (viz. yellow, red, and white) on physiological and psychological states of individuals during the COVID-19 lockdown. Cut roses were arranged in cylindrical glass vases while the distance maintained between the subject and flower vase was 40-50 cm, visual exposure duration was 3 min and the height was adjusted according to the individual subject. To assess the psycho-physiological conditions, they evaluated the EEG output, heart rate variability, and skin conductivity measurements along with a semantic differential

■ Table 1. List of ornamentals coupled with respective beneficial effect on human life obtained from bibliographic databases.

Botanical name of ornamentals	Family	Habit	Benefit on human health	Source
<i>Narcissus pseudonarcissus</i>	Asparagaceae	Shrub	Visual exposure to its flowers aids to bring some positive mood while its phyto-extract is used to treat Alzheimer's disease	Acar and Polat, 2019; <a href="https://www.rxlist.com/daffodil/supplements.htm">https://www.rxlist.com/daffodil/supplements.htm</a>
<i>Polianthes tuberosa</i>	Asparagaceae	Shrub	Its white colored fragrant blooms bring calmness while the floral fragrance relaxes body and mind, managing anxiety, stress, anger, confusion, emotional disturbances and insomnia	Acar and Polat, 2019; Anonymous, 2020
<i>Santolina chamaecyparissus</i>	Asteraceae	Shrub	Except for different health impacts, its essential oil (EO) helps to bring the relaxing sensation	Acar and Polat, 2019
<i>Begonia semperflorens</i>	Begoniaceae	Shrub	Except for its value-added therapeutic potential, visual exposure to its multihued flowers can be a mood switcher	Acar and Polat, 2019
<i>Jacarandra mimosifolia</i>	Bignoniaceae	Tree	Used for flower arrangements; its ornamental bell-shaped purple-blue fragrant flowers favor relaxation; rich source of antioxidants	Aguirre-Becerra et al., 2020; Acar and Polat, 2019
<i>Abelia × grandiflora</i>	Caprifoliaceae	Shrub	Its highly fragrant white blooms aid to restore mental cognition	Acar and Polat, 2019
<i>Valeriana officinalis</i>	Caprifoliaceae	Shrub	It reduces stress and anxiety, hypertension, and depression; visual exposure causes memory improvement	Acar and Polat, 2019; Anonymous, 2022
<i>Viburnum opulus</i> 'Snowball'	Caprifoliaceae	Shrub	It possesses high decorative value along with pleasant almond-like fragrance; visual exposure to its ball-like blooms causes mental health benefits	Acar and Polat, 2019; Shikov et al., 2014; <a href="https://hside.org/plants-improve-mental-physical-health/">https://hside.org/plants-improve-mental-physical-health/</a>
<i>Matthiola incana</i>	Cruciferae	Shrub	Fully opened flowers give the environment a pleasant smell while bright colored flowers are definitely a mood booster	Acar and Polat, 2019
<i>Cupressus</i> sp.	Cupressaceae	Tree and/or shrub	Used for landscaping purpose and as indoor potted plant (ornamental foliage); it helps to recover from mental fatigue	Shibata and Suzuki, 2001; Acar and Polat, 2019
<i>Rhododendron</i> sp.	Ericaceae	Shrub	Visual exposure to its brightly colored blooms causes some cherishing and relaxed feelings while its phytochemical potential has been well-proven	Acar and Polat, 2019
<i>Wisteria sinensis</i>	Fabaceae	Ornamental climber	Its highly decorative and sweet smelling purple-colored blooms make it a perfect landscape element as well as a mood booster	Acar and Polat, 2019
<i>Philadelphus × purpleomaculatus</i>	Hydrangeaceae	Shrub	Its beautiful white flowers significantly cause impact on mental peace	Acar and Polat, 2019
<i>Iris</i> sp.	Iridaceae	Shrub	It's a representation of wisdom (purple), elegance (purple), faith (blue), purity (white) and compassion (red); it is used as a spiritual healer and for holistic mindset	Anonymous, 2020; Acar and Polat, 2019; <a href="https://themindfool.com/iris-meaning/">https://themindfool.com/iris-meaning/</a>



Botanical name of ornamentals	Family	Habit	Benefit on human health	Source
<i>Lavandula officinalis</i>	Lamiaceae	Shrub	The EO obtained from its blooms is popularly used in aromatherapy; the fragrance of the compounds present in lavender extract lessens the anxiety and creates a relaxing atmosphere bringing calming state of mind without any sedation	Acar and Polat, 2019; He et al., 2022
<i>Salvia officinalis</i>	Lamiaceae	Shrub	Visual exposure to the bright colored blooms helps to improve the mood, to get relief from stress and anxiety, to prolong the attention span, and to boost up self-confidence	Altshul, 2011; Acar and Polat, 2019
<i>Nelumbo nucifera</i>	Nelumbonaceae	Aquatic ornamental	Symbol of longevity, purity and beauty in Buddhism and Hinduism; its pleasant, subtle fragrance causes impact on mental sanity while broad ranges of therapeutic values are well-known	Acar and Polat, 2019; Lin et al., 2019
<i>Jasminum nudiflorum</i>	Oleaceae	Shrub	The pleasant intoxicating fragrance of its blooms helps to uplift the mood; its EO is also used in aromatherapy as antidepressant and sleep inducer	Acar and Polat, 2019; Pokhrel, 2022
<i>Syringa vulgaris</i>	Oleaceae	Shrub	Its EO is popularly used in aromatherapy for its pleasant floral fragrance; used in flower arrangements to dispel bad mood, mild depressions, anxiety, and migraines	Anonymous, 2022; Acar and Polat, 2019
<i>Passiflora caerulea</i>	Passifloraceae	Shrub	It is used to treat restlessness, agitation, insomnia, and anxiety	Acar and Polat, 2019; <a href="https://www.nccih.nih.gov/health/passionflower">https://www.nccih.nih.gov/health/passionflower</a>
<i>Primula sp.</i>	Primulaceae	Shrub	Its floral fragrance can effectively stimulate several psycho-physiological factors	Acar and Polat, 2019; Jiang et al., 2021
<i>Citrus aurantium L.</i>	Rutaceae	Tree	Its EO used in aromatherapy alleviates anxiety and has a myriad of health benefits	Russo, 1993; Mannucci et al., 2018; Acar and Polat, 2019
<i>Fortunella margarita</i> (Lour) Swingle	Rutaceae	Shrub (popular as potted plant)	Effective for obesity issues and its EO causes mental smoothness along with other therapeutic efficacies especially for cancer treatment	Russo, 1993; Acar and Polat, 2019; Patel et al., 2018
<i>Buddleja davidii</i>	Scrophulariaceae	Shrub	Chemical constituents obtained from this plant cause a wide range of health benefits while its beautiful, fragrant, purple colored terminal panicles positively affect human mood and emotion	Acar and Polat, 2019

(SD) questionnaire and profile of mood states (POMS). The higher mean values of  $\alpha$  brain waves in the prefrontal lobe increased parasympathetic nerve activity and values of overall mood states during visual exposure to red and yellow roses compared to white ones. This indicated a higher sense of relaxation, cheerfulness, and comfort during

visual viewing of the colored roses. By these recent studies, mental disorders caused by social isolation due to the pandemic could be soothed by human-flower interactions. Another interesting finding was obtained by Wang et al. (2021) who studied the psycho-physiological impact of five types of urban ornamental bamboos (OBs) with differ-

ent colors in different stems: i) OBs with green stalks; ii) OBs with non-green stalks; iii) OBs with multicolored stalks; iv) OBs with green leaves, and v) OBs with multicolored leaves. Based on the EEG, POMS, STAI, blood pressure, and pulse measurements they deduced that visual characteristics (shape and color) can affect several psycho-physiological

conditions. The “organ of expression,” e.g., stem or leaves, impacted each of the physiological indicators of the subjects (like low fatigue and irritation scores) while “organ color” mainly affected the systolic blood pressure. Visual exposure to varied colors and colored organs of OBs had increased and decreased the  $\alpha$  and  $\beta$  brain wave activities, respectively. Thus, in OBs, the organ expressing the color had a greater impact on psycho-physiological responses than did the type of color itself. Relying on this outcome, OBs could be recommended as a component of urban landscaping targeting to contribute to non-pharmacological and non-invasive therapy for mental well-being as well as the aesthetic upliftment.

Three years before the COVID-19 pandemic, Khan et al. (2016) wanted to assess the therapeutic values of several indoor foliage plants (*Cycus revoluta*, *Chlorophytum comosum*, *Syngonium podophyllum*, *Dracaena deremensis*, *Brassaia actinophylla*, *Araucaria beterophylla*, *Ficus macleilandii* ‘Alii’, *F. benjamina*, *Asparagus sprigeri*, *Raphis exelsa*, *Chamaedora seifrizii*, *C. elegans*, *Epiprem nummaureum*, and *Thuja orientalis*) and flower arrangements (*Canna indica*, *Rosa hybrida* ‘Cardinal’, *Gladiolus* sp., *Polyanthes tuberosa*, *Jasminum* sp., and *Tagetes* sp.). The study considered 270 patients who were subdivided in two groups. “Group A” were exposed to green atmosphere (considered as the experimental stimulus) and “Group B” were kept under the conventional hospital ambience (control). As a result of their experiment, they found significant optimistic behavior and health improvements (like reduced rate of palliative treatments, balanced hypertension, reduced fatigue level and post-operative complications) in “Group A” patients, while “Group B” patients failed to surmount all of these physio-psychological parameters. The conclusions were that a green atmosphere and interaction with nature (plants and flowers) can considerably improve the human senses and sanity.

Along with the visual impact of greeneries, the fragrant aroma of ornamentals could also be a meaningful physio-psychological stimulator. The floral aroma causes psycho-physiological relaxation via “olfactory channels” (Swamy and Sinniah, 2015). To evaluate this effect, Jiang et al. (2021) made an indoor experiment using fragrant *Primula forbesii* Franch (as the experimental stimulus) and non-fragrant *P. malacoides* Franch (as control). The participants at a straight sitting posture and at a distance of 0.2 m were allowed to get the visual as well as olfactory stimulation exposures under experimental vs. control conditions. The physiological and psychological responses in terms of blood pressure, pulse rate, EEG, relaxation scores,

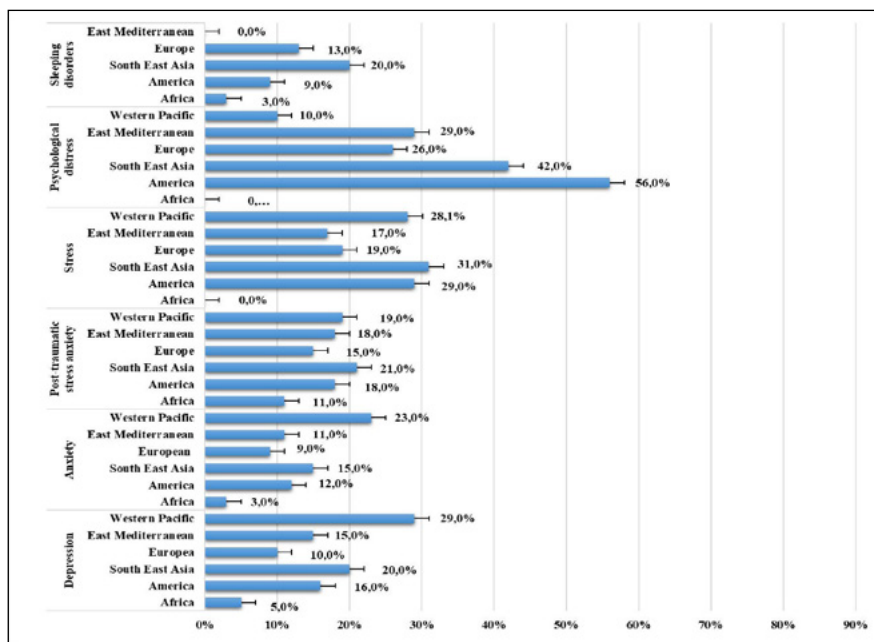


Figure 2. Status of mental health before the COVID-19 pandemic. Source: Baxter et al. (2013), Ettman et al. (2020), Friedrich (2017), Steel et al. (2014), Nochaiwong et al. (2021), WHO (2019, 2022), Marzo et al. (2021) and McCall (2021).

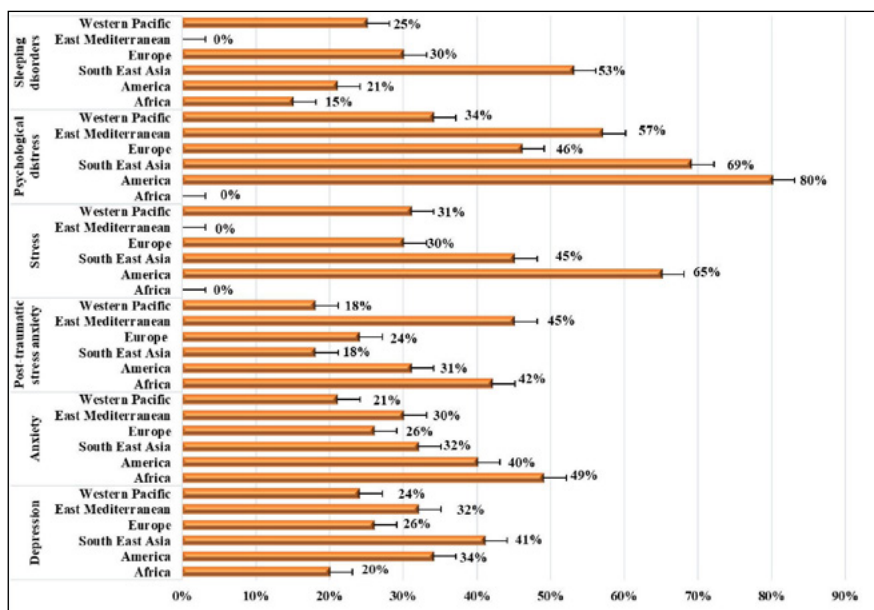


Figure 3. Status of mental health problems during the COVID-19 pandemic. Source: Nochaiwong et al. (2021) and Yang et al. (2020).

mood state, and SD scores, respectively, were found much better during the exposure to fragrant *Primula* than to non-fragrant species.

Recently, an interesting study had been conducted by Song and Wu (2022) on the significance of incorporating ornamental fragrant plants in landscape design. The study was based on ‘smell-scape’ perception, which is the assemblage of a myriad of spatially arranged smell sources sensed by human olfactory organs (i.e., nose) (Xiao et al., 2018). In this study, they employed five ornamental trees presenting different fragrance types: monoterpene, syringaldehyde,  $\beta$ -ionone,

and acetic acid phenylmethyl ester were the main compounds of magnolia (*Magnolia denudata*), syringa (*Syringa oblata*), osmanthus (*Osmanthus fragrans*), and wintersweet (*Chimonanthus praecox*) and linalool was the major compound of tree peony (*Paeonia suffruticosa*), osmanthus and wintersweet. The smell-walking method (a dynamic sensory approach) was adopted for the experiment. The survey was carried out in a significant sample of students and showed that magnolia and tree peony exhibited a woody and light medicinal fragrance. Syringa had a hyacinth-like odor, osmanthus emitted a strong sweet smell, and wintersweet had a fresh



sweet smell. They found most “positive” and “pleasant” smell-scape perception in osmanthus, followed by magnolia, wintersweet, syringa and tree peony. A less pleasant perception was experienced by tree peony due to its mixed fragrance. They concluded that fragrant flowering plants had a positive impact on human emotional behavior and mental peace and sanity, while a myriad of diffusion factors of aroma and “olfactory geography” of the receptors should be integrated sensibly to achieve the best response.

### Future thrusts

From the reflections and data above, the use of ornamental plants must be considered not as a merely sparse whim and a show of luxury, but, in fact, the need-of-this-moment. The COVID-19 pandemic and the inevitable corollary of urbanization have taught us about the importance of connecting humans and nature (Nicola, 2022). The use of nature and plants as a form of therapy has been practiced for centuries. Horticulture as a therapeutic medium is increasing rapidly. It is a non-pharmacological and non-invasive therapy that includes a broad array of plants, especially the floricultural commodities (Thaneshwari et al., 2018). Healing gardens are designed for hospitals to stimulate sensory interaction between patient and the natural environment considering the right choice of plant species, flowering period, foliage color and arrangement of plants and shrubs. The use of horticulture in these approaches, apart from the undisputed benefits on human health, has led to working skills and has opened employment opportunities. Moreover, promoting the culture of flowers in our daily lives boosts the impact

of the ornamental sector in the world with subsequent economic advantages.

Taking into consideration these opportunities, several initiatives should be undertaken by society and government. First, extensive outreach programs are needed to examine the therapeutic potential of ornamentals. In addition, like vegetables and fruits, flowers need to be recognized as an essential utility commodity, not a mere adornment. Scientific studies on the use of ornamentals for ecological service and for human health should be encouraged. The results of previous scientific studies on these issues should be widely spread. Young minds should be trained to love flowers and take care of gardens. The application and implementation of natural flowers near humans should be encouraged instead of artificial lookalikes that are now common.

We note that flowers and ornamental plants not only have an impact on our mood and well-being, they also represent a €25bn global market that supports the careers of millions of people who grow, transport and sell this commodity.

When the world went into lockdown, florists were forced to close their doors. Fresh fruits and vegetables were the go-to first choice of people under lockdown. Obviously, producer and export countries of the global ornamental industries were affected by this crisis. The loss of sales was very serious in some countries like Kenya, which supplies one-third of all roses sold in the European Union. The Fairtrade Foundation described the situation in Kenya as a “humanitarian crisis” because flower farm workers were paid low wages. They were vulnerable to this sudden loss of income. Florists and growers

who specialized in events, weddings, and hospitality were also hit by this crisis. The pandemic unexpectedly caused a surge in e-commerce and an increasing interest of new generation in recognizing the benefits of nature and in buying flowers on-line. So, if on the one hand, the lockdown caused losses in the ornamental sector, on the other hand, a great opportunity for people to rediscover the benefits of flowers was initiated. This feeling towards a biophilic approach should be kept and enhanced even now that the situation has improved and the economy is recovering.

An advanced bio-medical instrument to monitor diversified physiological parameters like cortisol hormone level and changes in immunoglobulin A in presence and absence of green plants has been developed. The adoption of “biofeedback” methods (Mattson, 2010) may also be considered for successful future implementation.

Lessons have been learned from this crisis period that ornamental flora are not only related to the importance of the biophilic behavior. We saw that the ornamental sector has recovered but sustainability and resilience should be created in this productive flow for the long run. This pandemic period has triggered a discussion in the sector about diversification, local versus global supply chains, the environmental footprint of transporting flowers using planes and the vulnerabilities in the chain. These aspects should be taken into consideration besides promulgating the importance of ornamentals in human life and for the societal welfare, so that this sector can secure its position at the pinnacle.

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> Margherita Beruto

Margherita Beruto is the Chair of ISHS Division Ornamental Plants. She has expertise in plant tissue culture with particular attention to the micropropagation of ornamental plants. The studies have been carried out in close cooperation with the industry and focused on nutritional models for in vitro plant tissues through a multidisciplinary approach. From 2009 to 2021, she served as Director of Regional Institute for Floriculture, Sanremo, Italy, a public research institute whose mission is to support the growers and nurserymen involved in the floriculture sector. E-mail: margheberuto@gmail.com



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# > An invitation to the IV Asian Horticultural Congress (AHC2023) in Japan



**AHC 2023**

The 4th Asian Horticultural Congress  
Tokyo, JAPAN

August 28(Mon) – 31(Thu), 2023

[www.ahc2023.org](http://www.ahc2023.org)

**Saneyuki Kawabata**

We are delighted to announce that the IV Asian Horticultural Congress (AHC2023) will be held in Tokyo, Japan, from August 28-31, 2023.

Asia is rapidly becoming a very important region for the horticultural industry. Asia covers 30% of the world's land area and has a rich variety of climates and topography, from tropical to arctic, from coral reefs to the world's highest mountain, and a rich diversity of natural and biological resources. Sixty percent of the world's population live in this region, and as a result, the production, processing and distribution of fruit, vegetables and ornamental plants is significant. Many of these form the basis of the diverse food cultures found among the people living in the region.

The history of agriculture in Asia dates back to ancient civilizations. Asia was one of the earliest places where humans first began to cultivate plants. Along with the development of agriculture came the development of culinary traditions, such as those found in China, India, Thailand, Korea, Vietnam, Indonesia and Japan. Gardening cultures unique to Asia, most notably represented by Chinese and Japanese gardens, also developed.

The foundation for these culinary and gardening cultures is the rich diversity of plant

resources found in Asia. Of the eight centers of origin for the world's crop plants, three are in Asia: the Tropical South Asia Center, the East Asia Center, and the Southwest Asia Center. Central Asia is where many of the world's traditional horticultural crops originated.

The theme of this congress is "Heritage and innovation for future Asian horticulture". At this congress, we would like to discuss innovation and the future of Asian horticulture, while reaffirming the diverse traditions, history, development, and horticultural resources in Asia. Horticulture in the Asian region has made great strides over the past 100 years. We are now at a tipping point where innovation is needed to develop while simultaneously conserving the environment and resources for future generations. The congress will provide a platform to discuss the latest advances, new ideas, trends, experiences and research results in horticultural science.

Japan is a small country in terms of land area, but the climate varies widely, from Hokkaido in the north to Okinawa in the south. The climate ranges from subtropical to subarctic, from coastal to highlands. Taking advantage of these diverse climates, Japan has developed varieties suited to region, expanding the supply season for horticultural crops.

Japan is also rich in genetic resources for floriculture, with native ornamental plants such as hydrangeas, chrysanthemums, lilies, irises and camellias. In Edo (formerly Tokyo), citizens have enjoyed ornamental gardening for hundreds of years. This blend of tradition and high-tech is what makes Japan unique.

This congress will also provide a unique opportunity to discover Tokyo and the surrounding region. The reality, expertise and challenges facing Japanese horticulture will be described in light of both an Asian and a global context.

We would also like you to join us in celebrating the centenary of the Japanese Society for Horticultural Science (JSHS). The Japanese Society for Horticultural Science was established in 1923, with the aim of promoting horticultural research and technology. It currently has around 2,250 members. The Society publishes a quarterly English-language journal, *The Horticulture Journal* (Hort. J.), formerly known as the *Journal of the Japanese Society for Horticultural Science* (JJSHS), and a quarterly Japanese-language journal, *Engeigaku Kenkyu* (Horticultural Research (Japan)), and to date has published the findings from more than one hundred studies for Japanese and overseas audiences. These findings are of a high caliber, often being cited in



■ Figure 1. A) Yayoi Auditorium at Yayoi campus, B) Akamon Gate of Hongo campus of The University of Tokyo.



European and American scientific journals. They have contributed greatly to the development of the horticultural industry, not only in Japan, but also worldwide.

Since 2015, the Society has renamed the already internationally prestigious JJSHS to be Hort. J. to further strengthen international dissemination of information. In addition, the Society is actively engaged in research presentation and symposia in Japan, holding workshops that are regularly attended by 800-900 people, each spring and autumn. The Society brings together the expertise of all its members to further develop the integrated science of horticulture and to meet the expectations of wider society by contributing to the development of academic research and the horticultural industry. We thank our members for their continued support. We cordially invite anyone interested in horticultural education and research to become a member of the Society and to join us in our endeavors.

For and on behalf of the Executive Committee, we would like to invite you to join us for AHC2023, which will be held in Tokyo, Japan, from August 28-31, 2023. The venue for AHC2023 is the campus of the University of Tokyo.

AHC2023 will provide a great opportunity to promote the exchange of science, knowledge, and culture related to horticulture and the environment between the various countries and regions of Asia and the world. We are confident that Japan's relations with other Asian countries and regions will become closer and even more extensive in the future. ●

### > Contact

#### **AHC2023 Executive Committee**

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# AHC 2023

The 4th Asian Horticultural Congress  
Tokyo, JAPAN

[www.ahc2023.org](http://www.ahc2023.org)



August 28<sub>(Mon)</sub>-31<sub>(Thu)</sub>, 2023

Heritage and Innovation  
for Future Asian Horticulture

# › 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](http://www.ishs.org/young-minds-award).

## Distribution and major morphological traits of wild asparagus (*A. acutifolius* L. and *A. albus* L.) in Sicily



› Lucia Dinolfo

*Asparagus officinalis* L. (family: *Asparagaceae*) is the only cultivated member of the genus though many other congeners are widespread within global flora. Among these, *A. acutifolius* L. and *A. albus* L. are widely represented in the Mediterranean basin. Since ancient times, they have been used by local populations for food and medicinal purposes. The present focus on these wild

plants originates from their rediscovered use in local cuisine, the related biodiversity protection systems, and their consequent agronomic potential as new crops. Thus far no breeding program has been carried out for either species in Sicily. In view of the high potential interest of wild asparagus for cultivation and marketing purposes, exploratory research was conducted. First, a survey was carried out to determine the distribution of these two species in Sicily and to develop an ecological framework that could be the basis for additional studies. Secondly, morphological and physiological characterization of the accessions was performed to identify genotypes suitable for cultivation in semi-arid Mediterranean environments. The survey confirmed that these two species are typical of the Mediterranean maquis, found in arid areas, rocky soils, cliffs in coastal areas, roadsides, and abandoned land. Between the two species, *A. acutifolius* is relatively more ubiquitous. The data obtained from the characterization trials were subjected to multivariate statistical analysis. Significant morphological and physiological diversity was observed between the two *Asparagus*

species. In particular, they showed high dissimilarity in plant volume (22,233.81 cm<sup>3</sup> in *A. acutifolius*; 11,603.48 cm<sup>3</sup> in *A. albus*), but also in flowering and fruiting rates and in the presence of spears. Cluster analysis grouped the accessions according to potential use. The populations collected showed promising potential and can be considered a starting point to encourage breeding projects. The studied characteristics appeared to be a suitable tool to differentiate wild asparagus populations for the evaluation of genetic diversity in a semi-arid Mediterranean area. Lucia Dinolfo won the ISHS Young Minds Award for the best oral presentation at the XV International Asparagus Symposium in Spain in June 2022.

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## Conservation of dragon fruit genetic resources using seeds as well as clonal material



› Hannes Wilms

To face the future, farmers and breeders need access to a large genetic diversity. This diversity helps them to adapt to new circumstances, such as droughts by developing and planting drought tolerant varieties. This diversity has to be stored somewhere and while in

situ conservation is essential, it is in general more difficult to access and if unprotected at risk of disappearing. Gene banks therefore play an important role, providing ex situ conservation approaches such as field or seed banks. However, these gene banks face their own challenges. Field banks, on the one hand, are vulnerable to different external factors, such as storms, pests, and diseases. Seed banks, on the other hand, are not feasible for all crops because some plants, such as the coconut palm, have recalcitrant seeds, are clonally propagated, such as sweet potato and dragon fruit, or have seedless forms, such as banana. To provide a solution for these crops the Lab of Tropical Crop Improvement, Department of Biosystems, KU Leuven (Belgium) develops different conservation methods to safeguard these crops for the future. As a PhD researcher, Hannes Wilms works on the development of novel cryopreservation and micropropagation protocols for multiple tropical crops, including but

not limited to cacao, coconut, dragon fruit and sweet potato. His work led to a novel, user-friendly, droplet vitrification method for sweet potato and a patented micropropagation system for coconut palms.

Hannes Wilms won the ISHS Young Minds Award for the best oral presentation at the International Symposium on Conservation and Sustainable Use of Horticultural Genetic Resources at IHC2022 in France in August 2022.

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## Biodiversity of hot pepper germplasm from the Vegetable Research Development Station Buzau, Romania



› Ovidia Agapie

Ovidia Agapie is a junior research scientist at the Breeding and Biodiversity Department, part of Vegetable Research and Development Station Buzau, Romania. She is a PhD student at the University of Agronomic Science and Veterinary Medicine Bucharest and her thesis is entitled “Assessment of hot pepper germplasm collection from VRDS Buzau in order to obtain cultivars set by direction of use”, under the supervision of Prof. Dr. Florin Stănică. Her research is focused on the breeding and maintenance of genetic resources of hot pepper to obtain new genotypes set by directions of use.

In the last 20 years, the consumption of pepper has increased, with production ranging from 20 to 36 million tons per annum. The cultivated area has also increased by almost 35% over the last 2 decades. Further increases are expected due to the increasing demand for high-value nutritional products by consumers. Despite the positive trend, yields of pepper have steadily decreased around the world due to infections and related diseases from plant pathogens.

At the XXXI International Horticultural Congress (IHC2022), Ovidia described for the first time the large-scale morphological characterization of the hot pepper germplasm collection at the Breeding and Biodiversity Department from VRDS Buzau, Romania. For two consecutive years (2020-2021), the germplasm collection, which consists of 203 hot pepper accessions, was evaluated from an agro-morphologic and biochemical point of view. The studied accession exhibited a wide variation in both qualitative and quantitative characters. Based on agro-morphological traits and hierarchical similarity, accessions were categorized into three groups. The phenotypic variation observed for agro-morphological traits was able to estimate the diversity between genotypes, providing an important tool for the knowledge and use of accessions in several breeding programs,

including tolerance to abiotic and biotic stress. The results have demonstrated a great variability within the studied germplasm collection and the most important traits will be used in future breeding programs.

Ovidia Agapie won the ISHS Young Minds Award for the best poster presentation at the International Symposium on Conservation and Sustainable Use of Horticultural Genetic Resources at IHC2022 in France in August 2022.

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## Aggregated nanoporous microparticles for slow release of plant growth regulators and their use for in vitro tissue culture



› Saba Taheri (SeyedehSaba Taheri)

Saba Taheri is a PhD candidate in the in vitro plant biotechnology and nanotechnology laboratory at the Faculty of Bioscience Engineering at Ghent University, Ghent, Belgium. She works under the supervision of Prof. Dr. Stefaan Werbrouck and Prof. Dr. Andre Skirtach. Her research focuses on the development of a new method for the slow release of plant growth regulators (PGR) by microcarriers. PGR are essential in the tissue culture of plants. Thus far, the mechanism of delivery of these compounds is through

absorption from the growing medium. Plant tissues that are in direct contact with the medium uptake a large influx of chemical. But in many biological developmental stages, hormonal gradients in space and time play an essential role in signaling PGR activity. The problem of the in vitro system is that hormonal control is difficult or impossible to achieve with a constant supply in the medium. One solution would be to develop slow-release systems. A promising possibility is to use candidate carriers for the PGR. Mesoporous micro CaCO<sub>3</sub> particles can slowly release PGR to induce a spatial/temporal gradient in plant tissue. Saba developed aggregates of CaCO<sub>3</sub> carriers with different physical properties that could influence the PGR absorption and release profiles. Then she evaluated these particles in bioassays with model species. Now she applies them to in vitro regeneration of meristems of various plant species. Combinations of differently charged particles in the media produce a range of effects. This technique provides a fascinating associated benefit. These candidate marker systems could become a novel tool to apply PGR to resolve many types of challenges in plant biotechnology. Saba also presented a second research project to

develop integrated techniques for chimera free in vitro meristem regeneration in olive. This project was funded by the International Atomic Energy Agency in Vienna. Micropropagation and shoot regeneration of olive trees are not easy because of phenol oxidation, pronounced apical dominance, excessive callus formation, or hyperhydricity. Her studies combine promising new in vitro tools to develop improved protocols.

Saba Taheri won the ISHS Young Minds Award for the best oral presentation at the International Symposium on In Vitro Technology and Micropropagated Plants at IHC2022 in France in August 2022.

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## Molecular analysis and visualization of adventitious root formation in rose



› David Wamhoff

David Wamhoff is a PhD candidate at Leibniz University Hannover, Institute for Horticultural Production Systems, Section Woody Plant and Propagation Physiology (section head: Prof. Dr. Traud Winkelmann), studying the potential genetic reasons for differences in adventitious root (AR) formation in rose. Roses are the most valuable ornamental plants spanning multiple market segments worldwide (cut roses, garden roses, and miniature roses). However, garden and cut

roses are mainly propagated via laborious and costly methods like grafting, budding, or stenting, and not by time- or cost-saving propagation such as cuttings. This is due to the genetic differences regarding the ability to form AR. The complex process of AR formation is not fully understood and in the case of rose, genetic factors causing differences in rooting ability have not yet been identified. The aim of this project was to determine the genetic differences in AR formation by genome wide association studies (GWAS) for different formation-related traits. Moreover, molecular markers will be developed to select genotypes with the ability to form AR. This would enable breeders to improve rooting ability in roses and establish cutting propagation for all market segments. This project made use of the valuable genetic rose collections held by the Molecular Plant Breeding section at Leibniz University Hannover (section head: Prof. Dr. Thomas Debenner). For these collections, genotypic marker information based on single nucleotide polymorphisms (SNPs) of the WagRhSNP 68k Axiom® SNP array was available. Cuttings of 96 garden and 96 cut roses were phenotyped in vivo for different AR formation-related

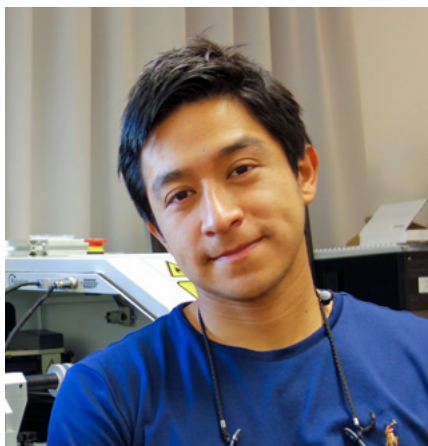
traits in 2020 and 2021. Phenotypic data was linked to the genotypic SNP data to perform GWAS. A promising SNP was identified, which showed a significant association between different AR formation traits and SNP allelic dosage. Based on these results, competitive allelic specific PCR (KASP) markers were developed. The markers will be validated in an independent rose population.

David Wamhoff won the ISHS Young Minds Award for the best oral presentation at the International Symposium on Innovation in Ornamentals: from Breeding to Market at IHC2022 in France in August 2022.

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## Stimulation of adventitious root formation by laser in rose cuttings



› Raúl Javier Morales Orellana

Wounding is a fundamental factor affecting the survival of woody cuttings for plant propagation. Adventitious rooting is directly related to mechanical damage as a result of plant detachment. In this sense, methods of manipulating wounded regions to stimulate adventitious roots have most frequently been applied to hardwood species. Our first experiments investigating the role of wounds in cutting propagation of woody species indicated that additionally injured tissue along the cutting base showed an apparent increase in rooting compared

to uninjured controls. Over time, a more detailed study of the effects of wounding on cuttings was investigated by the use of a laser as a wounding-tool. The aim of the present project was to implement laser-assisted tissue removal to study the effects of wounding on the induction of adventitious roots of leafy rose cuttings. Earlier experiments conducted with cuttings of two rose genotypes, *R. canina* and *Rosa hybrida* 'Beluga', demonstrated the laser's ability to perform a large number of wound treatments based on different marking patterns and varying levels of tissue exposure. By developing a laser wound marking protocol, specific tissue layers could be targeted in a reproducible manner, depending on the energy applied per surface and the diameter of the rose cut. Results demonstrated that wounding would induce roots when tissue damage exposed regions near the phloem without the need to expose deeper layers. Moreover, analysis showed different effects from the wounding pattern or the tissue penetration. A detailed study of root positioning showed that the laser was clearly able to stimulate root formation directly in the marked zones depending on the rose genotype. This demonstrated the potential of manipulating laser root positioning in conjunction with the presence of exogenous auxins.

The response of cuttings to laser-assisted wounding offered the opportunity to better understand the mechanism by which wounding can stimulate rooting in cuttings and will contribute to identifying the essential parameters that can improve the propagation of species by cuttings in commercial tree nurseries.

Raúl Javier Morales Orellana won the ISHS Young Minds Award for the best poster presentation at the International Symposium on Innovation in Ornamentals: from Breeding to Market at IHC2022 in France in August 2022.

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## How does far-red radiation influence the fruit set of sweet pepper?



› Sijia Chen

Sijia Chen is a PhD candidate working on the effect of light spectrum on the fruit set of sweet pepper (*Capsicum annuum* L.), at the Horticulture and Product Physiology Department, Wageningen University (The Netherlands). She studies under the supervision of Dr. Ep Heuvelink, Professor Leo Marcelis, and Professor Remko Offringa. She found that the fruit set of sweet pepper can vary

strongly under different light spectra. Far-red radiation strongly reduced the fruit set of sweet pepper grown within climate chambers. However, the underlying mechanism is unknown. Based on observations during her studies, Sijia hypothesized that the strong auxin stream from apical shoots (which causes apical dominance) may inhibit the auxin export from flowers under far-red light according to the auxin transport canalization theory. She suggested that blocked auxin export from flowers increased the sensitivity of the abscission zone to ethylene, and triggered abortion. To test this hypothesis, Sijia conducted a series of climate chamber experiments. She found that although far-red light increased fruit abortion in sweet pepper, this effect disappeared when the apices of the plants were removed. This suggested the important role of the shoot apex in mediating the effect of far-red on the fruit set of sweet pepper. However, chemically blocking the auxin basipetal stream did not restore the fruit set under the far-red condition. Thus, factors other than auxin, play a role in causing fruit abortion under far-red

light. The detailed mechanism of this effect awaits further investigation.

Sijia Chen won the ISHS Young Minds Award for the best oral presentation at the International Symposium on Advances in Vertical Farming at IHC2022 in France in August 2022.

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## Modifications of the texture of tomato purees by variety selection or by processing methods result from various physico-chemical parameters



► Miarka Sinkora

Tomato is the main horticultural crop for processing industry. Tomato puree is a source of phytonutrients such as carotenoids. Puree viscosity is a major quality trait, and industrial companies need reliable indicators of tomato fruit ability to produce viscous puree. Fruit quality is primarily assessed by measuring the soluble solid content, which is insufficient to predict puree viscosity. The choice

of the variety and transformation process are the levers for action used by industrial producers to manage the final puree viscosity. The objective of our study was to define the parameters involved in puree viscosity variations induced by variety or process. An integrative approach examining viscosity from field to can, including four varieties and two processes (cold and hot break), was conducted in 2019 and 2020. Fruits were grown in an open field, and then processed into puree following industrial methods. Several structural and physico-chemical parameters, known to be involved in puree viscosity, were measured. A partial least square discriminant analysis highlighted that viscosity variations induced by the process were due to differences in cell wall material quantity, structure, and conformation, and to differences in serum viscosity. Viscosity variations induced by the varieties were due to differences in pulp volume fraction and pulp dry matter content. Microscopic observations evidenced the agglomeration of small particles that may also contribute to puree viscosity. These results provide a better understand-

ing of the mechanisms determining puree viscosity and offer new perspectives for the development of viscosity indicators for industrials. Moreover, in a context of climate change, the knowledge of these mechanisms helps us understand how agro-environmental changes such as water deficit or temperature increase can interact and modify puree viscosity.

Miarka Sinkora won the ISHS Young Minds Award for the best oral presentation at the International Symposium on Integrative Approaches to Product Quality in Fruits and Vegetables at IHC2022 in France in August 2022.

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## Cactus pear and pitaya: fruit production and orchard management



► Milena Maria Tomaz De Oliveira

Dr. Milena Oliveira holds a PhD in Agronomy from the Federal University of Ceará (UFC), an MSc in Plant Physiology from the Federal University of Viçosa, and a BSc in Agronomy Engineering from UFC, Brazil. Currently, she is a postdoctoral researcher at Ben-Gurion University of the Negev (BGU), Israel, under the supervision of Prof. Noemi Tel-Zur. Milena has expertise in plant physiology, biochemistry, postharvest, and molecular biology for dryland agriculture. Since the completion of her PhD, she has studied *Cactaceae* species as alternative fruit crop for dryland agriculture. *Cactaceae* species such as cactus pear

(*Opuntia ficus-indica* Mill.) and pitayas (*Hylocereus* sp.) are major crops that can thrive in dry, even desert conditions, making their cultivation particularly valuable in marginal and subsistence agriculture economies. In view of their commercial exploitation under a wide range of environmental conditions that directly influence productivity and fruit quality, large crop performance differences are observed. Pitayas are native to shaded regions of the Americas with the optimum growth temperature ranging between 20 and 30°C. However, due to commercial exploitation, these species are farmed outside of their native area, in open fields under high solar radiation and high temperatures, conditions that are markedly different from their natural conditions. Milena has focused on strategies to cope with high solar radiation and high-temperature stress on several *Hylocereus* species and hybrids. During her PhD she studied the effects caused by high solar radiation on red pitaya (*H. costaricensis*), using shading as a strategy to cope with the stress, in the northeastern semi-arid region of Brazil. The results showed improved physiological performance, productivity, and postharvest quality of red pitaya under 35-50% shade. In Israel, Milena has studied the performance of several *Hylocereus* species and hybrids as a strategy for tolerance

to high temperature. The findings revealed that most of the hybrids, developed by the BGU breeding program of pitaya, performed better than their parental species, being suitable for cultivation in heat-challenging regions. Herein, knowledge of orchard management of cactus as crop is imperative to provide insight to improve yield, fruit quality, and dissemination of growing protocols, especially in dryland agriculture.

Milena Maria Tomaz De Oliveira won the ISHS Young Minds Awards for the best oral presentation at the X International Congress on Cactus Pear and Cochineal in Brazil in September 2022.

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## Mass-spectrometric determination of phyllobilins in leaves of medicinal plants and their application forms



› Lisa Marie Gorfer

In the Laboratory for Flavours and Metabolites of the Laimburg Research Centre (Autonomous Province of Bolzano, Italy), our working group is investigating the degradation products of chlorophyll in methanolic extracts of plant leaves and peels of apple fruits. These so-called phyllobilins (PB) are studied using high resolution mass-spectrometry in an untargeted approach, after

previously monitoring the content of chlorophyll and its decreasing in the samples using Ultra-Violet/Visual-spectrophotometry. The degradation of chlorophyll in higher plants is needed to avoid the accumulation of phototoxic reaction products within the plant. Once the strictly conserved degradation pathway, including all of its contributing enzymes, was clarified, it was evident that the resulting end-products could no longer be considered as simple 'waste' products. So far, plant matrices, such as apple peels and green as well as senescent leaves of medicinal plant species (e.g., *Echinacea purpurea* L. Moench, *Urtica dioica* L., *Fagopyrum esculentum* Moench) from different plant families have been screened. The focus is now detection of a special type of PB in medicinal plants, which was discovered to show bioactivity and has a remarkable biosimilarity to heme degradation products. A comparison of PB quantity in different pharmacognostic relevant plant species would be helpful for further application for human patients. In addition to the agronomic application of PB for ripening determination of apples (i.e.,

*Malus ×domestica* Borkh. 'Gala'), we seek to determine the relatedness of species within the same plant family by means of similarities in the PB pattern.

Lisa Marie Gorfer won the ISHS Young Minds Award for the best oral presentation at the International Symposium on Medicinal and Aromatic Plants: Domestication, Breeding, Cultivation and New Perspectives at IHC2022 in France in August 2022.

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## Mimicking the fruit repression effect on *Citrus* flowering through continuous gibberellic acid treatments



› Andrés Marzal

In *Citrus*, flower intensity could be partially reduced or increased by applying gibberellins (GA<sub>3</sub>) or paclobutrazol (PBZ). However, under extreme harvest conditions, very high or very low treatments of these chemicals do not have any effect. Fruit inhibits flowering by activating *CcMADS-box19* gene expression in the leaf, which blocks the inductive

signalling preventing the expression of the *CiFT3* gene. But signals that activate this repressive mechanism are unknown. The hypothesis of hormonal signalling is based on the inhibitory effect of GA<sub>3</sub> on flowering. During the cold season, i.e., when flowers are induced, fruit changes colour by reducing active GA<sub>3</sub> concentration in the flavedo. GA<sub>3</sub> is basipetally transported to the shoots and the buds. To maintain GA<sub>3</sub> concentration during the whole period of flower formation, vegetative shoots (those that always flower next season: OFF), and fruiting shoots (those that do not flower: ON) were treated weekly with GA<sub>3</sub> during the floral bud inductive and differentiation periods. Flowering gene expression was measured in leaves and buds. Continuous PBZ treatments were used to avoid GA<sub>3</sub> synthesis and promote flowering. GA<sub>3</sub> and fruit show quantitative differences in their inhibitory effect. While GA<sub>3</sub> partially reduced flowering, fruit prevented it. Fruit also prevented the promoting effect of PBZ. In our experiment, GA<sub>3</sub> treatments reduced the expression of some of the inductive and

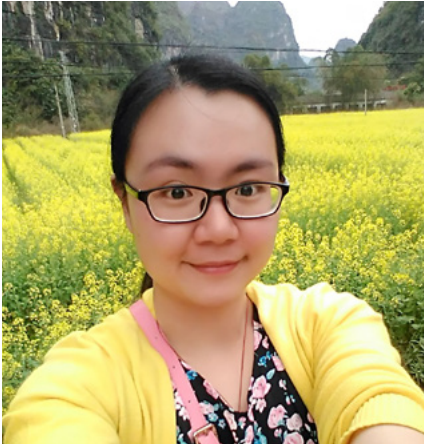
differentiation flowering genes, like *CiFT3* and *CiLFY*, but did not promote the expression of *CcMADS-19*. Besides those effects, GA<sub>3</sub> increased *CcCEN* gene expression.

Andrés Marzal won the ISHS Young Minds Award for the best poster presentation at the XIV International Citrus Congress in Turkey in November 2022.

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## Molecular regulation mechanisms of *Cymbidium sinense* leaf variegation



> Jie Gao

Dr. Jie Gao, a recent Ph. D. graduate, is an associate professor at the Environmental Horticulture Research Institute, Guangdong Academy of Agricultural Sciences, China. The objective of her study focused on the molecular regulation mechanisms of Chinese orchid, *Cymbidium sinense*, leaf variegation. The Chinese orchid is a symbol of elegance and purity in China. Among Chinese orchids, the leaf color variation of *C. sinense* is the most abundant. The leaf color variation makes *C.*

*sinense* more diversified and more valuable. However, the variegation formation process remains largely unexplored. In the present study, the proteome and phosphoproteome of *C. sinense* leaf variegation mutants were studied using tandem mass tag and liquid chromatography tandem mass spectrometry (TMT and LC-MS/MS) analysis. We identified 1,059 differentially expressed proteins (DEPs) and 1,127 differentially expressed phosphorylation sites belonging to 644 phosphoproteins (DEPPs) in the yellow section of the leaf variegation compared to the green section. Moreover, 349 co-expressing proteins were found in both omic profiles, though only 26 proteins showed the same expression patterns. The interaction network analysis of kinases and phosphatases showed that DEPs and DEPPs in photosynthesis, response to hormone, pigment metabolic process, phosphorylation, glucose metabolic process, and dephosphorylation may contribute to leaf color. Variations in the heat shock protein (HSP) family genes at the protein and phosphorylation levels may significantly affect the leaf variegation. To verify the function of the gene CsHSP70 and its phosphorylation sites, a transiently expressed method was

examined in tobacco. These results showed that the mutation of 339T and 603T sites caused a significant decrease in chlorophyll and carotenoid contents in tobacco leaves. This indicated that the 399T phosphorylation site of CsHSP70 protein plays an important role in maintaining chlorophyll content in leaves. Collectively, our current findings constructed a comprehensive view of protein and protein phosphorylation in the regulation of *C. sinense* leaf variegation, providing valuable insights into the underlying formation process.

Jie Gao won the ISHS Young Minds Award for the best oral presentation at the IV International Orchid Symposium in China in December 2022.

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## Intergeneric hybridization and unilateral compatibility caused by pollen tube growth in *Epidendrum* (*Epidendroideae*)



> Haruka Kondo

Haruka Kondo is a researcher of the Laboratory of Floriculture & Ornamentals, Chiba University, Chiba, Japan. His research focuses on orchid breeding using intergeneric hybridization. Many intergeneric hybrids of *Epidendrum* between other *Epidendroideae*, such as genus *Cattleya*, *Barkeria* and *Brasavola*, have been artificially bred. However, intergeneric hybrids or later generations are usually partially or completely sterile, which makes further breeding programs dif-

icult. This study will obtain knowledge of the success or failure of intergeneric crosses between *Epidendrum* and related genera with the aim of making new cultivars. Furthermore, Haruka focused on the unique orchid reproductive system, namely ovule development and fruit formation occurring during pollen tube growth. In the cross using *Epidendrum* as a pollen parent, high percentage of fruit set was observed in all cross combinations and plantlets were obtained from some. In the cross using *Epidendrum* as an ovule parent, the flower abscission occurred within 2-3 weeks in all cross combinations. It was found to be a unilateral incompatibility since *Epidendrum* does not form fruit in the crosses using *Epidendrum* as ovule parent. There are three possible causes of unilateral cross incompatibility: 1) inhibition of pollen germination or pollen tube stop in ovary, 2) pollen tube growth of related genera is slower than that of *Epidendrum*, 3) failure of fruit set, and ovule development caused by hormonal amount (e.g., insufficient amount of auxin, ethylene). Pollen germination and pollen tube growth of related genera was inhibited in the ovary of *Epidendrum* although the pollen tube growth in the self-pollina-

tion of related genera was equal to that of self-pollination of *Epidendrum*. Experiment of auxin treatment showed that all flowers aborted by 30 days after pollination although fruits swelled and days to flower abortion was extended. Therefore, Haruka concluded non-reciprocal intergeneric hybridization barrier is caused by pollen germination and pollen tube growth in the present study. A possible solution is stigmatic and cut-style pollination, to overcome these barriers. Haruka Kondo won the ISHS Young Minds Award for the best poster presentation at the IV International Orchid Symposium in China in December 2022.

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# ➤ Conservation techniques for dragon fruit

Hannes Wilms and Bart Panis



■ Figure 1. Dragon fruit or pitahaya sold at a market. Obtained from Paul Sableman under CC BY-SA 2.0.

Dragon fruit or pitahaya is an edible fruit of *Selenicereus*, a genus formerly known as *Hylocereus*, of the *Cactaceae* family (Korotkova et al., 2017). The fruit received its name from its bracts, which show a “dragon-like” scaly appearance (Figure 1). The genus name, meanwhile, refers to the plant’s night-time flowering habitat and growth pattern, roughly translated from Greek and Latin to mean “moon-candle” (Figure 2). This name reflects on the species characteristics that share both their night-time flowering habit, with each flower opening for only a single night, as well as their viny growth pattern. Thanks to their fragrance, size, and beauty, the flowers are often dubbed, “the queen of the night.” For example *S. megalantus* has 32 to 38 cm long creamy white flowers (Weiss et al., 1994). Of the multiple species that are cultivated, the three most important ones are *S. undatus*, *S. costaricensis* and *S. megalantus*. The former two share their red peel color but differ in pulp color, white and red respectively, while the latter has a yellow peel and white pulp.

Like many cacti, their origin lies in the tropical and subtropical regions of the Americas (Tel-Zur et al., 2004). Research suggests that this crop could have been brought into cultivation by 3400 BCE, in those regions (Colunga-GarcíaMarín and Zizumbo-Villarre-

al, 2004). While eaten for thousands of years by humans in Central and South America, outside of that region, the fruit remained unknown. It was introduced around 1860, by the French to Indochina (Tran et al., 2018). The optimal growing environment for dragon fruit requires rainfall between 1730-2540 mm per year and temperatures in the range of 20-30°C. Dragon fruit has developed a high demand and has become a major commercial fruit in Asia (Gunaseena et al., 2007). From what is now Vietnam, plant clones and fruits spread to the rest of south-east Asia. This regional popularity has led Vietnam, now the largest producing country in the world, to set up multiple plantations with an estimated 55,000 ha in 2019 (Research and Markets, 2022). This is estimated as more than 50% of the world production. Aside from fruit production, the plant is grown for its ornamental value in home gardens, especially for its flower (Figure 2).

The pitahaya plant is one of the vine cacti. In nature, it uses rocks or trees as support for its growth, growing like a liana. In plantations, this support is provided by wooden or concrete trellises (Figure 3). The vines are guided up on the pole, up to a platform around eye height. At that height it is topped causing branching of multiple new vines that grow horizontally over the platform

and back down (Figure 3). This is done to prevent the use of ladders during harvesting. These posts are spaced 3×3 m with 4 cuttings per pole. As such, farmers can grow more than 4000 plants ha<sup>-1</sup>, which if grown in full soil, can be kept there for 20 years before the plants need to be replaced (Gunaseena et al., 2007; Tran et al., 2018).

The plant is clonally propagated via cuttings that are planted in the soil. This way, harvesting can occur in the second year after planting and the fruit retains the taste, color, and other characteristics consistent with the mother plant. Flowering is triggered by the lengthening of days and is sometimes induced using supplemental lighting. When triggered, the flowering season lasts for several months, but any one flower opens only for a single night. This causes the plant to rely on effective pollinators such as moths and bats (de Almeida et al., 2013). After pollination, fruit ripening requires 25 days. Self-pollination is cultivar dependent; some cultivars need cross-pollination for fruit development.

When ripe, the fruit averages between 15-22 cm in length and 350 to 450 g in weight. Underneath its leathery scales, a sweet white or red pulp is filled with hundreds of



■ Figure 2. Hannes Wilms on one of his nightly visits to observe dragon fruit flowers in the greenhouses in Leuven, Belgium.



■ Figure 3. Small pitahaya plantation. Obtained from Ramon FVelasquez under CC BY-SA 3.0.

edible 1 mm-sized seeds (Figure 4), similar in size to those of kiwifruit. The fruit is low in calories, rich in vitamins, such as thiamin, riboflavin, and ascorbic acid, and contains natural colors that can be extracted for making dyes (Ibrahim et al., 2018). Research has been initiated related to the nutritional values and potential medicinal properties of the fruit, with >130 publications in the Web of Science over the past two years. The fruit is mostly eaten raw, but can also be added to smoothies, used for making wine, or in yoghurt. However, because its shelf life at ambient temperature is limited, correct storage procedures using cold temperature or controlled environment were developed to export the fruits and reach global markets (Ho et al., 2021).

While the fruit was virtually unknown in Europe before the 1990s, its popularity has grown (Le Bellec et al., 2006). As new markets

open, more countries are researching the viability of dragon fruit farming or setting up breeding programs (Tel-Zur, 2015; Wakchaure et al., 2021). These breeding schemes are essential because farmers need plants adapted to their environment. Consumers appreciate new flavors from these new markets. Not only professionals are interested in the fruit. A new influx of many hobby growers is active. This influx is apparent from the many YouTube channels talking about growing, grafting, and caring for dragon fruit plants, and the number of views for these channels and videos.

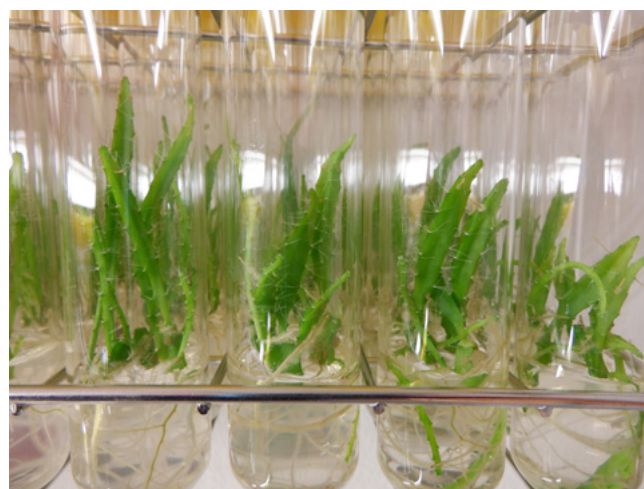
However, breeders and farmers need access to the widest possible pool of genetic resources, either collected from the wild or from other farmers. Genebanks play an important role because they can act as a centralized storage facility of diversity, besides characterizing and distributing their material. Multiple field genebanks (Tel-Zur, 2022), research collections, and botanical gardens, such as the genebank affiliated with the Ben Gurion University, Israel, already exist. Field genebanks have short-term benefits because germplasm can be evaluated, and cuttings can easily be provided. However, these banks are also exposed to the environment, so pests and diseases can potentially infest these fields. Additionally, field space is demanding. For a safe long-term conservation, complementary clonal storage methods such as *in vitro* storage or cryopreservation are being established. These back-up methods require less space and can be used to remove viral infections (Helliot et al., 2002). Seed storage is also a possibility to store germplasm. While this is practical due to their small size and putative orthodoxy, seeds are a result of outcrossing. Offspring are uncharacterized. Seeds are excellent for storing diversity, or the result of crosses that have yet to be screened, but are less valu-

able for farmers who need known characterized clonal material for their production. The Laboratory for Tropical Crop Improvement, Department of Biosciences, KU Leuven, Belgium, is specialized in the conservation of tropical crops, having years of experience in hosting the world banana bank and developing plant cryopreservation protocols for a wide range of plant species (Panis et al., 2020; Wilms et al., 2019, 2020). Our laboratory is researching complementary options to combat the problems that dragon fruit field banks are facing. With the help of several MS students and researchers, we successfully propagated *in vitro* cultured plant material from our partner, the Botanical Garden of Meise, Belgium, who provided initial sterile stock (Figure 5). This *in vitro* material was further grown and sub-cultured monthly while some material was set aside and was not sub-cultured. Both materials were kept in the plant growth room at 26°C under a 16/8 h light/dark regime. The non-sub-cultured material could be stored for up to 6 months in these conditions, whereafter small cuttings could be made that rooted quickly (Figure 5). *In vitro* conservation uses material that is smaller compared to the field cuttings, but is free from pests and diseases. Additionally, this plant material is safer and easier to transport across international borders.

After we succeeded in executing our *in vitro* initiation, subsequent conservation, and micropropagation, we attempted long term conservation via cryopreservation. Cryopreservation conserves biological materials at ultra-low temperatures, mostly -196°C, the temperature of liquid nitrogen. At this temperature neither physical, chemical, nor metabolic processes take place, making storage for decades or centuries possible. For each tissue, plant species, or even cultivar, a suitable cryopreservation protocol needs to be established. Though cryopreservation of

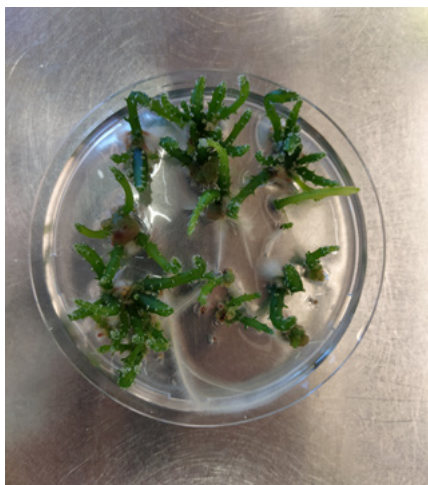


■ Figure 4. A cross section of a white fleshed dragon fruit. Obtained from Maja Dumat under CC BY 2.0.



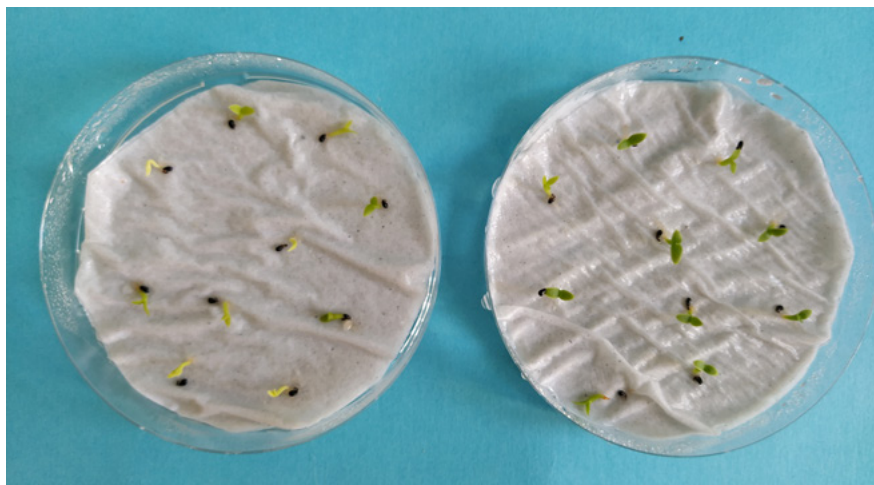
■ Figure 5. Dragon fruit plantlets grown *in vitro*.





■ Figure 6. Dragon fruit shoots cryopreserved via droplet vitrification.

Cactaceae has not been previously reported, our initial studies obtained post-cryopreservation regeneration rates ranging between 0 and 90%, depending on the experiment. We used the droplet vitrification protocol on meristems excised from in vitro shoots (Figure 6). We are currently standardizing and optimizing the cryopreservation protocol to



■ Figure 7. Germinating dragon fruit seeds after storage.

reach acceptable regeneration rates for all dragon fruit accessions. Finally, we tested whether dragon fruit seeds were orthodox, recalcitrant, or showed an intermediate storage behavior. We stored the seeds at room temperature, in the fridge (7°C) and freezer (-20°C) and showed that after 6 months of storage, the seed germi-

nation rate remained >90%, independent of the storage temperature (Figure 7). Longer conservation periods are now being tested. With our experiments, we want to provide dragon fruit germplasm curators and breeders with different options to store their valuable germplasm safely for future generations. ●

## › About the authors



› Hannes Wilms

Hannes Wilms has been working as a PhD researcher at the Laboratory for Tropical Crop Improvement at KU Leuven, Belgium, for the past five years. There he studies the conservation and in vitro multiplication of different tropical crops such as cassava, coconut, dragon fruit, oil palm, and sweet potato, which lead to the development of different cryopreservation protocols and a patented novel shoot multiplication system for coconut. Besides his primary research, he trains multiple master students on in vitro conservation. E-mail: hannes.wilms@kuleuven.be



› Bart Panis

Bart Panis obtained his PhD in 1995, at KU Leuven, Belgium, where he was involved in cryopreservation and the development of embryonic cell suspensions, protoplast culture and techniques for genetic engineering of banana. As postdoctoral researcher, and later as research manager, he coordinated different international projects dealing with plant biotechnology and cryopreservation. In 2013, he started working for The Alliance of Bioversity International and CIAT and developed the world's largest banana cryobank. Major achievements are the development of a novel plant cryopreservation protocol (i.e. droplet-vitrification) and a novel and patented micropropagation protocol for coconut. He is currently a member of the editorial board of CryoLetters and Associate Editor of PCTOC. He trained more than 150 researchers from all parts of the world on plant tissue culture and cryopreservation, and developed cryopreservation protocols for about 50 plant species. He has published more than 400 contributions, resulting in an h-index of 32. E-mail: bart.panis@kuleuven.be



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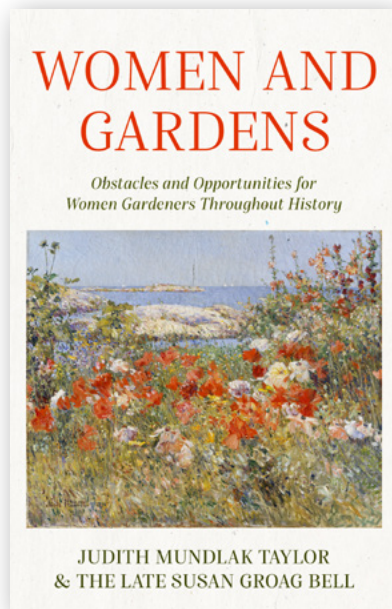


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Taylor, J.M., and Groag Bell, S. (2021). *Women and Gardens. Obstacles and Opportunities for Women Gardeners Throughout History* (Taylorhort Press). pp.302. ISBN 978-0578942476 (paperback).

The book focuses on women's relationship with horticulture over the centuries and their natural belonging to this sector thanks to the parallelism between nature and fertility. It also highlights how women have, throughout history, been penalized by male hegemony, which has relegated them to humanistic cultural activity and kept them away from the ambit of science. Horticulture has multidisciplinary characteristics and combines the artistic-humanistic aspects with scientific knowledge and applications. This concept is well expressed by the authors who retrace the origin of the relationship between horticulture and women

which began with the care of the home and the health of relatives and evolved into the figurative arts and writing. Only in relatively recent times women have forayed into science and in the technological applications of the horticultural sector.

Therefore, the first link women had with horticulture was related to survival (the use women made of plants as food and medicine). Women were able to expertly combine the care of plants for ornamental purposes with practical uses. In the Renaissance period, the division between scientific and humanistic culture relegated women to a passive role that excluded them from science which was reserved for men. The authors recall how many female figures have distinguished themselves in the creation of drawings relating to horticultural species used in many specialist books in the sector and how, subsequently, they have been active in encouraging the birth of gardening schools. Unfortunately, these roles were often unrecognized, underestimated, and reserved only for the upper classes of society. The book reports that many female founding mothers have not been appropriately evaluated, often due to the greater prominence given to the male figures with whom they worked. Women were heavily penalized from the possibility of introducing new species (a fundamental aspect in ornamental horticulture) because they could not dispose of their money and could not travel to countries where males could go to import unknown plants to acclimatize in parks and gardens. The inclusion of women in teaching programs or in horticulture associations with important positions is a relatively recent occurrence (mid-late 1800s), and of variable impact according to the country. The countries in which women's right to vote was obtained presented a great-

er openness to recognize an active role for women in horticulture.

Though a significant gallery of women performed horticultural activities, the scarce access that women have historically been known to have in the sector, is indicated in the book. At the same time, this book underlines important figures who, despite the prejudices of the time, were able to establish themselves in a field considered purely male. The book also indicated that women often performed jobs of importance for the sector but remained in the shadow of men, due to the limited access they had to the sciences and related careers. The authors cited studies to show that there is no gender difference for intellectual performance in the field, and therefore the notion that certain subjects (such as landscaping) are the prerogative of men should be eradicated. Women have always played an active role in various production and postharvest activities of horticultural crops. The number of women engaged in horticulture has increased continuously not only in manual tasks. Women are now entrepreneurs and scientists who actively contribute to the field. Women, given the chance and thanks to their natural propensity towards interdisciplinarity connectivity, could have increased success for the horticulture sector throughout history. To face today's various challenges, a transverse approach involving the interaction of different sectors and multiple genders, is needed. Therefore, today we are witnessing a greater representation of women in horticulture. We hope that this trend will increasingly assert itself, with a particular thought for women who struggle to defend their freedom or are denied credit for their success.

*Reviewed by Margherita Beruto,  
Chair of ISHS Division Ornamental Plants*



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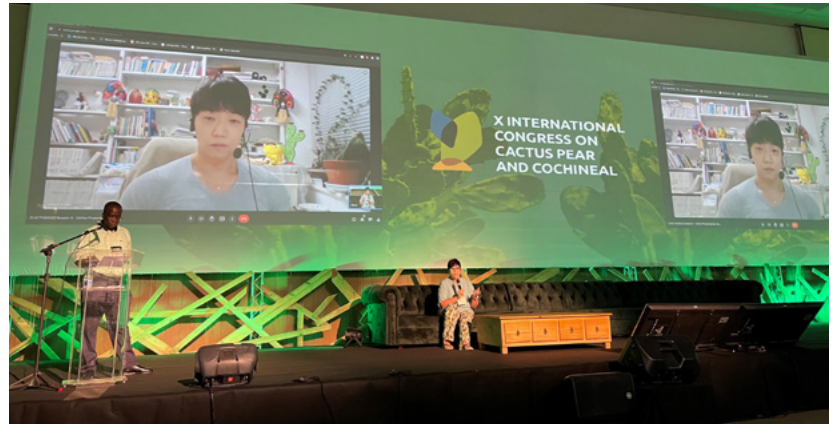
# > X International Congress on Cactus Pear and Cochineal

Division Temperate Tree Fruits

#ishs\_dfru



> Opening session.



> Hybrid format during the scientific sessions.

Drylands cover 40% of global terrestrial area and 30% of human population. Cactus pear is a viable crop with a multitude of uses and it is adapted to these regions. From September 26-29, 2022, the X International Congress on Cactus Pear and Cochineal was held in João Pessoa, Paraíba State, Brazil. The congress was organized by the FAO-ICARDA CACTUS-NET professional network that includes 716 members from more than 70 countries. The

theme for this edition was “Cactus: The New Green Revolution in Drylands.” The convener was Mr. Mario Borba, President of FAEPA, and Dr. José Dubeux from the University of Florida led the scientific committee. The meeting was organized in a hybrid format (online and in-person) with 326 attendees. The congress addressed multiple areas of cactus production, ecology, and utilization. This congress was organized in seven ses-

sions including genetic resources and breeding of cacti, cactus use as fodder and energy, ecophysiology of *Cactaceae* and its role in future agroecosystems, fruit and nopalito<sup>1</sup> production, agro-industrial uses of cactus crops and cochineal products, advances in biochemical characterization and pharmaceutical uses of cactus crops, and management of pests and diseases of cactus crops. The congress received 144 abstract submis-



> Social dinner with invited speakers and organizing committee.

<sup>1</sup> Editor's note: “Nopalito” is a dish made with diced nopales, the naturally flat stems, called pads, of prickly pear cactus (*Opuntia*).





► Dr. Maria Loreto Prat del Rio, Chair of ISHS Working Group Cactus Pear and Cochineal, presenting the ISHS Young Minds Awards to A) Milena Oliveira (best oral presentation) and B) Kenneth Oduor (best poster presentation).

sions from 16 countries. Subsequently, 78 manuscripts were accepted for publication in *Acta Horticulturae* issue 1343. Thanks to the exceptional effort of the organizers and the ISHS, papers were made available as open access. For the first time, the proceedings were published by the congress date. Dr. Milena Oliveira from Ben-Gurion University of the Negev, Israel, received the ISHS Young Minds Award for the best oral presentation entitled “Cactus pear and pitaya: fruit production and orchard management.” Mr. Kenneth Oduor from the University of Florida, USA, received the ISHS Young Minds Award for the best poster presentation entitled “Optimization of biogas production from cactus *Opuntia* spp. feedstock by use of cattle manure.” During the congress, there were invited speakers, oral, and poster presentations, and a field visit to cactus production

farms and the National Institute of Semiarid (INSA). During the meeting, there were several stands displaying cactus recipes, research highlights, and recent technology on cactus production and utilization, including a prototype of a cactus harvesting machine. ●

José C.B. Dubeux, Jr. and  
Mércia V.F. dos Santos

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► Field demonstration of cactus harvesting machine.

## ► VIII International Symposium on Edible Alliums

Division Vegetables, Roots and Tubers

#ishs\_dveg

The VIII International Symposium on Edible Alliums was due to be held from May 24-27, 2021, in Pula, Croatia. However, due to travel and other restrictions that were imposed by the COVID-19 pandemic, the symposium was held as a virtual event from May 23-25, 2022. The symposium was organized by the Institute of Agriculture and Tourism under the aegis of the International Society for Horticultural Science (ISHS). The convener of the symposium was Dr. Smiljana Goreta Ban. The symposium programme included two invited keynote lectures and 37 oral presentations organized in five sessions: 1)

Biodiversity, genetic resources, genomics, and transcriptomics; 2) Production technology, crop management and organic farming; 3) Plant (eco)physiology and propagation; 4) Pest and disease management; 5) Quality and postharvest technology. Allium is a taxonomically complicated genus with more than 750 species, and approximately 60 taxonomic groups at subgenera, sectional, and subsectional ranks. The origin of the *Allium* spp. is still a mystery and many botanists doubt that *Allium cepa* L. exists as a wild plant. Domestication of Alliums occurred more than 4000 years ago. Currently

Allium is widely distributed all around the world. Allium is one of the most important vegetable crops in the world and includes onions, garlic, leek, bunching (spring) onion, different types of shallots and potato onions, listed cultivars, old landraces, ecotypes, and spontaneous hybrids. The main objective of this symposium was to give scientists from around the world an opportunity to discuss the current trends in research, production, processing, and marketing of Allium crops. In the first invited lecture, Dr. Masayoshi Shigyo presented “Recent advances and future challenges for a multi-omics analy-

sis pipeline as a breeding tool in the Allium research community". Dr. Shigyo introduced the multi-omics approach as a tool for enabling detection of associations between phytochemical content, gene expression and specific genome regions for targeting Allium breeding towards disease and pest control. The second invited lecture was given by Dr. Rina Kamenetsky-Goldstein. This paper focused on "Strategies for garlic breeding: challenges and achievements". She highlighted that novel methods of genome editing and marker-assisted breeding were not yet available for garlic. Consequently, fertility restoration, hybridization, and seed

production were the most important goals for future breeding programs. Traditional techniques including cleaning from viruses and diseases and in vitro propagation of outstanding varieties can improve existing garlic cultivars. During the symposium, participants from all over the world presented their research, highlighting the need a) to introduce new molecular breeding techniques to improve existing and develop new cultivars of Allium crops; b) to improve production technology to increase crop climate resilience while obtaining high yield and product quality; c) to improve pest and disease management in



> Iva Bažon, winner of the ISHS Young Minds Award for the best oral presentation.



> A puzzle of the presenters and presentations from the VIII International Symposium on Edible Alliums held as a virtual meeting from May 23-25, 2022.

organic and conventional crops by introducing new compounds and forecasting models; and d) to develop new materials and technologies to maintain product quality and shelf-life.

Regardless of the limitations caused by the need to hold a virtual event, the VIII International Symposium on Edible Alliums successfully gathered scientists from all around the world. The proceedings of the symposium will be published in *Acta Horticulturae* after editorial review.

To select the most promising young scientists for the ISHS Young Minds Awards, a special committee was established. The award for the best oral presentation was given to PhD student Iva Bažon from the Institute of Agriculture and Tourism for her presentation entitled "The bulb morphological traits of Croatian garlic (*Allium sativum* L.) genetic resources". No poster award was presented. The next symposium, IX International Symposium on Edible Alliums, will be held in 2025, in Bogor, Indonesia. Dr. Masayoshi Shigyo was re-elected by the majority of ISHS members as Chair of ISHS Working Group Edible Alliums.

*Smiljana Goreta Ban and Nikola Major*

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From the  
Secretariat

# > New ISHS members

ISHS is pleased to welcome the following new members:

## New Individual Members

**Australia:** Dr. Roberta De Bei, Dr. Claudia Gonzalez Viejo, Dr. Oluyoye Idowu, Ms. Deidre Jaensch, Ms. Alison Lu, Ms. Brittany Oswald, Dr. Soumi Paul Mukhopadhyay, Mr. Daniel Polson, Dr. Tonya Wiechel; **Belgium:** Dr. Maarten Ameye, Dr. Ellen De Keyser, An Decombel, Dr. Qianyan Han, Ms. Xindan Li, Ms. Alexandra Ty, Rune Vanbeylen; **Bulgaria:** Prof. Dr. Diyan Georgiev, Assist. Prof. Georgi Popski; **Canada:** Mr. Talal Asif, Camille Boucher, Dr. Gale Bozzo, Ms. Danielle Buklis, Robab Mahmoudi, Mr. Charles Parent, Amanda Trommelen, Alberto Zárate Carbajal; **Chile:** Dr. Guillermo Pascual Aburto; **China:** Dr. Zhe Chen, Prof. Dr. Ningbo Cui, Jinlong Dong, Dr. Wensheng Fang, Quanjuan Fu, Jie Gang, Dr. Qingli Han, Yi Hong, Sen Hou, Duyue Li, Xiang Meng, Dr. Muhammad Sajjad, Ms. Yunlian Song, Yue Tan, Lili Wan, Assist. Prof. Jiawei Wang, Dr. Jing Wang, Dr. Siwei Wang, Xiaonan Wang, Prof. Dr. Xiaorong Wang, Yan Wang, Dr. Zheng Wang, Mr. Zhuang Wen, Assoc. Prof. Dongdong Yan, Ms. Fafa Yan, Dr. Xiao Yang, Prof. Qiong Yao, Assoc. Prof. Dongdong Zhang, Can Zhao, Mr. William Zhou; **Chinese Taipei:** Wen-Shi Tsai; **Costa Rica:** Mr. Freddy Gamboa Quirós; **Croatia:** Dr. Ines Pohajda; **Czech Republic:** Dr. Stacy Denise Hammond Hammond; **Denmark:** Jesper Jorgensen; **Finland:** Anu Koivisto, Dr. Priscille Steensma; **France:** Cédric Abriat, Dr. Stéphanie Arnoux, Dr. Erick D.M. Campan, Juliette Chevalier, Ms. Marwa Jallouli, Mr. Vincent Richert, Dr. Cindy Torres; **Georgia:** Mr. Matias Eduardo Avendano Ceballos; **Germany:** Ms. Xue An, Lea Boeckstiegel, Mr. Samuel Elolu, Dr. Leila Fazlikhani, Tanja Harrass, Marius Hobart, Tuany Gabriela Hoffmann, Dr. Renate Loewe, Reinhard Meier, Mr. Timo Strack, Markus Szoegi, Mr. Muhammad Tayyab, Dr. Jens Weyen; **Greece:** Assist. Prof. Helen Kalorizou, Assist. Prof. Panagiotis Madesis; **Hungary:** Prof. Dr. Károly Hrotkó; **India:** Dr. Pratheepa M, Ms. Pooja Rawat, Assist. Prof. Arun Sharma; **Iran:** Ms. Aida Shomali; **Iraq:** Aven Ahmed; **Ireland:** Prof. Jorge Oliveira; **Israel:** Ms. Abiola Owoyemi; **Italy:** Dr. Donata Arena, Mr. Jahan Zaib Ashraf, Debora Bagattini, Paola D'antonio, Ms. Poonam Devi, Dr. Erica Di Pierro, Ms. Petra Engel, Dr. Marta Ferrati, Ms. Carmen Fidalgo-Illesca, Assoc. Prof. Matteo Francavilla, Mr. Andrea Giovannini, Assoc. Prof. Lorenzo Guerrini, Dr. Nour Jouni, Dr. Iuliia Khomenko, Dr. Arash Khosravi, Dr. Mauro Lo Cascio, Ms. Silvia Locatelli, Dr. Valentina Melini, Dr. Soraya Mousavi, Dr. Michele Pedrotti, Dr. Francesco

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# > In memoriam

## Omer Verdonck (1942-2022)



Many within ISHS, especially those linked to the former Commission Plant Substrates and Soilless Culture, will be saddened to learn of the passing of Dr. Ir. Omer Verdonck, a pivotal figure within the Society, and whose life and times were recounted very recently in *Chronica Horticulturae* 61 (2), 5–6 (<https://www.ishs.org/chronica-horticulturae/vol61nr2>). Dr. Verdonck chaired the former Commission Plant Substrates and Soilless Culture twice: from 1982 to 1994, and from 1999 to 2006, when I had the privilege to follow in his footsteps.

Dr. Verdonck referred to his early life and his interest in horticulture from an early age in that *Chronica* article. His studies at the University of Ghent under the auspices of Professor M. de Boodt from 1960 to 1965 led to the award of his Masters degree, followed in 1974 by the award for his PhD thesis entitled “Bijdrage tot de studie van de bodemfysische en fysico-chemische eigenschappen van tuinbouwsubstraten (Study of physical and physicochemical soil properties of horticultural substrates).” From his thesis and other work within the Soil Physics laboratory at the University of Ghent, a series of technical papers emerged on the physical properties of substrates, many of which are routinely referenced by current researchers. Dr. Verdonck was among the first to address the methodology of analysis of soilless media, effectively developing procedures that reflected the necessity of distinguishing measurement of the properties of soilless media from those of soils. Indeed Dr. Verdonck and his colleagues pioneered and developed procedures for physical analysis of substrates, paving the way for developments in this critical area of substrate research. Furthermore, Dr. Verdonck and his colleagues were among the first to consider a range of materials in addition to those of peat as potential substrates for use in growing media, including bark, coir, composted materials, and sludges.

His papers given at meetings of the Working Group then titled ‘Substrates other than soils in situ’ reflect these advances, particularly in the physical aspects of substrates. Subsequent papers with Professors Cappaert and de Boodt from the University of Ghent are among the most widely quoted in the sphere of soilless cultivation (e.g. De Boodt and Verdonck, 1972). Dr. Verdonck was one of the first to initiate and report on ‘ring trials’ between laboratories in an effort to standardise procedures and working practices: work that subsequently proceeded for many years within the Working Groups on Growing Media and Standardisation of the former Commission Plant Substrates and Soilless Culture.

Throughout his research and development of methods, Dr. Verdonck saw his work as primarily of technical importance, which is reflected within his many publications in *Acta Horticulturae*. Indeed Dr. Verdonck put his technical knowledge of substrates to good use in moving from Head of Horticulture Soil Science at the University of Ghent to becoming a consultant with the primary role of evaluating the quality of substrates, a role he undertook from 1986 until his retirement in 2012.

Dr. Verdonck’s chairmanship from 1982 to 1994 of the former Commission Plant Substrates coincided with challenges both within the Commission itself and indeed the Society as a whole. Prior to his chairmanship, within the world of Substrates and Soilless Culture, both the ISHS Commission Plant Substrates and the International Society of Soilless Culture (ISOSC) existed as separate entities, sometimes without coordination leading to potential participants having to make a choice between either symposia of ISHS or that of ISOSC. Along with others, Dr. Verdonck maintained dialogue with ISOSC that ultimately led to a fusion with the Commission Plant Substrates of ISHS, and eventually to an abridged title of Commission Plant Substrates and Soilless Culture (subsequently merged with Protected Cultivation to form the ISHS Division Protected Cultivation and Soilless Culture).

However, even more significant threats arose towards the end of Dr. Verdonck’s initial tenure as Commission chair. Difficulties arose during the transition period of ISHS management in 1994 when Omer Verdonck stepped in as an interim Executive Director for one year. It is no exaggeration to state that the future of the Society was at stake during that period. Dr. Verdonck was closely

involved in the subsequent move of the Society’s administrative centre to Leuven where it continues to this day.

During Dr. Verdonck’s second period as Commission chair (1999 to 2006), firm links with the International Peat (now International Peatland) Society (IPS) were established, partly in attempts to coordinate symposia to minimise overlapping but also because of common areas of interest. From an ISHS perspective, Dr. (now Professor) Jean-Charles Michel from the University of Angers pioneered this initiative via dialogue with Dr. Gerald Schmilewski of Klasmann-Deilmann – then chair of the IPS Horticultural Peat Working Group and latterly President of IPS – which resulted in the first agreement between the two societies. The aim of this cooperation was the co-organization of international symposia in the field of growing media. Drs. Norman Looney, former ISHS President, and Markku Mäkelä, former IPS President, formally signed the first agreement of collaboration at the ISHS International Symposium on Growing Media in Angers in 2005, and this very successful cooperation continues (Michel, 2018).

In recognition of his contribution for over 40 years of membership and service to ISHS, Omer Verdonck was elected as an Honorary member of the Society in 2014. Some thirty years ago, I remember being approached by Omer to stand for Chair of one of the ISHS Commission working groups and greatly valued his support thereafter. On behalf of ISHS I’d extend the Society’s condolences to Colette and his family.

*Bill Carlile, former Chair, ISHS Commission Plant Substrates and Soilless Culture (with thanks to Gerald Schmilewski)*

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# > Calendar of ISHS events

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

## Year 2023

- April 18-21, 2023, Molfetta (Italy): **XI International Symposium on Artichoke, Cardoon and their Wild Relatives**. Info: Prof. Giancarlo Colelli, Dip. DAFNE Università di Foggia, Via Napoli 25, 71100 Foggia, Italy. Phone: (39) 320 4394535, E-mail: giancarlo.colelli@unifg.it or Prof. Antonio Elia, Dip. DAFNE - University of Foggia, via Napoli, 25, 71122, Foggia, Italy. Phone: (39)0881589237, E-mail: antonio.elia@unifg.it E-mail symposium: info@artichoke2023.org Web: <http://artichoke2023.org>
- April 24-27, 2023, Murcia (Spain): **III International Symposium on Beverage Crops**. Info: Rocio Gil Muñoz, Avda Ntra Sra de la Asunción N24, 30520 Jumilla, Spain. E-mail: mariar.gil2@carm.es or Prof. Dr. Encarna Gómez-Plaza, Universidad de Murcia, Fac. Veterinaria, Dep. Tecnología Alimentos, Campus Espinardo, 30071 Murcia Murcia, Spain. Phone: (34) 868887323, E-mail: encarna.gomez@um.es or Prof. Dr. Cristina Garcia-Viguera, Phytochemistry & Healthy Foods Lab (LabFAS), Dept Food Science Technology CEBAS-CSIC, Campus Espinardo 25, Espinardo, 30100 Murcia, Spain. Phone: (34) 968396200, Fax: (32)9686213, E-mail: cgviguera@cebas.csic.es Web: <https://www.bevcrops23.es/>
- May 7-12, 2023, Davis, CA (United States of America): **VIII International Symposium on Almonds and Pistachios**. Info: Dr. Louise Ferguson, 2037 Wickson Hall, Plant Sciences Department Mail Stop II, UC Davis 1 Shields Ave. Davis CA 95616, United States of America. Phone: (1) 559 737 3061, Fax: (1) 530 752 8502, E-mail: lferguson@ucdavis.edu or Dr. Thomas M. Gradziel, Department of Pomology, University of California, 1 Shields Avenue, Davis, CA 95616-8683, United States of America. E-mail: tmgradziel@ucdavis.edu or Bruce Lampinen, Dept of Plant Sciences, University of California, 1 Shields Avenue, Davis, CA 95616, United States of America. E-mail: bdlampinen@ucdavis.edu Web: [https://ucanr.edu/sites/Almond\\_Pistachio\\_2021/](https://ucanr.edu/sites/Almond_Pistachio_2021/)
- May 14-16, 2023, Wageningen (Netherlands): **XII International Symposium on Postharvest Quality of Ornamental Plants**. Info: Prof. Dr. Ernst J. Woltering, Wageningen UR, Food and Biobased research, PO Box 17, 6700 AA Wageningen, Netherlands. E-mail: ernst.woltering@wur.nl or Rob Schouten, Wageningen University, Horticulture and Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands. E-mail: rob.schouten@wur.nl Web: <https://www.wur.nl/en/show/Postharvest-Unlimited-Conference-Postharvest-Ornamentals-Symposium.htm>
- May 14-17, 2023, Wageningen (Netherlands): **VII International Conference Postharvest Unlimited**. Info: Prof. Dr. Ernst J. Woltering, Wageningen UR, Food and Biobased research, PO Box 17, 6700 AA Wageningen, Netherlands. E-mail: ernst.woltering@wur.nl or Rob Schouten, Wageningen University, Horticulture and Product Physiology, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands. E-mail: rob.schouten@wur.nl Web: <https://www.wur.nl/en/show/Postharvest-Unlimited-Conference-Postharvest-Ornamentals-Symposium.htm>
- May 15-19, 2023, Uvero Alto, La Altagracia (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 E-mail symposium: xpineapple2020@gmail.com Web: <http://www.cedaf.org.do/eventos/xpineapple2020/>
- May 21-25, 2023, 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 or Prof. Li Tianhong, No. 2 Old Summer Palace West Road, Haidian District, Beijing, China. E-mail: lith@cau.edu.cn or Assoc. Prof. Guohua Yan, Jia 12, Xiangshanruiwangfen, Beijing, China. E-mail: bigjohn6524@hotmail.com E-mail symposium: cherrysymposium9@126.com Web: <http://2021.cherries.org.cn/>
- May 22-24, 2023, Chengdu (China): **VertiFarm2023: II International Workshop on Vertical Farming**. Info: Prof. Dr. Qichang Yang, 211, IEDA, CAAS, 12#, Zhongguancun South Street, Haidian District, Beijing City, 100081, China. Phone: (86)010-82105983, Fax: (86)010-82106021, E-mail: yangqichang@caas.cn Web: [https://vertifarm2023.scimeeting.cn/en/web/index/16975\\_](https://vertifarm2023.scimeeting.cn/en/web/index/16975_)
- June 6-8, 2023, Almeria (Spain): **X International Symposium on Soil and Substrate Disinfestation**. Info: Dr. Miguel de Cara, IFAPA-Centro La Mojonera, Camino San Nicolás, 1, 04745. La Mojonera, Almería, Spain. Phone: (34)671532026, Fax: (34)950558055, E-mail: franciscom.cara@juntadeandalucia.es Web: <http://sdalmeria2023.com>
- June 11-15, 2023, Quebec City (Canada): **I International Symposium on Growing Media, Compost Utilization and Substrate Analysis for Soiless Cultivation**. Info: Prof. Dr. Jean Caron, Dep Soil Sciences and Ag Engineering, Université Laval, Pavillon Environtron, 2480 Boul Hochelaga, Quebec, QC G1V 0A6, Canada. Phone: (1)4186562131, Fax: (1)4186563723, E-mail: jean.caron@fsaa.ulaval.ca or Prof. Dr. Jacynthe Dessureault-Rompré, 2480 boul Hochelaga, Quebec, Canada. E-mail: jacynthe.dessureault-rompre@fsaa.ulaval.ca Web: <http://www.re3-quebec.org/en>
- June 11-14, 2023, Potsdam (Germany): **VII International Symposium on Applications of Modelling as an Innovative Technology in the Horticultural Supply Chain - Model-IT 2023**. Info: Dr. Pramod Mahajan, Leibniz-Institut für Agrartechnik und Bioökonomie e.V. (ATB), Max-Eyth-Allee 100, D-14469 Potsdam, Germany. E-mail: pmahajan@atb-potsdam.de or Dr. Martin Geyer, Inst. for Agricultural Eng. and Bioeconomy, Dept. Horticultural Engineering, Max-Eyth-Allee 100, D-14469 Potsdam, Germany. Phone: (49)3315699610, Fax: (49)3315699849, E-mail: mgeyer@atb-potsdam.de or Dr. Manuela Zude-Sasse, Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Max-Eyth-Allee 100, 14469 Potsdam-Bornim, Germany. Phone: (49)3315699612, Fax: (49)3315699849, E-mail: mzude@atb-potsdam.de E-mail symposium: model-it2023@atb-potsdam.de Web: <https://model-it2023.atb-potsdam.de>
- June 11-15, 2023, Zhengzhou, Henan (China): **VII International Symposium on Cucurbits**. Info: Liu Wenge, Zhengzhou Fruit Research Institute, Chinese Academy of Agricultural Science, South of No.63 Middle School, Hanghai East, 450009 Zhengzhou,

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- Henan Province, China. E-mail: lwgwm@163.com E-mail symposium: ISHSCucurbits@caas.cn Web: <http://www.cucurbits2023.cn>
- June 12-16, 2023, Grenoble (France): **IX International Symposium on Walnut and Pecan**. Info: Dr. Fabrice Lheureux, CTIFL, 28, route des neobuts, 24130 Prignonrieux, France. Phone: (33)553580005, E-mail: [fabrice.lheureux@ctifl.fr](mailto:fabrice.lheureux@ctifl.fr) or Benoit Benjamin Villard, RAISONOIX, 1 Le Verger, 26730 Hostun, France. E-mail: [mpouchard@senura.com](mailto:mpouchard@senura.com) or Ms. Eloïse Tranchand, Perrical, 46600 Creysse, France. E-mail: [e.tranchand.creysse@orange.fr](mailto:e.tranchand.creysse@orange.fr) E-mail symposium: [contact@francenut2023.com](mailto:contact@francenut2023.com) Web: <https://francenut2023.com/en/>
  - June 12-15, 2023, Oslo (Norway): **IV International Symposium on Plant Cryopreservation**. Info: Dr. Dag-Ragnar Blystad, NIBIO - Norwegian Institute of Bioeconomy R, Division of Biotechnology and Plant Health, Høgskoleveien 7, No-1431 Ås, Norway. Phone: (47)90872588, E-mail: [dag-ragnar.blystad@nibio.no](mailto:dag-ragnar.blystad@nibio.no) Web: <https://nibio.pameldingssystem.no/cryo-2023>
  - June 18-21, 2023, Zagreb (Croatia): **V Balkan Symposium on Fruit Growing**. Info: Prof. Dr. Boris Duralija, University of Zagreb Faculty of Agriculture, Department of Pomology, Svetosimunska 25, 10 000 Zagreb, Croatia. Phone: (385)12393726, Fax: (385)12393630, E-mail: [bduralija@agr.hr](mailto:bduralija@agr.hr) or Prof. Dr. Martina Skendrovic Babojelic, Faculty of Agriculture University of Zagreb, Department of Pomology, Svetosimunska 25, 10000 Zagreb, Croatia. Phone: (385)1 23 94 070, Fax: (385)1 23 93 630, E-mail: [mskendrovic@agr.hr](mailto:mskendrovic@agr.hr) E-mail symposium: [info@5bsfg.com](mailto:info@5bsfg.com) Web: <https://www.5bsfg.com/>
  - June 26-29, 2023, Lugo (Spain): **VII International Chestnut Symposium**. Info: Prof. Santiago Pereira-Lorenzo, Universidad de Santiago de Compostela, Escola Politécnica Superior de Ingeniería, Avda. Benigno Ledo sn, 27002 Lugo (Galicia), Spain. Phone: (34)982823128, E-mail: [santiago.pereira.lorenzo@usc.es](mailto:santiago.pereira.lorenzo@usc.es) E-mail symposium: [chestnutlugo23@gmail.com](mailto:chestnutlugo23@gmail.com) Web: <http://chestnutsymposium.com/>
  - June 26-28, 2023, Almería (Spain): **International Symposium on Models for Plant Growth, Environments, Farm Management in Orchards and Protected Cultivation - HorchiModel2023**. Info: Prof. Dr. Francisco Domingo Molina Aiz, Universidad de Almería, CITE II-A, Despacho 1.07, Carretera Sacramento s/n, 04120 Almería, Spain. Phone: (34)950015449, Fax: (34)950015491, E-mail: [fmolina@ual.es](mailto:fmolina@ual.es) or Dr. Lorenzo Leon, IFAPA Centro "Alameda del Obispo", Avda. Menendez Pidal s/n, E-14004, Córdoba, Spain. Phone: (34)671532697, Fax: (34)957016043, E-mail: [lorenzo.leon@juntadeandalucia.es](mailto:lorenzo.leon@juntadeandalucia.es) E-mail symposium: [horchimodel2021@ual.es](mailto:horchimodel2021@ual.es) Web: <http://www2.ual.es/horchimodel2021/>
  - June 27 - July 1, 2023, Guangzhou (China): **VII International Symposium on Lychee, Longan and Other Sapindaceae Fruits**. Info: Prof. Dr. Xuming Huang, College of Horticulture, South China Agricultural University, Guangzhou 510642, China. Phone: (86)2085283086, Fax: (86)85282107, E-mail: [huangxm@scau.edu.cn](mailto:huangxm@scau.edu.cn) Web: <https://yy.scau.edu.cn/7thLLsym/>
  - July 2-5, 2023, Genoa (Italy): **XXVII International EUCARPIA Symposium Section Ornamentals - From Nature to Culture: Breeding Ornamentals for Sustainability**. Info: Prof. Mauro Mariotti, DISTAV, University of Genoa, Corso Europa 26, 16132 Genova, Italy. Phone: (39)3538139, E-mail: [m.mariotti@unige.it](mailto:m.mariotti@unige.it) or Dr. Margherita Beruto, Vicolo Barbarossa, 13, 18038 San Remo (Imperia), Italy. Phone: (39) 0184670781, E-mail: [margheberuto@gmail.com](mailto:margheberuto@gmail.com) E-mail symposium: [eucarpia2022.gbh@unige.it](mailto:eucarpia2022.gbh@unige.it) Web: <https://gbh.eucarpia27.unige.it/>
  - July 3-7, 2023, 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](mailto: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](mailto: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: [viton.savino@gmail.com](mailto:viton.savino@gmail.com) E-mail symposium: [info@certfruit2020.org](mailto:info@certfruit2020.org) Web: <http://www.certfruit2020.org>
  - July 10-14, 2023, Hangzhou, Zhejiang Province (China): **III International Symposium on Fruit Culture along Silk Road Countries**. Info: Prof. Dr. Yuanwen Teng, Dept. Of Hort., College of Agric.& Biotech., Zhejiang University, Zijingang Campus, Hangzhou 310058, China. Phone: (86)571-88982803, Fax: (86)571-88982803, E-mail: [ywteng@zju.edu.cn](mailto:ywteng@zju.edu.cn) or Prof. Dr. Zhen-Hai Han, Institute for Horticultural Plants, China Agricultural University, No. 2 Yuanmingyuanxilu, 100193 Beijing, China. Phone: (86)1062732467, Fax: (86)1062734391, E-mail: [rschan@cau.edu.cn](mailto:rschan@cau.edu.cn) or Prof. Dr. Xingjiang Qi, No. 298 Desheng Middle Road, Hangzhou, China. E-mail: [qixj@zaas.ac.cn](mailto:qixj@zaas.ac.cn) Web: <http://www.silkroad2021.org/>
  - July 16-21, 2023, Portland, OR (United States of America): **XIII International Rubus and Ribes Symposium**. Info: Assoc. Prof. Lisa DeVetter, WSU, 16650 Washington 536, Mount Vernon, WA 98273, United States of America. E-mail: [lisa.devetter@wsu.edu](mailto:lisa.devetter@wsu.edu) or Dr. David Bryla, USDA ARS, Horticultural Crops Research Unit, 3420 NW Orchard Ave, Corvallis, OR 97330, United States of America. Phone: (1)541-738-4094, Fax: (1)541-738-4025, E-mail: [david.bryla@usda.gov](mailto:david.bryla@usda.gov) Web: <https://cvent.me/71bzGL>
  - August 14-20, 2023, Weiyuan, Neijiang City, Sichuan Province (China): **VII International Symposium on Fig**. Info: Prof. Dr. Huiqin Ma, China Agricultural University, Yuan Ming Yuan Xi Lu No. 2, Beijing, China. E-mail: [hqma@cau.edu.cn](mailto:hqma@cau.edu.cn) or Lei Sun, 42 Wenhua East Road, Jinan, 250014, Shandong Academy of Forestry Sciences, 250014 Jinan, China. Phone: (86)053188557776, E-mail: [sun7776@163.com](mailto:sun7776@163.com) E-mail symposium: [figsymposium2023@cau.edu.cn](mailto:figsymposium2023@cau.edu.cn) Web: <http://www.fig2023.org.cn>
  - August 21-24, 2023, Cappadocia (Turkey): **XIII International Conference on Grapevine Breeding, Genetics and Management**. Info: Assoc. Prof. Arif Atak, Bursa Uludağ University, Agriculture Faculty, Department of Horticulture, 16059 Bursa, Turkey. Phone: (90) 224 2941578, E-mail: [arifatak@uludag.edu.tr](mailto:arifatak@uludag.edu.tr) E-mail symposium: [secretariat@gbg2023.org](mailto:secretariat@gbg2023.org) Web: <https://www.gbg2023.org/>
  - August 28-31, 2023, Tokyo (Japan): **IV Asian Horticultural Congress - AHC2023**. Info: Prof. Dr. Saneyuki Kawabata, Inst. Sustainable Agro-Ecosystem Services, The University of Tokyo, 1-1 Midori-cho, Nishitokyo, Tokyo 188-0002, Japan. Phone: (81)7064429499, Fax: (81)424644393, E-mail: [skawabata@g.ecc.u-tokyo.ac.jp](mailto:skawabata@g.ecc.u-tokyo.ac.jp) E-mail symposium: [ahc2023@jtbcom.co.jp](mailto:ahc2023@jtbcom.co.jp) Web: <https://ahc2023.org>
  - September 5-9, 2023, Bucharest (Romania): **IX South-Eastern Europe Symposium on Vegetables and Potatoes**. Info: Assoc. Prof. Marian Bogoescu, Bucharest, Intrarea Binelui, No.1A, Sector 4, Cod. Postal 042159, Romania. Phone: (0040)214610706, Fax: (0040)214600725, E-mail: [bogoescumarian@gmail.com](mailto:bogoescumarian@gmail.com) or Assist. Prof. Viorica Lagunovschi-Luchian, University of Agricultural Sciences, Horticulture, 59 Marasti Bld., Sector 1, 011464 Bucharest, Romania. Phone: (40)745254406, E-mail: [vluchian@hotmail.com](mailto:vluchian@hotmail.com) or Prof. Dr. Nazim Gruda, University of Bonn, INRES Horticultural Sciences, Auf dem Hügel 6, 53121 Bonn, Germany. E-mail: [ngruda@uni-bonn.de](mailto:ngruda@uni-bonn.de) E-mail symposium: [simp.pota2023@asas.ro](mailto:simp.pota2023@asas.ro) Web: <https://symp.2023-vegetpota.asas.ro/>
  - September 10-14, 2023, Davis, CA (United States of America): **IX International Olive Symposium**. Info: Dr. Giulia Marino, Department of Plant Sciences, University of California, Davis,



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- 1 Shields Ave., Davis, CA 95616, United States of America. Phone: (1)5303044509, E-mail: giumarino@ucdavis.edu or Dr. Selina Wang, Department of Food Science and Technology, University of California, Davis, 1 Shields Ave., Davis, CA 95616, United States of America. Phone: (1)5307525018, E-mail: scwang@ucdavis.edu or Prof. Reza Ehsani, Department of Mechanical Engineering, University of California, Merced, 5200 N. Lake Road, Merced, CA 95343, United States of America. Phone: (1)2092283613, Fax: (1)2092284047, E-mail: rehsani@ucmerced.edu Web: [https://ucanr.edu/sites/2021\\_Olive\\_Symposium/](https://ucanr.edu/sites/2021_Olive_Symposium/)
- September 11-16, 2023, Dresden-Pillnitz (Germany): **XVI EUCARPIA Symposium on Fruit Breeding and Genetics**. Info: Prof. Dr. Henryk Flachowsky, Pillnitzer Platz 3a, 01326 Dresden, Germany. E-mail: henryk.flachowsky@julius-kuehn.de or Dr. Jiri Sedláč, Res. & Breeding Inst. of Pomology Holovousy, Holovousy, 50801 Horice, Czech Republic. Phone: (420) 435 692 821, Fax: (420) 435 69 33, E-mail: sedlak@vsuo.cz Web: <https://eucarpia-fruit2023.julius-kuehn.de/>
  - September 24-28, 2023, Bucharest (Romania): **VI International Jujube Symposium**. Info: Prof. Dr. Florin Stanica, University of Agronomic Sciences, Faculty of Horticulture, B-dul Marasti, 59, Sector 1, 011464, Bucuresti, Romania. Phone: (40)722641795, Fax: (40)213182888, E-mail: flstanica@yahoo.co.uk or Prof. Dr. Mengjun Liu, Research Center of Chinese Jujube, Agricultural University of Hebei, Baoding, Hebei, 71001, China. Phone: (86)312754342, Fax: (86)3127521251, E-mail: lmj1234567@aliyun.com E-mail symposium: jujube@usamv.ro Web: <http://www.jujube.usamv.ro>
  - September 25-29, 2023, Almería (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 E-mail symposium: papaya2021@ual.es Web: <http://www2.ual.es/VI-simposium-on-papaya/>
  - September 29 - October 3, 2023, 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.mango2023.es/>
  - October 2-5, 2023, York (United Kingdom): **III International Symposium on Carrot and Other Apiaceae**. Info: Ms. Coral Russell, BGA House, Nottingham Road, LN110WB Louth, United Kingdom. Phone: (44)7792893336, E-mail: coralrussell@live.co.uk or Rosemary Collier, Warwick Crop Centre, School of Life Science, The University of Warwick, Wellesbourne, United Kingdom. E-mail: rosemary.collier@warwick.ac.uk E-mail symposium: info@carrotsymposium.com Web: <http://www.carrotsymposium.com>
  - October 9-12, 2023, 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 Web: <http://www.tropmed2020.it>
  - October 9-12, 2023, 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>
  - October 18-21, 2023, 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: nznsl@njau.edu.cn Web: <http://bmbh2022.com/>
  - October 22-27, 2023, Cancun (Mexico): **IV International Symposium on Organic Greenhouse Horticulture**. Info: Dr. Irineo Lopez Cruz, Postgrado en Ingeniería Agrícola, Universidad Autónoma Chapingo, KM 38.5 Carretera Mexico Texcoco, 56230 Chapingo, Mexico. Phone: (52)5959521551, Fax: (52)5959521551, E-mail: ilopez@correo.chapingo.mx or Prof. Dr. Efrén Fitz-Rodríguez, Universidad Autónoma Chapingo, Ing. Mecánica Agrícola/Posgrado IAUIA, km 38.5 Carretera México-Texcoco S/N, Texcoco, Edo. de México C.P. 56230, Mexico. Phone: (52)5959521500x6252, E-mail: efitzr@taurus.chapingo.mx or Prof. Martine Dorais, Centre de recherche & d'innovation-végétaux, Laval University, Envirotron Bldg, Room 2120, Quebec G1K 7P4, Canada. Phone: (1)418-6562131, Fax: (1)418-6563515, E-mail: martine.dorais@fsaa.ulaval.ca E-mail symposium: greensys2023@gmail.com Web: <https://www.greensys2023.org/>
  - October 22-27, 2023, Cancun (Mexico): **GreenSys2023: International Symposium on New Technologies for Sustainable Greenhouse Systems**. Info: Dr. Irineo Lopez Cruz, Postgrado en Ingeniería Agrícola, Universidad Autónoma Chapingo, KM 38.5 Carretera Mexico Texcoco, 56230 Chapingo, Mexico. Phone: (52)5959521551, Fax: (52)5959521551, E-mail: ilopez@correo.chapingo.mx or Prof. Dr. Efrén Fitz-Rodríguez, Universidad Autónoma Chapingo, Ing. Mecánica Agrícola/ Posgrado IAUIA, km 38.5 Carretera México-Texcoco S/N, Texcoco, Edo. de México C.P. 56230, Mexico. Phone: (52)5959521500x6252, E-mail: efitzr@taurus.chapingo.mx E-mail symposium: greensys2023@gmail.com Web: <https://www.greensys2023.org/>
  - October 31 - November 3, 2023, Rotorua (New Zealand): **XII International Workshop on Sap Flow**. Info: Dr. Michael Clearwater, Department of Biological Sciences, University of Waikato, Private Bag 3105, 3240 Waikato Hamilton, New Zealand. Phone: (64)7-8384613, Fax: (64)78384324, E-mail: m.clearwater@waikato.ac.nz E-mail symposium: sapflow2023@confer.co.nz Web: <https://confer.eventsair.com/sapflow2023>
  - November 8-10, 2023, Aracaju, Sergipe (Brazil): **III International Symposium on Moringa**. Info: Arthur Begliomini, chacara 11 Núcleo CAUB I, 71884-690 Brasília-DF, Brazil. Phone: (55)61999990031, E-mail: ahh.agro@outlook.com or Prof. Dr. Gabriel Francisco da Silva, Rua Pastor Jason Oliveira dos Anjos, 435, 49046090 Aracaju-SE, Brazil. Phone: (55)7931946556, Fax: (55)7931946556, E-mail: gabrieldasilva1961@gmail.com Web: <https://ism2023.com/>
  - December 3-8, 2023, Tatura, Victoria (Australia): **II International Symposium on Precision Management of Orchards and Vineyards**. Info: Dr. Mark O'Connell, DJPR, Agriculture Victoria, 255 Ferguson Road, Tatura, VIC 3616, Australia. Phone: (61)354831101, Fax: (61)358335299, E-mail: mark.oconnell@agriculture.vic.gov.au E-mail symposium: bradley@ccem.com.au Web: <https://ccem.eventsair.com/pm2023/>

## Year 2024

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■ January 16-19, 2024, Bologna (Italy): **VertiFarm2024: III International Workshop on Vertical Farming**. Info: Dr. Francesco Orsini, University of Bologna, Viale fanin, 44, Bologna 40127, Italy. Phone: (39)0512096677, Fax: (39)0512096241, E-mail: f.orsini@unibo.it or Dr. Giuseppina Pennisi, University of Bologna, Viale Giuseppe Fanin 44, 40127 Bologna, Italy. E-mail: giuseppina.pennisi@unibo.it E-mail symposium: vertifarm2024@unibo.it Web: <https://site.unibo.it/vertifarm2024/>

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■ February 11-15, 2024, Sde Boker (Israel): **II International Symposium on Reproductive Biology of Fruit Tree Species**. Info: Prof. Avi Sadka, ARO, The Volcani Center, Department of Fruit Trees Sciences, 68 HaMaccabim Rd., P.O. Box 15159, Rishon LeZion 7528809, Israel. Phone: (972)3-9683343, Fax: (972)3-9669583, E-mail: vhasadka@volcani.agri.gov.il or Prof. Noemi Tel-Zur, Ben-Gurion University of the Negev, Beersheba, Israel. E-mail: telzur@bgu.ac.il Web: <https://www.reproductive-biologyfruittree.org.il/>

■ February 20-24, 2024, Mount Maunganui (New Zealand): **XI International Symposium on Kiwifruit**. Info: Dr. Sarah Pilkington, 120 Mt Albert Road, Mt Albert, 1025 Auckland, New Zealand. Phone: (64)21-809645, E-mail: sarah.pilkington@plantandfood.co.nz or Dr. Juliet Ansell, 400 Maunganui Road, Mt Maunganui, 3116 Tauranga, New Zealand. E-mail: juliet.ansell@zespri.com Web: <https://events.zespri.com/ishs-kiwifruit2024>

■ February 26 - March 1, 2024, Marrakech (Morocco): **V All Africa Horticultural Congress - AAHC2024**. Info: Prof. Dr. Abdelhaq Hanafi, Inst. Agronomique et V. Hassan II, BP 30152, Cité Founty, Agadir, Morocco. Phone: (212)48248152, Fax: (212)48248152, E-mail: hanafi.abdelhaq1@gmail.com E-mail symposium: a.hanafi@aahc2024.com Web: <https://www.aahc2024.com/>

NEW

■ April 14-17, 2024, Warsaw (Poland): **XIV International Symposium on Flower Bulbs and Herbaceous Perennials**. Info: Dr. Dariusz Sochacki, Warsaw University of Life Sciences, Dept of Ornamental Plants, Nowoursynowska 166, 02-787 Warsaw, Poland. E-mail: dariusz\_sochacki@sggw.edu.pl

■ April 21-25, 2024, Matsue, Shimane (Japan): **V International Symposium on Woody Ornamentals of the Temperate Zone**. Info: Prof. Dr. Nobuo Kobayashi, Faculty of Life and Environmental Science, Shimane University, Nishikawatsu, Matsue 690-8504, Japan. Phone: (81)852-32-6506, Fax: (81)852-32-6506, E-mail: nkobayashi@life.shimane-u.ac.jp or Dr. Takashi Handa, Meiji University, School of Agriculture, Higashimita 1-1-1, Tama-ku, Kawasaki, 214-8571 Kanagawa, Japan. Phone: (81)449347814, Fax: (81)449347814, E-mail: thanda@meiji.ac.jp Web: <http://wotz2024.jshs.jp/>

■ April 23-26, 2024, Brasília, DF (Brazil): **VII International Symposium on Tomato Diseases**. Info: Prof. Eduardo Mizubuti, Departamento de Fitopatologia, Universidade Federal de Viçosa, 36570-900 Viçosa-MG, Brazil. Phone: (55) 31 3899 1090, E-mail: mizubuti@ufv.br or Dr. Alice Kazuko Inoue-Nagata, Embrapa Vegetables Km 09, BR060, 70275970 Brasília-DF, Brazil. Phone: (55)6133859053, E-mail: alice.nagata@embrapa.br or Prof. Dr. Nadson Pontes, BR 153, km 633. CP 92, Zona Rural, 75650-000 Morrinhos-GO, Brazil. Phone: (55)64-34137900, E-mail: nadson.pontes@ifgoiano.edu.br E-mail symposium: 71std@71std.com

NEW

■ May 12-16, 2024, Bucharest (Romania): **V European Horticultural Congress - EHC2024 (SHE2024)**. Info: Prof. Dr. Florin Stanica, University of Agronomic Sciences, Faculty of Horticulture, B-dul Marasti, 59, Sector 1, 011464, Bucuresti, Romania. Phone: (40)722641795, Fax: (40)213182888, E-mail: flstanica@yahoo.co.uk

■ May 19-22, 2024, Seoul (Korea (Republic of)): **X International Symposium on Light in Horticulture**. Info: Prof. Dr. Myung-Min

Oh, Dept. of Horticultural Science, Chungbuk National University, Cheong-Ju, 28644, Korea (Republic of). Phone: (82)43-261-250, Fax: (82)43-271-0414, E-mail: moh@cbnu.ac.kr or Prof. Dr. Seung Jae Hwang, Division of Horticultural Science, College of Agriculture & Life Science, Gyeongsang National University, Jinju, 52828, Korea (Republic of). Phone: (82)55-772-1916, Fax: (82)55-772-1919, E-mail: hsj@gnu.ac.kr or Prof. Dr. Wook Oh, Department of Horticultural Science, Jeju National University, 102 Jejudaehak-ro, Jeju 63243, Korea (Republic of). Phone: (82)7543327, Fax: (82)7254905, E-mail: wookoh@jenunu.ac.kr or Prof. Dr. Jung-Eek Son, Dept of Agriculture, Forestry & Bioresources, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea (Republic of). Phone: (82)28804564, Fax: (82)28732056, E-mail: sjeenv@snu.ac.kr

■ June 9-13, 2024, Budapest (Hungary): **XVII International Symposium on Processing Tomato - XV 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 Prof. Dr. Lajos Helyes, Hungarian University of Agriculture, and Life Science, Páter K. str. 1, 2100 Gödöllő, Hungary. Phone: (36)28522071, E-mail: helyes.lajos@uni-mate.hu or Prof. Zoltán Pék, Hungarian University of Agriculture, and Life Sciences, 2103 Gödöllő, Páter Károly u. 1., Hungary. Phone: (36)28522071, Fax: (36)28410804, E-mail: pek.zoltan@uni-mate.hu E-mail symposium: symposium@worldtomatocongress.com

■ September 23-26, 2024, Athens (Greece): **I International Symposium on Protected Cultivation, Nettings and Screens for Mild Climates**. Info: Dr. Dimitrios Savvas, Agricultural University of Athens, Laboratory of Vegetable Production, Iera Odos 75, 11855 Athens, Greece. Phone: (30)2105294510, Fax: (30)2105294504, E-mail: dsavvas@aua.gr or Assoc. Prof. Thomas Bartzanas, Agricultural University of Athens, Laboratory of Farm Structures, Iera Odos 75, 11855, Athens, Greece. Phone: (30)2105294045, Fax: (30)2105294045, E-mail: t.bartzanas@aua.gr

NEW

■ September 25-28, 2024, Wisley, Woking (United Kingdom): **III International Symposium on Greener Cities: Improving Ecosystem Services in a Climate-Changing World (GreenCities2024)**. Info: Dr. Tijana Blanus, Science Department, RHS Garden Wisley, GU23 6QB Woking, United Kingdom. E-mail: tjanablanusa@rhs.org.uk or Dr. Mark Gush, Royal Horticultural Society, Wisley, GU23 6QB Surrey Woking, United Kingdom. E-mail: markgush@rhs.org.uk

NEW

■ October 28-30, 2024, Coimbra (Portugal): **International Symposium on Arbutus unedo (Strawberry Tree) and Related Species: from Biology to Biotechnology**. Info: Prof. Dr. Jorge Canhoto, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal. Phone: (351)239240700, E-mail: jorgecan@ci.uc.pt or Dr. João Martins, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal. Phone: (351)239240700, E-mail: joao.martins@uc.pt Web: <https://www.uc.pt/en/uid/biotec/events/arbutus2024>

■ November 11-15, 2024, 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 Prof. Andrew East, Massey University, Private Bag 11222, Palmerston North, New Zealand. E-mail: a.east@massey.ac.nz Web: <https://www.scienceevents.co.nz/postharvest2024>

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## > *Chronica Horticulturae* author information

*Chronica Horticulturae* is the quarterly publication of the International Society for Horticultural Science (ISHS) and is received by all members of the Society and numerous libraries throughout the world. Members and non-members are urged to contribute articles for consideration. However, it needs to be understood that *Chronica* is not to be construed as a scientific journal that publishes original research. Research articles appropriate for *eJHS*, *Fruits* or *Acta Horticulturae* are usually inappropriate for *Chronica*. We seek horticultural articles of interest to a broad audience composed of ISHS members and the horticultural, scientific, and academic communities.

*Chronica Horticulturae* is currently made up of as many as nine sections as follows:

**News & Views from the Board.** This section is usually confined to editorials from Board Members as well as general announcements of the Society.

**Issues.** Articles of a broad focus that often involve controversial topics related to horticulture, including broad social issues and economic development, are appropriate for this section. These articles are intended to stimulate discussion. Often, guest writers are invited to contribute articles.

**Spotlight on Honoured ISHS Members.** ISHS Fellows and Honorary Members complete an interview on how they started and progressed in their careers, what affected their decisions and attitudes and how their involvement with the ISHS assisted them. In addition, they are invited to comment on how they see the future of horticultural science for young people. Articles in this section are by invitation only.

**Horticultural Science Focus.** This section is intended for in-depth articles on a topic of horticulture that is generally, but not always, scientific in nature. Many articles are mini-reviews and will provide up-to-date information on current topics of interest to the horticultural community. We encourage these articles to be illustrated.

**Horticultural Science News.** Shorter articles about current topics including horticultural commodities and disciplines are welcome.

**History.** This section includes articles on the history of horticulture, horticultural crops, and the ISHS.

**The World of Horticulture.** Articles in this section highlight horticultural industries and research institutions of particular countries or geographic regions throughout the world. Illustration with figures and tables is extremely helpful and highly advised. This section also includes book reviews that are requested by the Editor. Members who wish to recommend a book review should arrange for a copy of the book to reach the Secretariat.

**Symposia and Workshops.** Meetings under the auspices of ISHS are summarized, usually by a participant of the meeting. These articles are arranged by the symposium organizers.

**News from the ISHS Secretariat.** This section contains information on membership, memorials of deceased ISHS members, and a calendar of ISHS events. Brief memorials (up to 500 words) should be sent to the Secretariat.

Authors who wish to submit articles for publication in *Chronica* should contact ISHS headquarters and their request will be transmitted to the Editor. Authors should be aware that most articles should have a broad international focus. Thus, articles of strictly local interest are generally unsuited to *Chronica*. Illustrated articles are usually 1500 to 5000 words long. There are no page charges for *Chronica Horticulturae*. Photographs submitted should be of high resolution ( $\geq 300$  pixels per inch). Send articles or ideas for articles to:

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