

A publication of the International Society for Horticultural Science

Chronica Horticulturae



Horticultural highlights

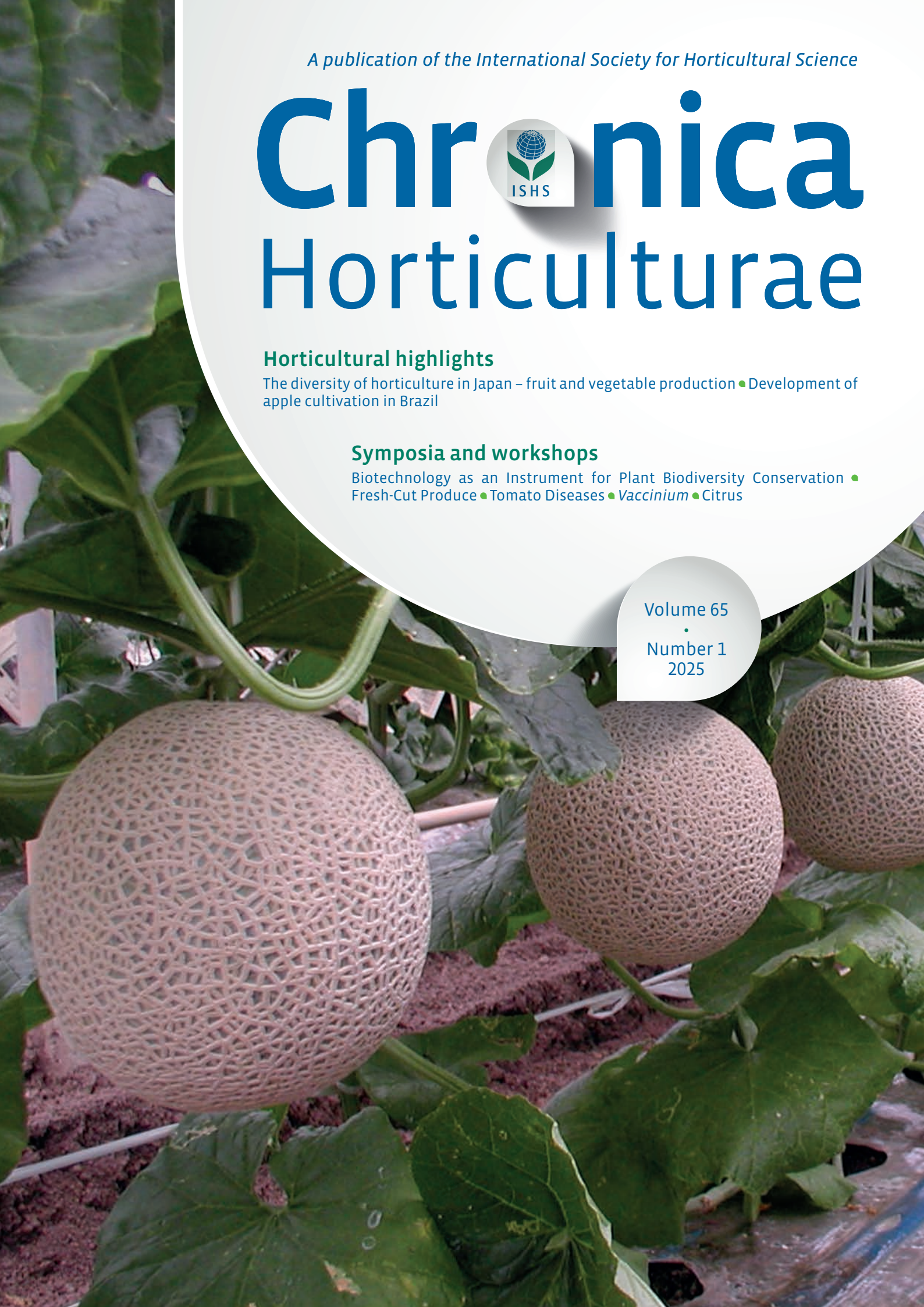
The diversity of horticulture in Japan – fruit and vegetable production • Development of apple cultivation in Brazil

Symposia and workshops

Biotechnology as an Instrument for Plant Biodiversity Conservation • Fresh-Cut Produce • Tomato Diseases • *Vaccinium* • Citrus

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Acta Horticulturae

Acta Horticulturae is the series of proceedings of ISHS Scientific Meetings, Symposia or Congresses (ISSN: 0567-7572). ISHS Members are entitled to a substantial discount on the price of *Acta Horticulturae*. A complete and accurate record of the entire *Acta Horticulturae* collection, including all abstracts and full text articles, is available online at www.actahort.org. ISHS Individual Membership includes credits to download 20 full text *Acta Horticulturae* articles. All *Acta Horticulturae* titles - including those no longer available in print format - are available in the electronic e-*Acta Horticulturae* online format.

eJHS

eJHS (*European Journal of Horticultural Science*) is the official journal of the International Society for Horticultural Science. eJHS is an open access journal publishing significant plant science discoveries and new or modified methodologies and technologies with a broad international and cross-disciplinary interest in the scope of global horticulture. The journal scope covers both applied and fundamental aspects of the entire food value chain, including breeding, production, processing, trading and retailing of horticultural crops and commodities grown in temperate, Mediterranean, tropical and subtropical climates. Additional information can be found at www.ishs.org/ejhs

Scripta Horticulturae

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

PubHort – crossroads of horticultural publications

PubHort is a service of ISHS as part of its mission to promote and to encourage research in all branches of horticulture, and to efficiently transfer knowledge on a global scale. Additional information can be found at www.pubhort.org

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Earl's melon variety ('Venetia'), cultivated in Shimabara City, Nagasaki Prefecture, Japan, and greenhouse-grown using a meticulous method that allows only one branch and one fruit per plant. Farmers harvest the fruit 55-60 days after fertilization, with a sugar content ranging from 15-17 °Brix. See article p.11.



> From the cockpit: a new year, new challenges

Peter J. Batt, Editor, *Chronica Horticulturae*



> Peter J. Batt

Welcome back. We're already three months into 2025 and two months into the Year of the Snake. In Chinese culture, snakes are valued for their intuition, their strategic thinking, and their adaptability and patience – the very qualities that are needed to overcome the challenges that lie ahead of us.

Within a scientific society such as ISHS, there would be few of us who do not recognise the immediate need to transform our global food system. Agriculture is not only the second largest contributor to global greenhouse gas emissions, but it's also the largest consumer of freshwater and it's the leading cause for the loss of biodiversity. On the production side, things need to change and they need to change now, but producers alone cannot shoulder the responsibility – we all need to – and herein lies the primary reason for our inaction – the political will to instigate change and to recognise that business as usual cannot address these pressing issues. However, in the pursuit of more sustainable outcomes, change also needs to occur on the demand side. Today, non-communicable diseases (NCDs) are the leading cause of death and the majority of these – things like cancer, cardiovascular disease, hypertension and Type II diabetes – are induced by the poor dietary choices consumers make. Far too many people are eating diets high in calories but low in nutrients, and with greater urbanisation, more processed and convenience foods that are high in salt, sugar and saturated fats.

Fortuitously, as an industry, we can make a difference, for it's widely recognised that people need to eat more fresh fruit and vegetables, nuts and whole grains. Furthermore, to support our mental health and general wellbeing, horticulture plays a fundamental role in providing the ornamental plants that adorn our parks and gardens, our homes and our workplaces. Collectively, we can make a difference, and through our Society, we have a unique opportunity to *advance horticulture for a better tomorrow together*.

In this first edition for 2025, while IHC2026 is still 17 months away, Kazuyoshi Nada, Shinya

Kanzaki, Takeshi Kurokura and Masayoshi Shigyo begin to set the scene by providing us with an introduction to fresh fruit and vegetable production in Japan. With its diversity of climates from subtropical to subarctic, vegetable production occurs all year round in Japan, both in the open field and under various forms of protected cropping from simple rain shelters to highly sophisticated environmentally controlled greenhouses. In Okinawa, tropical fruits such as mangoes and pineapples are cultivated, while the western regions of Honshu specialize in citrus, particularly the Satsuma mandarin. In the cooler regions of Tohoku and Hokkaido, deciduous fruit trees, including sweet cherries and apples, are grown, exemplifying the principle of cultivating crops best suited to local conditions. A notable characteristic of fruit production in Japan is the extraordinary emphasis placed on fruit quality, for in Japanese culture, fruit is often presented as a gift for celebrations. These ultra-premium fruits must not only meet exacting standards in terms of their shape and physical appearance, but also in taste, and as a result, it is not unusual for consumers to spend more than JPY 10,000 to purchase a single mango, rock melon or bunch of grapes.

While most of us acknowledge that Brazil is one of the world's largest producers of coffee and oranges, it's also a major producer of apples. In this article, José Luiz Petri and Everlan Fagundes provide us with a brief introduction to the apple industry in Brazil and the technologies that apple producers in Brazil are adopting to increase productivity whilst reducing the environmental impacts.

In pursuing more sustainable outcomes, Sophie Wenz describes her work in encouraging greater biodiversity through companion planting in commercial strawberry crops. Julia Morales is investigating optimum fertilization strategies for persimmon. The outcomes of her research not only improve productivity and fruit quality, but by preventing the overuse of fertilizers, help preserve the ecosystem and support the transition to more environmentally responsible agricul-

tural systems. Among the ornamental crops, Sakari Välimäki describes efforts to protect the endangered *Ulmus laevis* (Pall.) and *Ulmus glabra* (Huds.) through cryopreservation of dormant buds. Through HiFi sequencing technology, Wenxing Chen traces the evolution of our modern persimmons from their wild relatives in Madagascar, Borneo and China. Stefania Bennici explores the genetic foundations for self-incompatibility in citrus, while Balkrishna Nayak looks at the genotyping and phenotyping of ToLCD resistant lines of tomato for processing.

Finally, in the Spotlight this month is my fellow Board member, Patrícia Duarte de Oliveira Paiva, a professor at Universidade Federal de Lavras, Brazil. Patrícia eloquently describes her introduction to horticulture and the role ISHS has played in building her distinguished career. Patrícia is the Board member responsible for our Young Minds program and I can think of no one better to lead this group and to inspire the next generation of horticulturists. Patrícia talks about the need to define your dreams and to align your passions with your professional aspirations. Success is built upon a foundation of dedication, consistent effort, organization and continuous learning. Equally important, however, is personal development, for being a competent professional holds a deeper meaning when paired with the pursuit of becoming a better person. In instigating change, Patrícia notes that transformation begins with small, thoughtful actions that ripple outward, creating a better and more compassionate future for us all. ●

> Refreshing and revitalising ISHS

François Laurens, President of ISHS



> François Laurens

As we step into 2025, I am excited to share with you several pivotal initiatives that will guide us through the year ahead:

A sustainable future for ISHS

In aligning with our strategy 2022-26, we plan to introduce a new business model to secure the Society's long-term sustainability. While this will entail significant structural and organizational change, we remain steadfast in upholding our core values and objectives: *Advancing horticulture for a better tomorrow together.*

Science at the core

As a scientific society, through our events, we are committed to addressing major global challenges, including mitigating the impact of climate change, reducing the use of phytosanitary products and natural resources, and integrating cutting-edge technologies such as artificial intelligence into everyday horticultural practices. We want ISHS to be a place for the exchange of knowledge and ideas. In this respect, I

invite you to contribute your work to our international journal *eJHS*, relaunched and refreshed in cooperation with CABI.

Leveraging our network

Our extensive network positions us uniquely to provide an informed perspective on the critical issues facing horticulture, ensuring that science remains a driving force in addressing them.

Broadening membership

We aim to strengthen our ties with industry by fostering collaboration and innovation across all sectors of horticulture and attracting corporates as members and sponsors. Thanks to our new retired membership category, we look forward to engaging and drawing on the experience of our more senior and distinguished members.

Nurturing young minds

Attracting and supporting young talent is a key priority for ISHS. We are dedicated to helping young and emerging professionals

to integrate into our community, and to offer them the resources and opportunities they need to thrive in careers aligned with their aspirations.

Enhancing communication

To revitalize ISHS, we will launch a new website, a refreshed social media strategy, and a new logo, each reflecting a modern society firmly rooted in its values.

Thank you for your unwavering support and dedication. Together, we will continue to advance horticulture and contribute to a better world. ●

This space is for you



We, the Board, are cognisant that *Chronica Horticulturae* is the primary communication vehicle for our Society. However, it is largely one way – and that's something that we would like to change.

We would like to hear from you – what issues concern you – do you have things you would like to say – or contributions you might wish to make on articles we have presented.

By email, please submit your comments and contributions to peterjbatt@gmail.com, Editor of *Chronica Horticulturae*, or kelly.vandijck@ishs.org, Associate Editor of *Chronica Horticulturae*.

Upon receipt, we will direct your correspondence to the appropriate member of the Board, but we reserve the right to exercise appropriate editorial control over all submissions received.

In publishing your contributions – and our response – we will identify you only by using your first name and country, unless you request otherwise.

> eJHS, the official journal of the ISHS, begins a new chapter in its publication history and chooses CABI as its publishing partner

Maria Campbell [CABI] and Yao-Chien Alex Chang [ISHS Board – Publications]

The International Society for Horticultural Science (ISHS) and CABI are delighted to announce the relaunch of the *European Journal of Horticultural Science* (eJHS), which from January 1, 2025, will be published by CABI. This marks the official start of a publication partnership between the two organizations and the culmination of preparations for the launch throughout 2024. As part of the partnership, CABI will not only publish the *European Journal of Horticultural Science* (eJHS) but will also provide an archive for the content of *Fruits*, *The International Journal of Tropical and Subtropical Horticulture* through the CABI Digital Library.

“I am delighted CABI’s first society partnership for journals is with ISHS,” commented Andy Robinson, Managing Director of CABI’s Publishing and Knowledge Business. “It’s such a good match both in terms of subject area, global reach, and a shared community-focused ethos encompassing research from low- and middle-income countries.”

“From the beginning, it made complete sense to forge this partnership with CABI,” said François Laurens, ISHS President. “Both organizations have abundant, specialist knowledge, and horticulture is a key area for CABI.

We are confident eJHS is in safe hands with CABI as our new publisher.”

The first article published directly on the CABI Digital Library is “Research on lignification of post-harvested bamboo shoots by metabolomics technology” by Jingsong Huang, Yixiang Zhang and Jun Guo. The research article explores the preservation of bamboo shoots and is an excellent representation of the journal’s scope, which includes the key topic of post-harvest processing. The article is an excellent representation of the journal’s scope and the editorial’s team determination to help authors publicise the results of their research. eJHS reports on plant breeding, production, processing, trading and retailing of horticultural crops and commodities grown in temperate, Mediterranean, tropical and subtropical climates. ISHS members are eligible for a discount on article processing charges. Discounts and waivers are also available for Research4Life authors.

“eJHS was founded by Julius Springer back in 1929 and has had an interesting journey to this point,” observed Yao-Chien Alex Chang, ISHS Board member – Publications. “As eJHS approaches its centenary, it is well-placed to

continue serving horticulturists worldwide for a long time to come.”

The *European Journal of Horticultural Science* (eJHS), the official journal of the International Society for Horticultural Science (ISHS), is an international, open access journal publishing significant plant science discoveries and new or modified methodologies and technologies with a broad, cross-disciplinary interest in the scope of global horticulture. eJHS is led by Editor-in-Chief, Renato Paiva, Universidade Federal de Lavras, Brazil.

CABI is a unique, inter-governmental, not-for-profit scientific research and publishing organization, supported by forty-eight member countries. Its mission is to improve people’s lives worldwide by providing information and applying expertise to solve problems in agriculture and the environment. A core objective is to increase the impact of science to practically address several Sustainable Development Goals (SDGs). CABI is a signatory to the UN SDG Publishers Compact and a member of the Association of International Research and Development Centers for Agriculture (AIRCA) and the United States Agricultural Information Network (USAIN). ●

European Journal of Horticultural Science

Official journal of the International Society for Horticultural Science

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Spotlight
on Honoured
ISHS Members

> Patricia Duarte de Oliveira Paiva

Position

ISHS Vice-President in charge of Young Minds
Professor, Universidade Federal de Lavras, Brazil

Your involvement with ISHS (roles/positions)

My first contact with a scientific society was in 1995 when I joined the Brazilian Society of Floriculture and Ornamental Plants (SBFPO). Through this national society, I was introduced to the International Society for Horticultural Science (ISHS) in 2008 when I attended the X International Symposium on Flower Bulbs and Herbaceous Perennials, in Lisse, The Netherlands.

Since then, I have actively participated in the Society's scientific activities, attending numerous meetings as a delegate, serving as a convener, and inviting speakers at ISHS symposia and congresses. I endeavor to attend as many ISHS events as possible, as they provide invaluable opportunities to connect with colleagues, to build networks, and to gain new knowledge in my field of expertise.

From 2013-2017, I served as President of SBFPO and acted as Brazil's representative on the ISHS Council. In 2018, the ISHS Stat-



> ISHS Board 2022-2026 at IHC2022 in France.

utes were revised to create a position for a South American representative on the Board. I ran for this position and was elected for the 2018-2022 term, and re-elected in Angers for the 2022-2026 term. It is a great honor to represent South America on the Board, for I am able to share my expertise and foster greater collaboration between ISHS and the region. For both terms on the Board, I have been responsible for the Young Minds Program. It is a privilege to lead this initiative, which aims to inspire young people by highlighting the importance of horticulture and its potential to shape their futures and careers.

I take great pride in working with the next generation to demonstrate the vital role horticulture plays in addressing global challenges and advancing sustainable development.

What encouraged you to select horticulture as a career?

When I finished high school, my dream was to pursue a career in genetic engineering. However, such a job was not available in my country at that time, so I had to choose between two paths that could bring me closer to this goal: biology or agronomy. Fortunately, my hometown is close to one of the top three agronomy colleges in the country, making my decision clear – I chose agronomy!

During my first year, I had the opportunity to work as a teaching assistant in Plant Anatomy. This incredible experience not only deepened my knowledge but also ignited my passion for plant sciences. As the course progressed, I discovered a fascinating new field in Brazil during a Plant Breeding class: plant tissue culture. I was captivated by its potential and was determined to specialize in it. My dedication paid off when I secured an internship in a Plant Tissue Culture laboratory. That was the true beginning of my research journey, leading to a master's degree in 1992 and a PhD in 1998, both centered on this field.

Throughout my academic career, my focus has remained on ornamental plants. I have had the privilege of working with many diverse species, including ferns, violets, chry-



> ISHS presentation during the X International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects) in November 2024 in New Delhi, India.

santhemums, and strelitzias, which further fueled my passion for this remarkable field. Alongside my work in plant tissue culture, I delved deeply into the world of ornamental plants by taking various courses on flower production and landscaping. Since these topics were not well-established in my university at the time, I sought training elsewhere, attending private courses, and completing internships with private companies. This additional learning proved invaluable in broadening my expertise.

Before completing my PhD, a faculty position opened at my university to teach Floriculture and Landscaping, and I was selected. This opportunity marked the beginning of my dream career as a professor and researcher – a path I had been preparing for diligently. Stepping into this role came with a significant mission: to develop the university's Floriculture and Landscaping program. Starting from scratch, I had to create and structure the entire curriculum without any pre-existing materials or guidance. It was an exciting yet challenging endeavor, especially at a time before the internet, when resources were far less accessible. Despite these obstacles, it was a deeply rewarding experience, laying the foundation for a program that would inspire and educate future generations.

Highlights of your career

To date, I have had the privilege of supervising 46 master's and 24 doctoral students, many of whom completed both degrees under my guidance. These collaborative efforts have resulted in the publication of over 200 peer-reviewed scientific articles. In addition, since 2013, I have served as the Editor of *Ornamental Horticulture*.

As a faculty member, I coordinated the Graduate Program in Agronomy/Plant Science, leading its internationalization efforts. I also lead the "Floriculture and Landscaping" research group and coordinate the Study Group on Landscaping and Floriculture (Nepaflor), fostering collaboration among undergraduate and graduate students.

Recognizing the need to offer reference materials for students and producers, I authored the book entitled *Paisagismo – Conceitos e Aplicações (Landscaping – Concepts and Applications)* in 2008, a comprehensive 600-page resource widely regarded as a key academic and technical reference in Brazil. In 2012 and 2014, I published the two-volume series *Produção de Flores de Corte (Cut Flower Production)*, providing detailed, illustrated guides on cut flower cultivation in Brazil.

Beyond books, I initiated the "Estrada Real Squares Collection," a series of 16 booklets documenting the history and evolution of public squares in Brazil's historical cities.



> ISHS Board 2018-2022 at the ISHS Secretariat in Belgium.

I have also played a pivotal role in organizing major academic events, including several Landscaping Symposia and the 2003 XIV Brazilian Congress of Floriculture and Ornamental Plants, held alongside the I Brazilian Congress of Plant Tissue Culture. For many years, I have contributed to the beautification of the university campus by designing and maintaining its gardens.

In addition to teaching, research, and outreach, I have embraced opportunities to contribute to administrative roles. I have served as Department Head, Graduate Program Coordinator, and Director of International Affairs, further broadening my impact within the university.

Outside academia, my passion for flowers and gardens remains a driving force in my life. I spend most of my free time cultivating my home garden and exploring diverse landscapes, continually drawing inspiration from the beauty and diversity of nature.

How your participation in ISHS has facilitated/encouraged your career?

After attending more than 20 symposia and congresses organized by ISHS, I can confidently say that the structure and relationships fostered by the Society and its members have been pivotal in advancing my career. The expansion of my professional network through these events has been extraordinary. These gatherings not only introduce new professionals but also strengthen connections with long-time colleagues.

As a result, countless opportunities have arisen, including collaborations, research projects, lectures, and other academic activities. These events provide an excellent platform for staying updated on the latest knowledge, sharing experiences, and gaining practical insights into initiatives from various countries in the symposium's field of study through technical visits. Furthermore, the cultural immersion offered by these events adds an enriching dimension to the experience.

This engagement serves as a powerful motivator for my research activities, which I enthusiastically share with colleagues and students. The inspiration and insights gained from ISHS events continuously shape and refine my work.

As a Board member, I have the privilege of further expanding these connections while actively contributing to proposals and projects aimed at strengthening and growing our Society. It is incredibly rewarding to be part of such meaningful efforts that foster collaboration, innovation, and progress within the ISHS community.

What words of advice do you have for students/graduates/early career researchers?

It is essential to define your dreams and align your passions with your professional aspirations. Once this alignment is clear, the next step is to set goals and outline a plan to achieve them. Success is built on a foundation of dedication, consistent effort, and organization. Continuous learning is crucial for any professional seeking growth.

However, when a goal isn't achieved as planned, it's important to view it as an opportunity to learn and grow. Every objective comes with its risks, but stepping out of your comfort zone is indispensable. Embracing new challenges paves the way for new opportunities.

Equally important is personal development, as being an excellent professional holds a deeper meaning when paired with the pursuit of becoming a better person. Personal growth involves nurturing spiritual, physical, and mental well-being, creating a balanced and fulfilling life.

A life lived with sensitivity enables us to recognize the needs of others and identify ways, through our professional actions, to leave a meaningful legacy. Transforming the world begins with small, thoughtful actions that ripple outward, creating a better and more compassionate future. 🌱



> 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.

Tissue culture and cryopreservation to conserve the genetic diversity of elms in Finland



> Sakari Välimäki

The genetic diversity of trees is most often conserved in situ at their natural growing sites by establishing conservation areas or gene reserve forests. However, for endangered species, additional methods are often warranted. *Ulmus laevis* (Pall.) and *Ulmus glabra* (Huds.) are two native elm species in Finland. Both species are endangered and

globally affected by the Dutch elm disease. Due to the scattered distribution of the natural populations of *U. laevis* and *U. glabra* in Finland, their genetic diversity has been conserved in field genetic reserve collections, which consist of grafted elms from the natural population. In these collections, trees are able to produce more diverse and adaptable seed. However, field collections are vulnerable to abiotic hazards, pests and pathogens, like Dutch elm disease. While Dutch elm disease is not currently present in Finland, it is likely to spread in the future due to a warming climate. Because of the pathogen threat, supplementary static conservation through cryopreservation of dormant buds has been implemented. The buds are regenerated from cryostorage through tissue culture. The development of protocol has involved testing different surface sterilization methods, subculture techniques and media. *U. laevis* can be cryopreserved with controlled slow cooling and minimal pre-treatments, but dormant buds of *U. glabra* require a dehydration

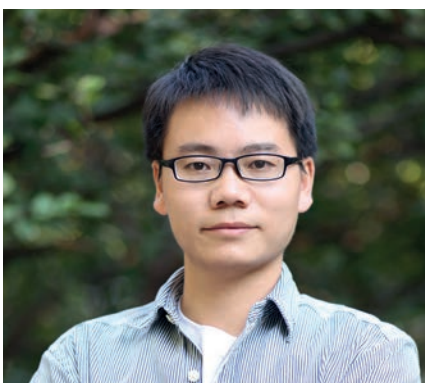
treatment, which improves the sterilization outcome and regeneration rate. The cryocollection currently houses 116 *U. laevis* and 45 *U. glabra* genotypes.

Sakari Välimäki is currently a research scientist at Natural Resources Institute Finland (Luke) in Savonlinna. He recently defended his dissertation titled “Tissue culture and cryopreservation in the utilization and conservation of genetic resources of Norway spruce (*Picea abies*) and elms (*Ulmus glabra*, *U. laevis*)” at the University of Helsinki. Sakari won the ISHS Young Minds Award for the best oral presentation at the IV International Symposium on Plant Cryopreservation in Norway in June 2023.

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Evolutionary insights from *Diospyros* genomes illuminate the history of persimmon domestication



> Wenxing Chen

The genus *Diospyros*, encompassing approximately 500 species, is predominantly pantropical with most species being evergreen trees and shrubs, while a few temperate species are deciduous. *Diospyros* is renowned for its edible fruits (commonly known as persimmons, specifically *D. kaki*), valuable black wood (notably from *D. ebenum*), and

ornamental species. The fruit of the genus is notable for its accumulation of high proanthocyanidins (PAs), which induce a strong astringency. In this paper, we present an allele-aware, chromosome-level genome assembly for three species with varying ploidy levels: *D. sp.* Yemaoshi ($2n = 2x = 30$), *D. rhombifolia* ($2n = 4x = 60$), and *D. kaki* ($2n = 6x = 90$). Utilizing HiFi sequencing technology, we assembled 60 and 90 pseudo-chromosomes for *D. sp.* Yemaoshi and *D. kaki*. each comprising 4 and 6 homologous groups of 15 chromosomes, respectively, and identified 10,315 and 14,343 genes, including their allelic variations. Our analysis revealed a significant expansion of the *CHS* gene families in *Diospyros* species, potentially explaining their high PA content. Genome evolution studies indicate that Madagascar is a hotspot for *Diospyros* distribution, followed by Borneo, while the middle reaches of the Yellow River could be the diversity center for *D. kaki*. We hypothesize that the ancestors of cultivated persimmons migrated from Southeast Asia

into China, undergoing genome duplication to form the hexaploid cultivated persimmons that subsequently spread from China to other regions. These *Diospyros* genomes provide valuable insights for the genetic improvement of persimmons.

This research was supported by the National Key R&D Program of China (2019YFD1000600). Wenxing Chen won the ISHS Young Minds Award for the best oral presentation at the VIII International Symposium on Persimmon in China in October 2024.

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Enhancing insect diversity through companion plants for creating a resilient organic strawberry cropping system



> Sophie Wenz

Sophie Wenz is a PhD student at the Department of Crop Protection at Hochschule Geisenheim University, Germany, under the supervision of Prof. Dr. Annette Reineke. Her research focuses on the application of a conservation/biological control strategy for organic berry cultivation. Specifically, the aim of her current work is to modify prevailing

strawberry cultivation systems through various companion plantings to enhance crop resilience. She is collaborating on this project with partners from the Institute for Food and Environmental Research Bad Belzig, the University of Agronomic Sciences and Veterinary Medicine of Bucharest, the University of Copenhagen, the National School of Agriculture of Meknès and the Research Institute of Horticulture Skierniewice. In an experimental strawberry field in Geisenheim, flower strips were established to provide an additional food resource and a refuge for beneficial insects. They also serve as trap plants to divert harmful insects away from the crop, thereby reducing fruit damage. Undersowing has also been employed to promote the soil microbiota. In 2023, samples were collected using a suction sampler to assess the effect of the companion plantings on the insect community. Collected insects were counted and taxonomically sorted, resulting in a total of almost 19,000 individuals. The data revealed a surprisingly rapid colonization of companion plants by different arthropod orders with a notably high abundance of

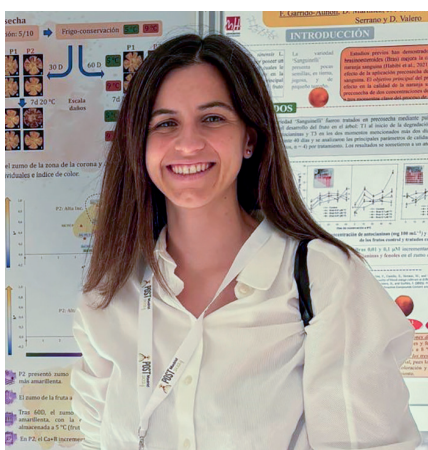
parasitoid Hymenoptera, which are of particular importance for the control of harmful insects. A detailed taxonomic analysis will determine whether the companion plantings had a significant effect on the establishment of beneficial insects and the regulation of harmful insects. Overall, the findings highlight the importance of promoting biodiversity to create a holistic and sustainable agricultural system that supports organic farming principles.

Sophie Wenz won the ISHS Young Minds Award for the best poster presentation at the IV International Organic Fruit Symposium and II International Organic Vegetable Symposium in Poland in September 2024.

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Nutritional diagnosis using the DRIS tool for 'Rojo Brillante' persimmon in the Mediterranean area of Spain



> Julia Morales

Julia Morales is a researcher at the Center for Sustainable Agriculture Development of the Valencian Institute of Agricultural Research (IVIA) in Valencia, Spain. She specializes in both pre- and postharvest management of Mediterranean woody crops. Currently, alongside her team, her work focuses on optimizing fertilization strategies for Mediterranean crops, particularly citrus and

persimmon. This research emphasizes the importance of understanding not only the optimal nutrient concentrations, but also the balance between essential macro- and micronutrients, which is crucial for achieving healthy crop development and optimal yields.

In the case of the 'Rojo Brillante' persimmon, foliar analysis has been used to establish the optimal balance between nutrient pairs observed in plots with high yields and fruits of superior physicochemical and organoleptic quality. Based on these findings, advanced diagnostic tools have been developed, including the diagnosis and recommendation integrated system (DRIS) equations. These equations enable a plant's nutritional status to be comprehensively evaluated. Additionally, nutrient optimal ranges (NOR) have been defined to indicate ideal nutrient levels at various stages of vegetative development: post-flowering, during fruit growth, at the color-change phase, and at harvest. The practical applications of this knowledge are significant for the agricultural sector. By utilizing these tools, farmers can adjust fertilization strategies more accurately, relying

on data obtained through foliar analyses of their fields. This approach not only improves productivity, but also allows the cultivation of higher-quality fruits, ensuring that nutrient management is tailored to the specific requirements of the crop at different phenological stages. Furthermore, by preventing the overuse of fertilizers, this approach helps preserve ecosystems and supports the transition to more environmentally responsible agricultural systems.

Julia Morales won the ISHS Young Minds Award for the best poster presentation at the VIII International Symposium on Persimmon in China in October 2024.

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S-genotyping and genome editing to investigate the genetic basis of self-incompatibility in citrus



› Stefania Bennici

Stefania Bennici is a researcher at the University of Catania (Italy), where she is investigating the molecular mechanisms of sterility in citrus to ensure the production of seedless fruits. In citrus species, seedlessness is one of the most appreciated quality traits, especially for fresh fruits. Most commercial citrus cultivars exhibit some level of parthenocarpy which, in combination with mechanisms of

sterility that prevent fertilization, ensures the production of seedless fruit. Several citrus species such as pomelos, mandarins and mandarin-like accessions also show self-incompatibility (SI), a mechanism that prevents self-fertilization under the control of the *S-ribonuclease (S-RNase)*, a highly polymorphic gene encoding a stylar protein that inhibits the growth of pollen tubes where the pollen grains are from the same plant or from plants with the same alleles. Knowing the S-genotype is important in selecting SI varieties to cultivate in blocks isolated from any cross-compatible pollen source. On the other hand, important citrus species such as sweet oranges, lemons or grapefruits may exhibit a self-compatible behavior that seems to be associated with the presence of a mutated S-allele (*Sm*-allele). In this case, a revert mutation of the *Sm*-allele could restore SI and consequently seedlessness in self-compatible genotypes. In her research, consensus primer-based PCR and Sanger sequencing were used to define the composition of S-alleles from a collection of 41 accessions belonging to different species and genera of the *Rutaceae* family, identifying 15 differ-

ent S-alleles. Among them, five new alleles were identified. In addition, Stefania performed a CRISPR/Cas experiment to edit the mutated *Sm*-allele in the self-compatible sweet orange 'Doppio Sanguigno' with the aim of restoring SI and obtain a seedless sweet orange genotype. The next steps in her research will involve the phenotypic evaluation of fruit from self-pollinated regenerated edited plants. The results should facilitate the development of seedless citrus fruit in breeding programs using self and/or cross-compatible pollen donors, selected by gene markers or using genome editing.

Stefania Bennici won the ISHS Young Minds Award for the best poster presentation at the XV International Citrus Congress in South Korea in November 2024.

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Genotyping and phenotyping of ToLCD resistant backcross lines of tomato for processing traits



› Balkrishna Nayak

Tomato (*Solanum lycopersicum* L.) is one of the most widely grown warm season vegetable crops for both fresh consumption and processing. The present study aims to evaluate tomato leaf curl disease (ToLCD) resistant genotypes for processing. In this study, a set of 46 genotypes, including a control ('Punjab Chhuhara'), were evaluated for resistance to disease and fruit quality traits through gene linked markers and phenotyping. To identify superior processing traits among the selected genotypes, fruit

quality parameters like TSS (°Brix), pH, acidity (%), pericarp thickness (mm), fruit shape index (FSI), viscosity (cP), number of locules, firmness (kg cm⁻²), juice recovery (%), and paste recovery (%) from fruits of all the genotypes were studied. Paste samples were prepared and subjected to analysis of minerals, phytonutritional content (lycopene and beta carotene) and biochemical components (ascorbic acid, titratable acidity, total phenolic content, total antioxidant activity, total flavonoid content). Two genotypes, Pusa Tomato Hybrid-6 (PTH-6) and DTH-162, had superior processing quality traits along with multiple disease resistant genes, *Ty-3* and *Ph-3* for tomato leaf curl disease (ToLCD) and late blight, respectively, compared to the control. Genotypes having promising processing quality with high recovery rates were identified among the evaluated genotypes: PTH-6 had high yield (986.7 q ha⁻¹), juice recovery (84.3%), puree and paste recovery (37.2 and 16.7%, respectively) and was found to be the most promising for either market. Among the selected genotypes with excellent fruit quality and processing attributes were: DTK-128 with fewer locules (2), DTK-91 for its superior firmness (6.0 kg cm⁻²), DT-396 for a thick pericarp (9 mm), DTK-103 for its FSI of 1.9, DT-904115 with a TSS of 5.2 °Brix,

and DTK-1 (SPS-6) for high viscosity (61.4 cP). Paste samples with superior biochemical properties included PTH-6 for high lycopene content (15.8 mg 100 g⁻¹), Punjab Chhuhara for beta carotene (4.4 mg 100 g⁻¹), DTK-134 for titratable acidity (1.2 mg 100 g⁻¹), DTK-135 for high ascorbic acid content (78.0 mg 100 g⁻¹), DT-411-1-6-11-15(27) for high total antioxidant activity (505.5 µmol Trolox 100 g⁻¹) and total phenolic content (167.0 mg 100 g⁻¹), and DTK-117 with the highest flavonoid content (142.3 mg 100 g⁻¹).

Balkrishna Nayak won the ISHS Young Minds Award for the best poster presentation at the X International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic and legal aspects) in India in November 2024.

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> The diversity of horticulture in Japan – fruit and vegetable production

Kazuyoshi Nada, Shinya Kanzaki, Takeshi Kurokura and Masayoshi Shigyo

In Japan, the production of edible crops such as fruit and vegetables is differentiated into three main categories: staple crops, oil-processing crops and forage crops. While staple foods, including rice, meat and fish are primarily intended for carbohydrate and protein intake, fresh fruit and vegetables provide essential vitamins, minerals and dietary fiber.

In recent years, the importance of functional foods that lead to the prevention of lifestyle-related diseases has been emphasized, and the importance of fresh fruit and vegetables that contain an abundance of these components has been increasing. Vegetables are indispensable as a side dish, and are enjoyed for their color, taste, and aroma. While fruit is often considered a luxury in Japan, they are important as gifts, but they are also used in daily life as snacks and desserts.

Compared to the cultivation of major cereal crops, horticulture generally involves intensive cultivation on relatively small plots of land. There are two types of cultivation: open field cultivation and protected cropping, which may be either heated or unheated, using glass or plastic film during periods when open field cultivation is difficult. In the case of protected cropping, soil cultivation, hydroponics, rockwool and other substrates are used. In addition to temperature control, growers may also utilize supplementary lighting to maintain photosynthesis or manipulate flowering time through the control of day length. Such highly sophisticated cultivation systems are one of the characteristics of horticultural production in Japan, where plant factories and smart technology may help solve some of the problems associated with an aging workforce and labor shortages.

In 2022, agricultural output in Japan was worth approximately JPY 9 trillion. While the value of the food industry was estimated to exceed JPY 100 trillion (Agriculture, Forestry and Fisheries Basic Data Collection), the importance of agriculture cannot be mea-

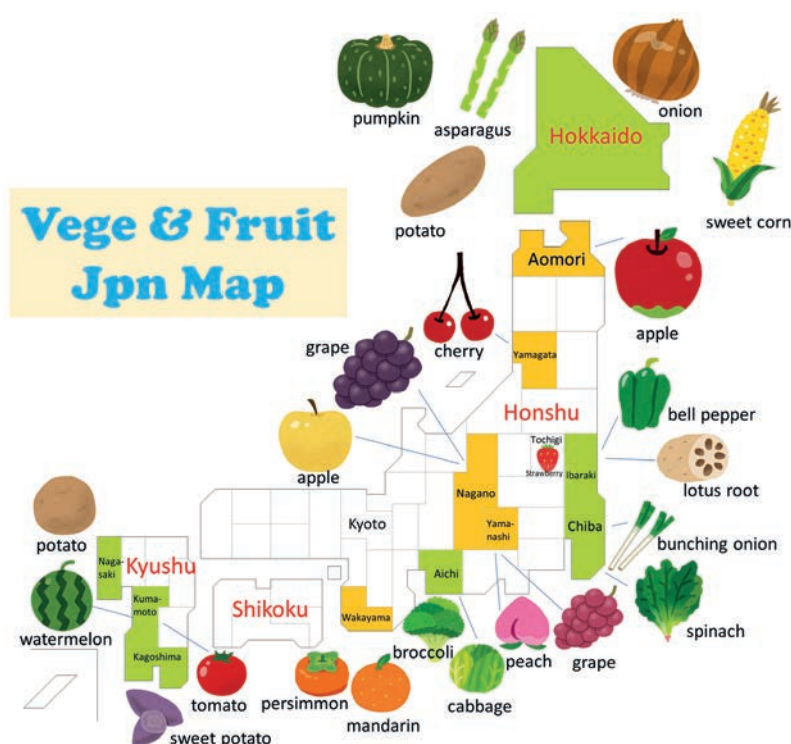
sured solely in monetary terms. Agriculture has a critical role to play in food security and environmental sustainability. Today, the value of vegetable production exceeds JPY 2 trillion, with fruit production contributing around JPY 900 billion: about 35% of the total value of agricultural outputs.

By region, in 2022, Hokkaido was the leading producer of fresh vegetables (JPY 222.8 billion) (10.0%), followed by Ibaraki (7.2%) and Chiba (6.0%) in Kanto Prefecture, Kumamoto (5.6%) in Kyushu, and Aichi (5.0%) in the Chubu region (Figure 1). As for fruit production, the Tohoku and Hokuriku regions dominate, with Aomori (11.4%), Nagano (9.8%), Yamanashi (8.8%), Yamagata (8.3%) and Nagano (4.9%) making up the top five prefectures. In 2023, on the basis of the wholesale market throughput, cabbages (1,130,000 t), onions (1,010,000 t), and Chinese cabbage (800,000 t)

accounted for the greatest quantities, while strawberries (JPY 175.3 billion), tomatoes (JPY 140.9 billion), and cucumbers (JPY 138.5 billion) were the most valuable crops. By volume, tangerines (480,000 t), apples (390,000 t) and bananas (320,000 t) were the major fruit crops traded in the wholesale markets. Grapes ranked fifth in terms of volume, but third in terms of value because, like strawberries, their price is significantly higher than other fruit crops. By contrast, most of the bananas are imported.

Vegetable production in Japan

In pursuing its agenda to be self-sufficient, given that most vegetable crops have only a limited shelf life, vegetable production in Japan occurs all year round. Depending on the region and the season, cultivation systems and the selection of varieties are



■ Figure 1. Japanese prefectures that are known for their high production of edible horticultural crops.



■ Figure 2. Tomato production in Kagoshima at the end of September (2018) (A) and in Nagano at the start of August (2018) (B).

adapted to local soil and climatic conditions. Depending on the type of vegetable and the region, vegetable production can be classified into one of two types: variety-utilizing and facility-utilizing. Under a facility-utilizing cropping regime, vegetables with a narrow temperature adaptation range are cultivated in greenhouses with supplementary environmental control to provide heat and where appropriate, supplementary light and carbon dioxide enrichment to extend the cultivation period. Conversely, under a variety-utilizing cropping regime, in either open fields or plastic tunnels, the ecological differences between varieties are exploited and referred to by seasonal names such as “spring sowing” or “winter harvesting,” depending on the sowing and harvesting seasons. Most leafy green vegetables and root vegetables fall within this classification.

Open field culture is a cropping system where vegetables are grown under natural or near-natural conditions for the majority of their growing season. Rain sheltered cultivation is included in open field cultivation because it only protects against rainfall and does not aim to regulate temperature.

Semi-forced vegetable cultivation includes the use of plastic tunnels or rain sheltered greenhouses. Under this cropping type, seedlings are grown in heated facilities and then transplanted into tunnels or rain sheltered greenhouses to accelerate harvesting. For semi-forced cultivation in plastic tunnels, the plastic is removed after the risk of late frost has passed, and cultivation shifts to open field culture.

Forcing culture describes those cultivation systems where vegetable crops are kept warm or heated in a greenhouse for most of the low-temperature period from late fall to spring or during the entire growing period in order to harvest the crop even earlier than semi-forcing culture.

Delayed-start culture is a cropping type in which vegetables are harvested later than those in the open field culture. This can be divided into two types: “delayed-start culture

using greenhouse,” which keeps or adds heat during the latter half of the growing period, and “delayed-start culture in open field” which takes advantage of mild weather in late fall and cool weather in mid-summer (Figure 2).

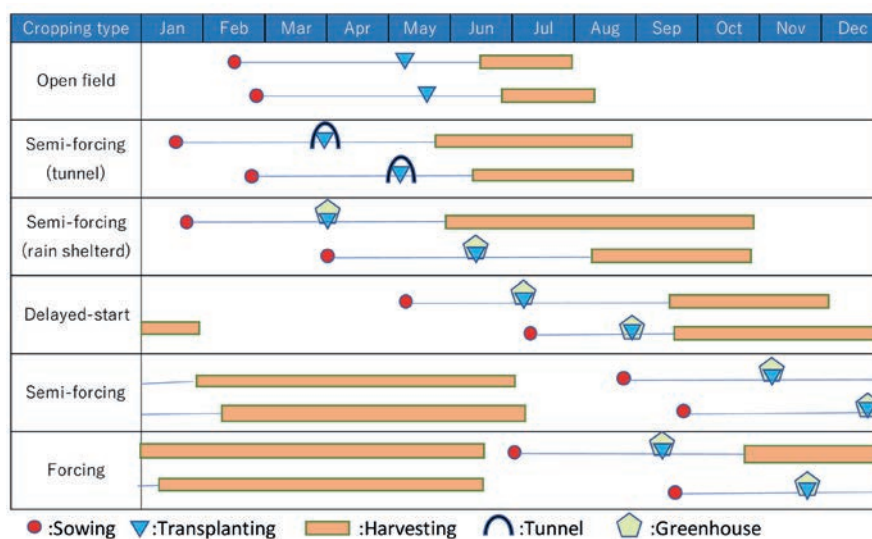
Tomato production in Japan

Tomato was first introduced to Japan via China in the late 17th to early 18th centuries. At that time, it was mainly used for ornamental purposes, but in the 1930s, its production for table consumption increased, and today it is cultivated year-round throughout Japan, primarily in greenhouses. In Japan, large tomatoes with a fruit weight of around 200 g, mini-tomatoes with a fruit diameter of 2-3 cm and a fruit weight of around 30 g, and medium-sized tomatoes with a fruit diameter of 5 cm and fruit weight of 50-100 g are produced. Tomato cropping types are not fixed and are constantly changing even in the same production region, depending on various factors such as varieties, cultivation techniques, and economic conditions. In Japan, semi-forced culture in greenhouses (with transplanting in December and harvesting from February

to June) and delayed-start culture (transplanting in July and harvest from August to December) are common (Figure 3).

In order to advance and extend the harvesting period, to reduce production costs and to meet the demands of institutional buyers, some production areas have introduced modern greenhouses with high eaves, and are adopting an overwintering cropping regime, with transplanting in September and harvesting from October to June (a 9-month harvest period). Under this cropping system, improved summer seedling cultivation techniques utilizing the direct planting of cellular seedlings may allow harvest to occur one month earlier and higher yields can be anticipated.

In contrast, a number of short-term cultivation methods are employed in some growing regions. Low-truss dense planting describes a cultivation method where seedlings are planted densely but only one to three trusses are harvested, allowing for up to four crops per year (with three-truss harvesting) (Figure 4). Here it is important to raise the seedlings in artificial growth chambers and to select varieties that are appropriate for the season.



■ Figure 3. The cropping types of tomato in Japan.

Variety-utilizing vegetable cropping systems

For many leafy/root vegetables such as cabbage and onions, flower bud differentiation, bolting, and flowering are strongly influenced by temperature and day length. These vegetables are usually cultivated in an open field, however, the high temperatures and humidity during the rainy season result in an increasing incidence of pests and diseases. Where climatic differences are extreme, the year-round cultivation of vegetables in open fields requires the use of appropriate varieties, a shift to different growing regions, and the use of complementary materials and facilities.

Cabbage production in Japan

Cabbage was introduced to Japan in the early 18th century, but it was the non-heading type. It was not until the mid-18th century that heading cabbage was introduced. When first introduced, cabbage was generally sown in cool regions in the spring months for harvest in fall. The subsequent introduction of both early and late varieties greatly extended the harvest period. Late bolting varieties have since made it possible for cabbages to be planted in the warmer regions during fall. In addition, varieties with traits such as heat tolerance, cold tolerance and head formation characteristics even at high/low temperature, have been developed, and from the use of these varieties, year-round production has been realized (Figure 5).

To avoid high temperatures during the head formation period, sowing in February and transplanting in March in warm and temperate regions is widely practiced. It's also possible to sow in March-April and to transplant in April-May in cold regions. Seedlings are grown in greenhouses in cellular trays to avoid frost damage and facilitate rapid plant establishment after transplanting. Harvesting occurs from June to August.

Under this method of cropping, damping-off is common during the rainy season in June. In addition, high temperatures during the head formation phase can easily lead to poor head formation. Varieties for this cropping period must be tolerant of waterlogging, disease resistant, and capable of forming heads even at high temperature.

In cold regions, seeds are sown from June to early August, with harvest occurring from September to January. In warm or temperate regions, while the sowing period can be delayed, if it is delayed too much, poor head formation due to low temperatures can occur. As the sowing and seedling growth periods occur when temperatures are hot, it is necessary to pay close attention to the occurrence of pests and diseases such as damping-off, yellowing disease, diamond-



■ Figure 4. The low-truss dense planting cultivation of tomato.

back moth, and cutworms, and to cover the seedlings with a tunnel. Early maturing varieties and cold heading varieties are used for cultivation during the hot summer and cold winter, respectively. For harvesting from December to March, late-bolting varieties need to be selected.

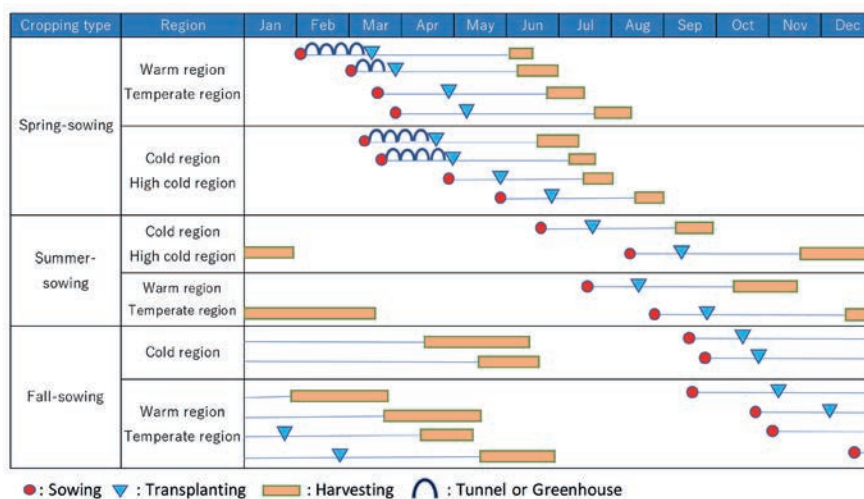
For seeds sown in September-October, with transplanting occurring before the end of the year, harvest will occur from February to May. Alternatively, seeds can be sown in November-December, overwintered, transplanted around February, and harvested from April to July. For harvest in early spring, early-maturing varieties with clod-heading characteristics are typically used.

Strawberry production in Japan

Under natural conditions, strawberries initiate flower buds under short-day, low-temperature conditions from late summer to

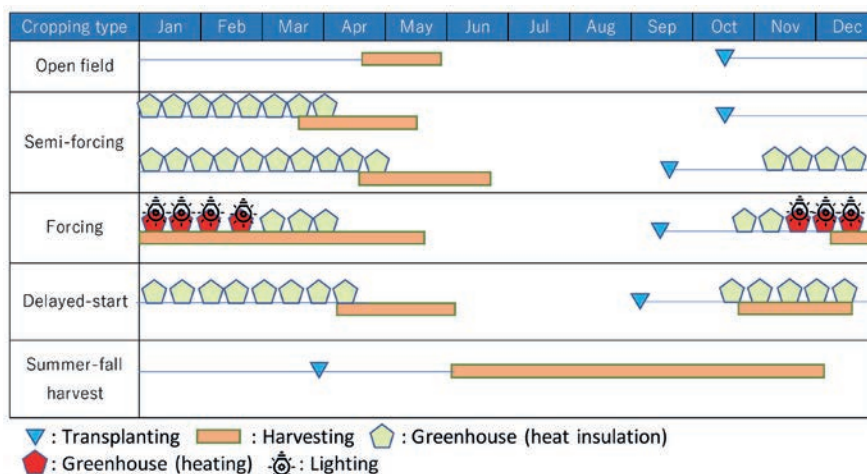
early fall, overwinter in a dwarf (rosette, dormant) state, and then bloom and bear fruit the following spring (April to May). After that, runners emerge under the long-day, high-temperature conditions from early summer. To produce fruit at other times, this life cycle must be manipulated.

The optimal growing temperature for strawberries is 15-25°C. Below 15°C, the plant becomes dwarf under short-day conditions and goes dormant below 5°C. However, unlike tree buds and bulbs, it continues to grow slightly, even outdoors in winter. When entering endodormancy, vegetative growth such as the emergence of runners and leaf elongation are suppressed by high temperature and long-day conditions. Endodormancy is broken by the low temperatures of winter, transitioning to ecodormancy, and growth resumes in spring as temperatures rise with flowering and fruiting. For the year-round



■ Figure 5. The cropping types of cabbage.

production of strawberries, controlling flower bud initiation and dormancy is crucial. The main cropping system for strawberries in Japan is forced culture. Seedlings that have undergone flower bud initiation through various methods are planted, and heating begins before they enter dormancy due to low temperatures and short days (Figure 6). By maintaining a semi-dormant state through extending the daylength and controlling temperature, flower buds can be continuously initiated, allowing harvesting to continue until early summer (around the end of May). Under a semi-forced cropping regime, early cropping is facilitated by erecting low tunnels after the dormant plants have met the minimum chilling requirement. Because the temperature is low and the amount of sunlight is insufficient, vegetative growth is poor. In semi-forcing regions like the Tohoku area, low temperature cut cultivation is practiced, during which the plants are kept warm enough not to bloom in winter, and the period of exposure to low temperatures is adjusted to initiate flower buds. For strawberries, the chilling requirement for breaking dormancy and the photoperiod and temperature needed for flower bud initiation vary greatly depending on the variety. For forcing, varieties that have early flower bud initiation and a short dormancy (requiring less chilling and having excellent cold elongation) are used, while varieties with a long dormancy are used for semi-forcing cultivation in cold regions and open field cultivation. New cultivars such as ‘Benihoppe’ and ‘Kaorino’ have excellent low-temperature elongation and are often grown without lighting. The cultivation of everbearing varieties is limited to summer and fall harvests in cold regions, whereas, under forced cultivation systems, single-harvest varieties, which are superior in quality, are utilized.



■ Figure 6. The cropping types of strawberry.

In the early 1990s, high-altitude areas such as the foothills of Mount Fuji and Senjogahara in Nikko were widely used for highland seedling cultivation. In these regions, seedlings initiate flower buds through natural cold stimulation, which are then used for forcing in lowland areas. However, in more recent times, as strawberry production has moved to the ‘Nyoho’ and ‘Toyonoka’ regions, techniques have been developed to promote flower bud initiation through low-temperature treatment at 10-15°C. In ‘Nyoho’, seedlings are placed in a short-day night cooling device for 16 hours and are exposed to natural temperature and light conditions for the remaining 8 hours. This process is continued for 10-20 days to induce flower bud initiation. While the effect of night cooling and short-day treatment is high, it does require a significant investment in night cooling equipment. In the production areas of ‘Toyonoka’, seedlings are placed in commercially available refrigerators for 10-15 days for low-temperature treatment. This method can be under-

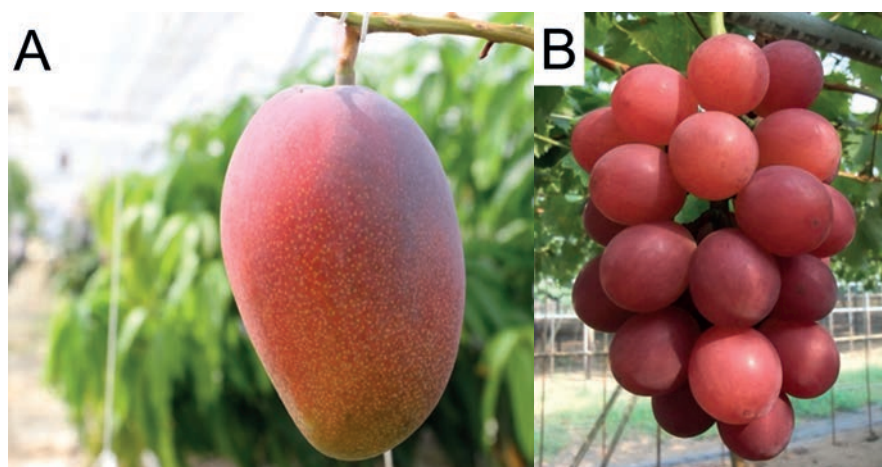
taken at relatively low cost. However, this method requires the cultivation of bigger seedlings, and the treatment effect is unstable, often resulting in lower yields. More recently, a technique called intermittent refrigeration treatment has been established and is expected to become widespread. This involves repeating the process 2-3 times, where photosynthesis is promoted under natural conditions after refrigeration at 15°C in darkness for 3-4 days.

Fruit production in Japan

The development of fruit cultivation in Japan has followed a unique trajectory, shaped by the nation’s distinctive geographical features and cultural heritage. The Japanese archipelago, stretching from north to south, encompasses many diverse climatic zones ranging from subtropical to subarctic, enabling the establishment of specialized fruit production systems tailored to each region’s characteristics. In Okinawa, tropical fruits such as mangoes and pineapples are cultivated, whilst Kyushu and the western regions of Honshu specialize in citrus, particularly the Satsuma mandarin. In the colder regions of Tohoku and Hokkaido, deciduous fruit trees, including sweet cherries and apples, are predominantly grown, exemplifying the principle of cultivating crops best suited to local conditions.

A notable characteristic of Japanese fruit cultivation is the extraordinary emphasis placed on fruit quality, which has led to the development of sophisticated cultivation techniques. However, the traditional Japanese fruit growing system currently faces significant challenges from climate change and labor shortages due to the rapid population decline.

A remarkable feature of Japanese fruit cultivation is the production of luxury fruit intrinsically linked to the nation’s gift-giving culture. In Japanese society, fruit has tradi-



■ Figure 7. Mango ‘Aikou’ (A) and grape ‘Ruby Roman’ (B) are traded as premium fruits for gift-giving. It is believed that the higher the price of the fruit, the better it conveys the sender’s feelings, and these command prices incomparably higher than fruits normally consumed for eating.



■ Figure 8. Japanese pear trees cultivated under a joint training system. The main branches extend horizontally and are joined to adjacent trees by grafting. The fruiting positions can be seen arranged in a planar layout.

tionally held a significant position as a gift for celebrations, visiting the ill, and seasonal gift-giving occasions such as “Oseibo” (year-end gifts) and “Ochugen” (midsummer gifts). Premium fruit such as mangoes and rock melons are often priced above JPY 10,000 (approximately 60 EUR) per fruit and grape clusters can cost tens of thousands of JPY (Figure 7). These ultra-premium fruits must meet exacting standards not only in taste, but also in size, color, and shape: aesthetic demands that have driven the development of sophisticated cultivation techniques.

For instance, table grape cultivation employs meticulous management practices, including limiting cluster numbers to one or two per shoot, whilst combining shoot-tip pinching and lateral shoot management to enhance photosynthesis and sugar translocation to the fruit. Additionally, techniques such as gibberellin treatment for seedless fruit production, peduncle trimming for cluster shape adjustment, and precise berry thinning are applied with extraordinary attention to detail.

Fruit bagging, a technique developed in Japan for preventing pest damage and blemishes to fruit, has now been adopted worldwide for various fruit crops including apples, peaches and pears (Sharma et al., 2014; Ali et al., 2021). In citrus cultivation, the “mulch-drip” system (year-round mulching and drip irrigation/fertigation system) has been established for water stress control, enabling the production of high-quality Satsuma mandarins with a sugar content exceeding 12 °Brix (Shimazaki and Nesumi, 2016).

As many of these premium fruit production techniques are labor intensive, there is growing interest in technological innovation to achieve labor-saving measures, mechanization and automation in the future.

In Japan, where approximately 70% of the land is mountainous terrain, much fruit cultivation occurs on slopes, resulting in sig-

nificantly lower operational efficiencies compared to flat terrain, and opportunities for mechanization are limited. Moreover, the agricultural sector faces intensifying challenges from an ageing workforce and a shortage of young farmers. Under these circumstances, labor saving and productivity enhancement have become urgent priorities in fruit cultivation, spurring various technological innovations.

The introduction of smart agriculture is regarded as one of the solutions to these challenges. Initiatives to quantify and visualize the tacit knowledge and experience of skilled farmers through AI image analysis, creating comprehensive databases, show promising potential for technical knowledge transfer. Whilst drones for pesticide application and autonomous harvesting robots have been successfully implemented in rice cultivation and some vegetable crops, their practical application in fruit cultivation requires further technological advancement. In fruit cultivation, the three-dimensional and complex tree architecture presents a significant obstacle to implementing smart agriculture technologies, making the development of mechanized harvesting particularly challenging. The joint training system (Figure 8), successfully implemented in Japanese pear and persimmon cultivation, represents an innovative cultivation system where main stems of young trees are trained horizontally and connected to adjacent trees through grafting to create linear composite trees (Shibata and Seki, 2021). This technique simplifies traditionally complex tree forms, enhancing operational efficiency. In pear cultivation, pruning time has been reduced by over 30% compared to conventional methods, with marked increases in yield. The improved joint V-trellis system has also been successfully adapted for persimmon and Japanese apricot, achieving enhanced light conditions and operational efficiency

(Shibata and Seki, 2021). These novel training systems, allowing for linear and planar arrangement of branches and fruiting positions, are well-suited for future smart agriculture technology integration.

Addressing climate change

Climate change, a global challenge, is severely impacting fruit cultivation in Japan. As perennial crops, fruit trees are particularly vulnerable to rapid climate change due to the extended time required to develop resilient cultivars and/or species. Since the 2000s, issues such as poor fruit coloration and delayed maturation have become evident in apple, grape and persimmon, whilst pears have experienced flowering disorders due to warming winters (Sugiura et al., 2012; Tominaga et al., 2022). Satsuma mandarin cultivation has seen an increase in rind puffiness (a physiological disorder where the peel separates from the flesh), particularly in late-maturing varieties. Additionally, fruit sunburn, caused by extreme summer temperatures, has become increasingly problematic in many fruit crops.

Climate change simulations predict a significant northward shift of major production areas for Satsuma mandarin and apple by the 2060s (Sugiura et al., 2009), with substantial changes anticipated in suitable cultivation areas for other fruit species. Adaptation strategies through cultivation techniques include modifications to growing seasons, soil improvement, girdling, mist cooling, and environmental control through protected cultivation. Concurrently, strategic crop transitions are underway, such as the introduction of tropical fruits in Kyushu and the conversion from apple to peach production in Aomori Prefecture. In grape cultivation, there is an accelerating shift from pigmented cultivars to green cultivars such as ‘Shine Muscat’.

Bridging science and practice for fruit improvement

Recent rapid developments in genome analysis technology have enabled the decoding of genomic information for numerous fruit tree species, advancing the efficiency and precision of breeding programs. Whilst genetic analysis of fruit trees had historically lagged behind annual crops, the implementation of next generation sequencing (NGS) technology has facilitated genome-wide association studies (GWAS) and quantitative trait loci (QTL) analyses across many fruit tree species, accumulating valuable genomic information related to important fruit characteristics. These achievements are now entering the practical application phase in breeding programs.

For instance, in apple breeding, methods have been established to accurately predict fruit soluble solids content, mealiness and susceptibility of water-core disorder from genomic information, enabling the implementation of genomic selection (Minami-kawa et al., 2024; Kuniyama et al., 2024). In persimmon, researchers have identified the sex-determining locus and genetic regions controlling fruit morphology and astringency (Horiuchi et al., 2023a, b). For pineapple, QTLs associated with important fruit traits such as sugar content, acidity, flesh color, and ascorbic acid content, have been identified (Nashima et al., 2024). Furthermore, the effectiveness of genomic selection has been demonstrated in both Japanese pear and Satsuma mandarin breeding programs. The practical application of genomic breeding technologies is expected to enhance the efficiency of crossbreeding and accelerate

cultivar improvement in fruit trees. Moreover, technological innovations, including advances in genome editing techniques and artificial intelligence-driven high-throughput phenotyping, are progressing at an unprecedented pace. These technological advances are anticipated to significantly reduce the breeding time for new fruit varieties, which have traditionally required more than a decade.

Japanese fruit production has evolved through adaptation to unique natural conditions whilst meeting cultural demands. Moving forward, further technological innovation will be essential to simultaneously address climate change adaptation and labor-saving requirements. The sustainable development of the fruit industry will undoubtedly require both a comprehensive approach to these challenges and strengthened international research collaboration.

A case study: the breeding of Japanese strawberry cultivars

Strawberry (*Fragaria* × *ananassa* Duch. ex Rosier) is one of Japan's most popular fruits. Next to tomatoes, its market size is estimated at JPY 200 billion, and over 300 cultivars are registered or undergoing the registration process.

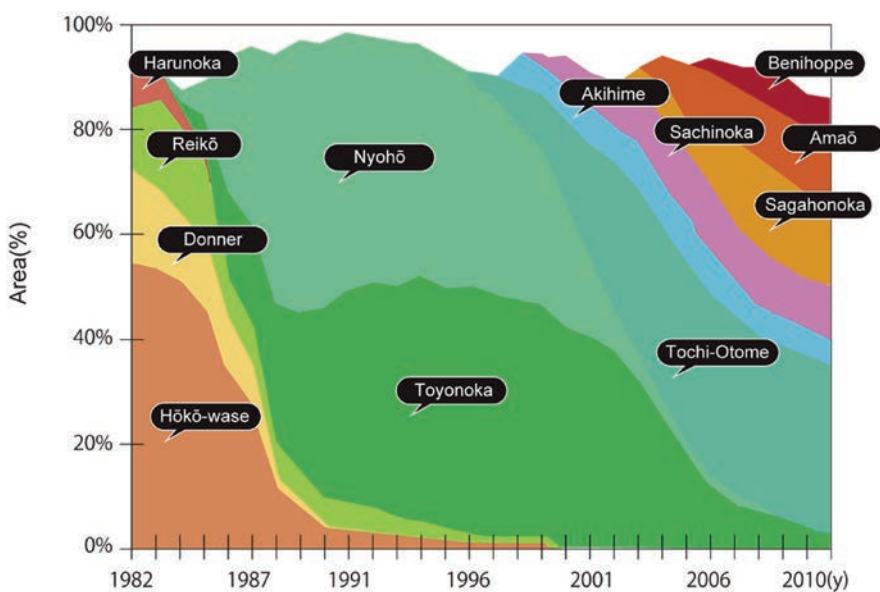
Historically, domestic wild berries such as *Potentilla* spp., *Rubus* spp. and alpine *F. iinumae*, and *F. nipponica* were used before the first introduction of *F.* × *ananassa* from the Netherlands in the 1830s-50s (the Edo era) and then from other countries in Europe and the USA in the 1870s. This is why the genus *Fragaria* in Japan is named "Oranda-Ichigo (Holland strawberry)." However,

this first introduction was largely unsuccessful because consumers were unfamiliar with Western crops. It was not until the 1900s (the Meiji era), with the introduction of some new cultivars ('Excelsior', 'Victoria', etc.) from Europe and the USA, that Western crops were more widely accepted.

The first Japanese bred cultivar, 'Fukuba', was raised from 'General Chanzu' seedlings in 1899 by Baron Fukuba and was mainly grown for the Imperial family and wealthy consumers in restricted fields. 'Fukuba' became popular after permission was granted to plant the runners in normal fields near big cities and it was one of the leading cultivars until the 1960s. As an old cultivar, 'Fukuba' had some defects in yield and fruit quality. 'Kōgyoku', also known as 'Yakumo', was bred from 'Fairfax' in the 1940s to improve sweetness and became popular as an open field cultivar. In terms of yield, as well as fruit quality, 'Donner' was introduced from the USA in 1950 and became very popular in eastern Japan. Today, 'Fukuba', 'Kōgyoku' and 'Donner' provide the basis for most Japanese cultivars.

Open field cultivation using plastic tunnels or mulching began in the 1950s. These simple structures were developed into plastic greenhouses in the 1960s, so from that time onwards, most of the cultivation has occurred in protected cropping systems. The use of protected cropping systems advanced the harvest season, with peak production shifting from April to February in the pursuit of higher prices in the off-season, especially in December. One of the strategies for out-of-season production is the use of less dormant cultivars, which require less chilling conditions after flower initiation. 'Fukuba' was selected for its earliness and was used as a forcing cultivar. However, this cultivar had defects under higher temperatures when adapted to southern Japan. 'Harunoka' was bred as a descendent of 'Fukuba' and 'Donner' in 1967 in Kyushu, and 'Hōkō-wase' was bred from 'Kōgyoku' × 'Tahoe' in 1960 (Figure 9). These two cultivars, especially 'Hōkō-wase', were the leading forcing cultivars in southwest Japan during the 1980s.

'Reikō' was bred in 1976 in Chiba Prefecture, eastern Japan, for its good red, conical berry shape from 'Fukuba' × 'Harunoka'. The introduction of 'Reikō' stimulated consumer awareness for good looking fruit. 'Donner' has deeper dormancy, so early season production was difficult for the eastern region. To overcome this, 'Nyohō' was raised from {'Harunoka' × 'Donner'} × 'Donner' × 'Reikō' in 1985 in Tochigi Prefecture and became the leading cultivar in eastern Japan until the 1990s. Meanwhile, the western cultivar 'Harunoka' was replaced by 'Toyonoka', a



■ Figure 9. The trend of main cultivars between 1982-2010 (according to NFACA Japan).

descendant of 'Harunoka' and 'Hōkō-wase', and was introduced in 1985. Both 'Nyohō' and 'Toyonoka' had good yield potential and good fruit quality (size, shape and taste). These were the leading cultivars in the eastern and western regions, respectively, until about 2000.

These cultivars were later replaced by 'Tochi-Otome' (1996), 'Aki-Hime' (1992), 'Sachinoka' (2000), 'Sagahonoka' (2001), 'Amaō' (2005) and 'Benihoppe' (2002). In addition, agronomic experimental stations in regions that were not traditional strawberry growing areas launched breeding programs to improve growers' income, attract newcomers, and actively promote local fruit. Their main breeding targets were big fruit sizes, while keeping durability for transportation and off-season production. The rise in growers' average age, in addition to changes in consumers' preferences, might explain why big fruit became the breeding target. Big fruits with fewer fruits per flower truss reduced the workload for growers. On the other hand, as it is a soft fruit, strawberries are difficult to transport over long distances, but many of these new production areas were far from the big cities. Hence fruit hardness became one of the breeding targets, especially for those areas that aimed to export fruit to South East Asia or the Middle East.

One of the characteristics of the Japanese strawberry market is year-round demand. Even though the introduction of protected cropping systems and early cultivars advanced the harvest season, off-season production was difficult to achieve. Everbearing cultivars provided a possible solution. The Japanese everbearing cultivar 'Ōishi-Shik-inari' (a descendant of 'Crimson Monarch') was introduced in 1966. This became the basis of most of the Japanese everbearing progeny. Everbearing also attracted attention from vertical farming, because of a better unit price over leaf vegetables and the suitability of the crop under continuous artificial light. However, strawberry production in vertical farming has a particular issue: pollination. Inventions in instruments, robotics, as well as breeding for vertical farming-friendly lines, may enhance production in vertical farming systems.

Another new trend in Japanese strawberry breeding is the development of F_1 cultivars used as seedlings. Utilization of seedlings rather than clonal runners has advantages in pathogen control, reducing the growers' investment in mother plant protection and plantlet production, in addition to the expected hybrid vigor. These new trends have triggered significant investment from the private sector, so that today, both the private and public sectors are engaged in strawberry breeding. ●

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EXPLORING THE DIVERSITY OF HORTICULTURE

› Development of apple cultivation in Brazil

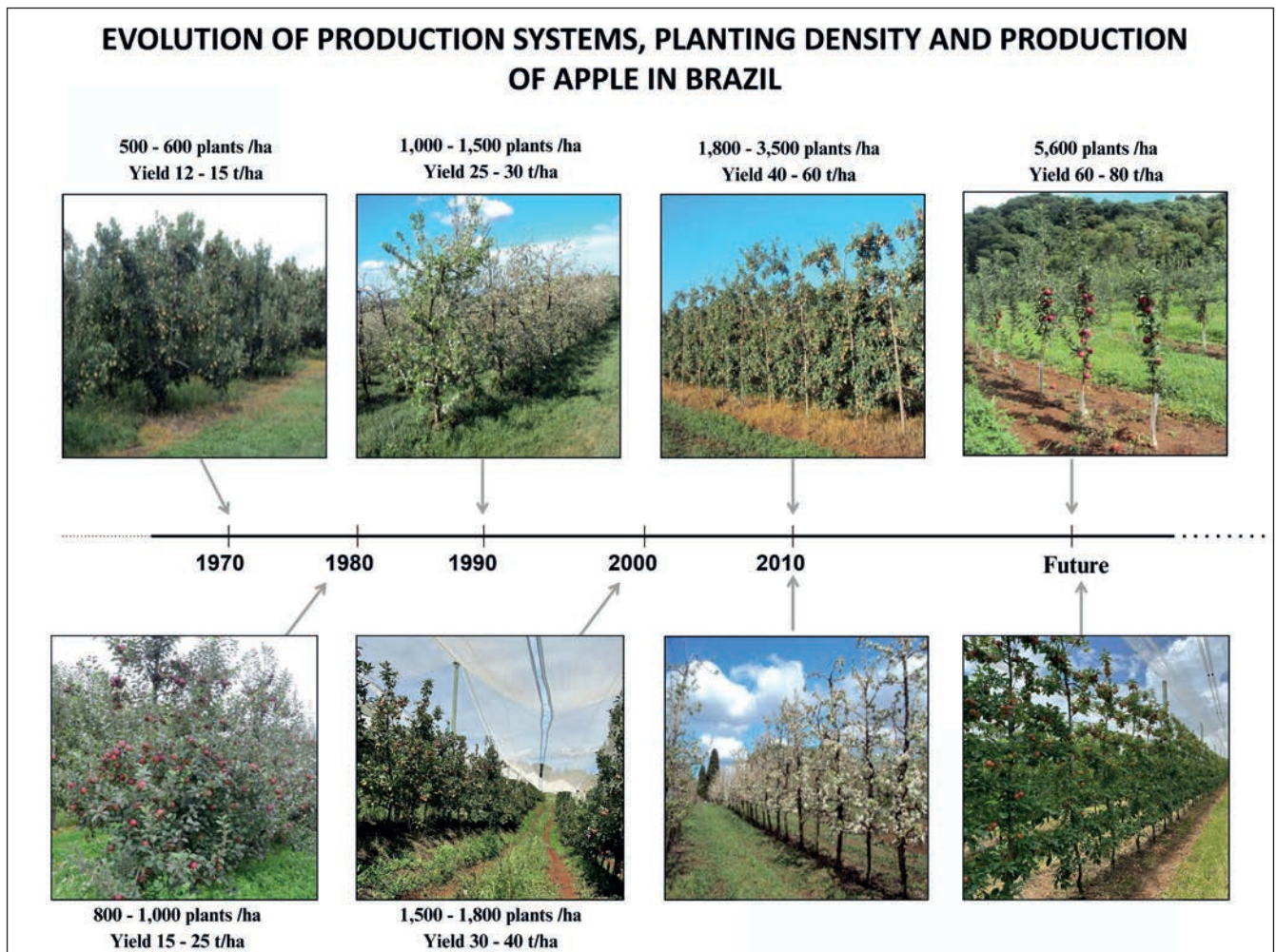
José Luiz Petri and Everlan Fagundes

While Brazil is more often recognized as one of the world's leading citrus producers, it is also a significant producer of apples. Until the early 1970s, Brazil had only a few apple orchards and with no organized production chain, was therefore reliant on imports to meet the domestic demand (Frey, 1987). In latter decades, commercial plantations began to appear and by the 1990s, apple production not only met the demands of the local market, but Brazil had also become an apple exporter.

The evolution of apple cultivation in Brazil occurred very quickly, increasing from 342,330 tons in 1987/88 to an annual average of 1,050,000 tons (Anuário Brasileiro da Maçã, 2019) (Table 1).



■ Figure 1. 'Fuji Suprema' (A) and 'Fuji Standard' (B), showing the difference and color of the epidermis.



■ Figure 2. Evolution of production systems, planting density and production of apple in Brazil.

■ Table 1. Evolution of the planted area, production, export and import of apples in Brazil.

Year	Area (ha)	Production (t)	Export (t)	Import (t)
1987/88	22,073.00	342,331	-	-
1988/89	22,777.00	364,830	-	-
1989/90	25,152.00	351,028	-	-
1990/91	25,327.00	330,751	-	-
1991/92	25,624.00	403,000	-	-
1992/93	25,233.00	513,387	-	-
1993/94	26,216.00	456,800	24,170	48,577
1994/95	26,236.00	495,400	30,146	87,666
1995/96	27,572.00	544,000	12,085	245,032
1996/97	28,116.00	669,102	3,309	324,780
1997/98	28,369.00	708,902	20,725	120,281
1998/99	29,213.00	726,083	10,706	125,166
1999/00	29,228.00	968,063	57,438	66,377
2000/01	31,006.00	709,815	64,480	43,651
2001/02	31,487.00	857,340	35,786	80,374
2002/03	31,516.00	703,385	65,927	53,487
2003/04	31,914.26	989,961	76,467	42,363
2004/05	33,936.82	884,347	153,043	42,478
2005/06	36,617.30	761,081	99,333	67,510
2006/07	37,802.55	995,277	57,153	77,741
2007/08	37,802.55	984,000	112,076	68,574
2008/09	38,726.00	1,053,000	112,250	55,042
2009/10	39,154.00	1,227,000	98,264	61,343
2010/11	38,325.00	1,251,284	90,818	76,879
2011/12	38,883.00	1,184,000	48,666	96,565
2012/13	38,420.00	1,067,665	72,253	57,920
2013/14	37,579.00	1,173,308	85,429	93,964
2014/15	35,872.00	1,156,176	44,294	116,697
2015/16	34,636.00	828,088	60,112	77,395
2016/17	33,973.00	1,338,364	30,617	155,479
2017/18	33,116.00	1,102,696	55,457	78,475
2018/19	32,222.00	1,108,449	70,997	75,121
2019/20	32,433.00	948,665	56,465	78,459
2020/21	32,469.00	1,276,784	62,564	107,320
2021/22	32,890.00	1,025,000	90,048	50,978
2022/23	33,311.00	1,057,000	35,052	129,986
2023/24	33,050.00	884,000	35,814	153,707
2024/25	33,000.00	850,000*	10,000*	220,000*

*estimate

The apples produced in Brazil primarily serve the domestic market, with 5-10% exported to China, India and 30 other countries. On average, exports range from 30,000 to 80,000 tons. Most of the apple production in Brazil is located in the southern states of Rio Grande do Sul, Santa Catarina and Paraná at an altitude of 900 to 1400 m. In recent years, the area planted with apples has been stable at around 33,000 ha, making Brazil one of the top ten largest apple producers in the world. With the high level of technology employed in orchards, combined with the increase in planting density, high yields have been consistently achieved without compromising the quality and sustainability of the sector.

The apple industry is an example of how the public sector and the private sector can work together and contribute to economic and social development. It is a productive and sustainable industry, producing primarily fresh fruit and a small quantity of juice. The industry generates direct and indirect jobs, providing income to all social strata, and preserves natural resources, reducing environmental impacts through the use of integrated production systems, which carefully select the agrochemicals used and give preference wherever possible to biological alternatives.

'Gala' and its clones are responsible for about 60% of the planted area, followed by 'Fuji' and its clones (30%) and other cultivars (10%), particularly 'Eva', which has a low chilling requirement and early maturation. Through genetic improvement, several new cultivars have been developed, including 'MonaLisa', 'Luiza', 'Venice', 'Serrana' and 'Isadora', where breeders have focused on the quality of the fruit and resistance to fungal diseases. Nevertheless, the introduction of new cultivars has been slow (Denardi et al., 2019).

Despite the area planted, 'Gala' has been found to be highly susceptible to *Colletotrichum* spp., which causes a disease known as Gala leaf spot that leads to premature leaf fall. Mutations resistant to this fungal disease have been selected, among which 'GalaGui' stands out with good color and stripes, and 'Galidia' for its intense red color without stripes. For 'Fuji', due to the climatic conditions, it has difficulty acquiring the red color, so the 'Mishima' mutation, with better red color than 'Fuji', was introduced, and the 'Fuji Suprema' mutation was selected, which acquires its red color very early at the beginning of fruit development. This is currently the most widely planted clone of 'Fuji' in Brazil (Figure 1).

In relation to orchard management, while yields in the 1980s were around 10-15 t ha⁻¹, apple production in Brazil currently achieves an average of 35-39 t ha⁻¹, with some producers reaching 60 t ha⁻¹. Among these technol-



■ Figure 3. New training systems in the two-dimensional system adopted in new plantations in Brazil.

ogies, planting density and improved training systems are the most prominent, not only increasing yield, but also facilitating the mechanization of orchards. At the end of the 1980s, the average planting density was 600-800 trees ha⁻¹, increasing to around 2500-3500 plants ha⁻¹ in two-dimensional training systems (Figures 2 and 3). Currently, new training systems are being introduced, such as the Goyo system, multi-leader system and the central two-dimensional leader system, all of which aim for better fruit quality and to reduce manual labor. To facilitate this, the M-9 or Marubakaido rootstock with M9 filter has increasingly been used, and the new CG series rootstocks such as the CG 202, CG 210, CG 213 and CG 814 are slowly being introduced. To accommodate climate change, technologies to induce sprouting (dormancy breaking)

have been introduced (Figure 4). More effective fruiting has been facilitated by the use of growth regulators; chemical thinning has improved quality and reduced labor costs; and, through the improved control of vegetative growth through training systems and the use of growth regulators, pruning operations have been reduced by up to 80%. Better harvest management, to either advance or delay the harvest point, has allowed growers to rationalize their labor. Improved fertilization, based on the export of nutrients by the fruits and mineral analysis of leaves, has seen yields further improve. Improved pesticide application technology has greatly reduced the negative impacts of chemicals and the environment and greatly improved the efficacy of treatments. Biological control of red mite through the rearing and introduction of predatory mites into the orchard, and

pest and disease monitoring technologies have greatly reduced the quantities of chemicals applied. Fruit losses have been reduced through improved controlled atmosphere storage systems that allow fruit to be stored for up to 10 months, with protected cropping systems greatly reducing losses from hail damage (Figure 5). Despite these improvements, one of the major concerns within the apple industry is labor (Bittencourt et al., 2011). Investments continue to be made in mechanization, especially in harvesting and mechanical pruning. To improve food safety, the industry has adopted certification systems to ensure that the consumer is supplied with high-quality fruit that is free of agrochemical residues, and that workers have been treated fairly and equitably. ●



■ Figure 4. View of an orchard with sprouting inducer (left) and with a lack of cold (right).



■ Figure 5. View of an orchard with anti-hail cover

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

Division Plant Genetic Resources and Biotechnology

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We are delighted to present our report on the successful X International Scientific and Practical Conference on Biotechnology as an Instrument for Plant Biodiversity Conservation (physiological, biochemical, embryological, genetic, and legal aspects) (BIOTECH2024),

held from November 19-21, 2024, at the NASC Complex, New Delhi, India. The primary objective of BIOTECH2024 was to bring together leading scientists and emerging researchers from across the globe to share ground-breaking research findings,

foster collaborative activities, and to chart a course for addressing pivotal challenges in plant biodiversity conservation, plant biotechnology, and related aspects. The conference encompassed critical areas of plant biology research, including physiological,



> Conference participants.

biochemical, embryological, genetic, and legal aspects of plant genetic conservation. The event was organized by the Indian Council of Agricultural Research - National Bureau of Plant Genetic Resources (ICAR-NBPGR), under the aegis of the International Society for Horticultural Science (ISHS), in collaboration with the Alliance of Bioversity International and CIAT, and CIMMYT (International Maize and Wheat Improvement Centre). The conference was attended by 87 participants from 12 different countries, including Brazil, Canada, China, Germany, India, Italy, New Zealand, the Russian Federation, Senegal, Spain, Thailand and the United States. The program featured a wide array of activities designed to engage and inspire delegates:

- 2 keynote lectures focused on critical areas of plant biodiversity conservation and biotechnology, presented by 1) Dr. Thomas A. Lumpkin, Emeritus Director General, Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), El Batán, Mexico, and



> Conference abstract book release at the inaugural session. From left to right: Dr. Surendra Kumar Malik, Conference Co-Convener; Dr. G.P. Singh, Director ICAR-NBPGR; Dr. D.K. Yadava, ADG (seed), ICAR; Dr. Himanshu Pathak, Secretary DARE & DG ICAR; Dr. Thomas A. Lumpkin, Emeritus DG CIMMYT and keynote speaker; Dr. Patrícia Paiva, ISHS Vice-President in charge of Young Minds; Dr. Sandhya Gupta, Conference Convener & Principal Scientist, ICAR-NBPGR.



> Eminent speakers: A) Dr. Sarada Krishnan, Director of Programs, Global Crop Diversity Trust, Germany; B) Prof. Praveen Saxena, Director, GRIPP, Department of Plant Agriculture, University of Guelph, Canada; C) Dr. Gayle Volk, National Program Leader, National Laboratory for Genetic Resources Preservation, USDA-ARS, USA.

Chairman, The Borlaug Training Foundation, Fort Collins, CO, USA, on topic “The nexus between climate change and biodiversity: a review of where we are”, and 2) Dr. G.P. Singh, Director, ICAR-NBPGR, New Delhi, India, on topic “Plant genetic resources management in India: achievements and current status”.

- 22 oral and 19 poster presentations provided a platform for researchers to showcase their innovative research work;
 - 2 outstanding contributions from emerging researchers were recognized through the ISHS Young Minds Awards: the award for the best oral presentation was given to Ms. Varshini Rajesh Ambekar from Ramaiah College of Law, India, for her presentation entitled “Ratnagiri mangoes and Basmati rice geographical indication – a case study of biodiversity conservation” and to Mr. Balkrishna Nayak from ICAR - Indian Agricultural Research Institute, India, for the best poster presentation entitled “Evaluation of leaf curl disease resistant backcross lines of tomato for agro-morphological and processing traits”.
- During the conference, social and technical events were organised to expose participants to Indian culture and research activity taking place in the country. On the first day, delegates attended a cultural programme, showcasing Indian culture and food. On the third day, delegates visited the National Gene Bank at ICAR-NBPGR and the National Agricultural Science Museum of ICAR. This was followed by visits to iconic landmarks, includ-



> Dr. Patrícia Paiva, ISHS Vice-President in charge of Young Minds, presenting the ISHS Young Minds Awards to A) Varshini Rajesh Ambekar for the best oral presentation, B) Balkrishna Nayak for the best poster.

ing Qutub Minar, India Gate, and the National War Memorial Museum in New Delhi. BIOTECH2024 served as an excellent platform for advancing knowledge, forging new collaborations, and inspiring innovative approaches to plant biodiversity conservation. We extend our heartfelt gratitude to all participants and speakers, and the team of ICAR-NBPGR for making this event a resounding success, and to the ISHS for giving us the opportunity to organise the conference in India. 🟢

Sandhya Gupta and Surendra Kumar Malik

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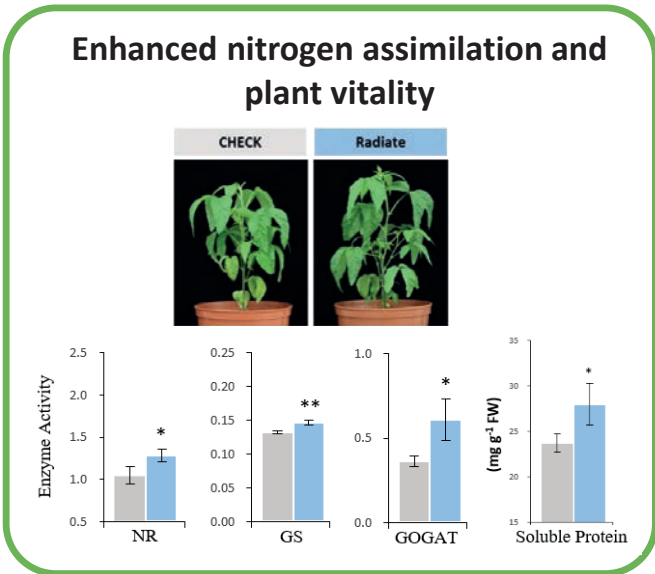
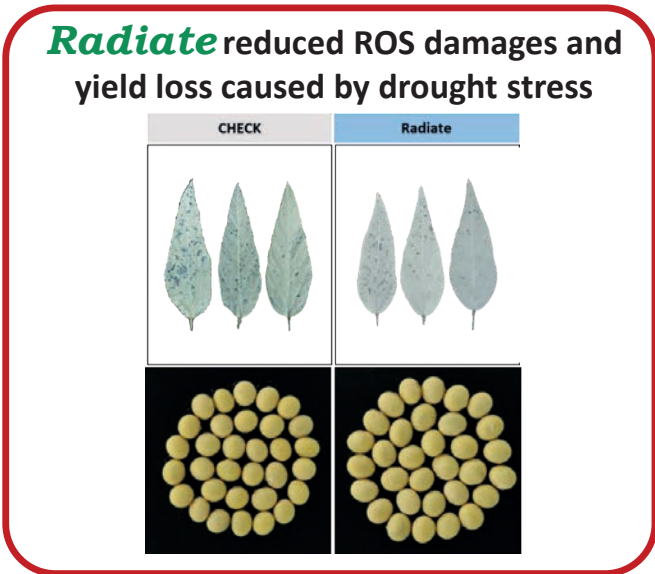
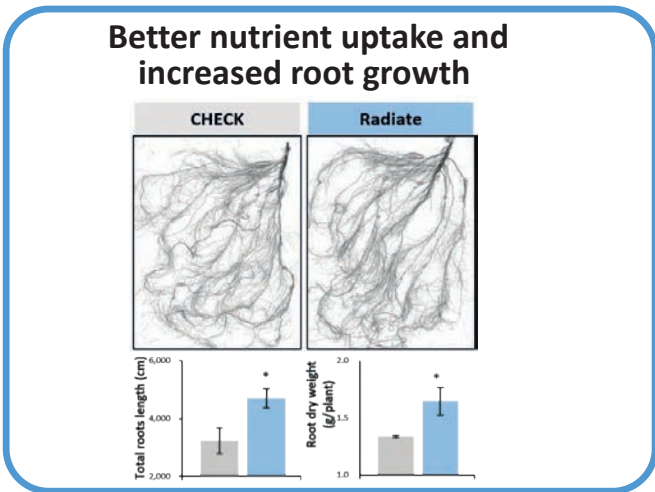
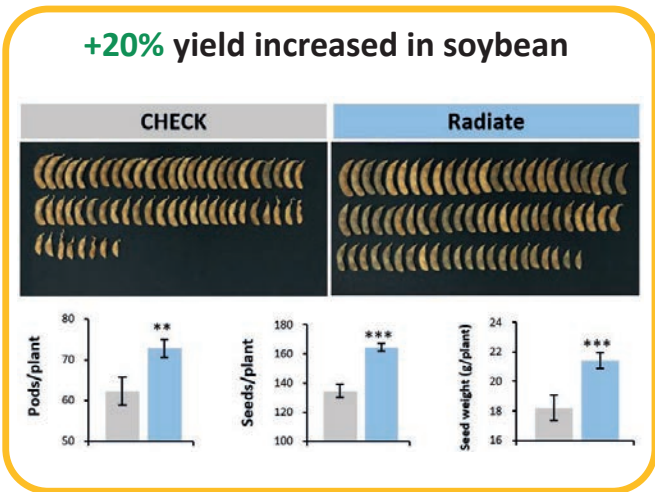
> Exhibition: display of biodiversity at ICAR-NBPGR stall.

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› V International Conference on Fresh-Cut Produce: Maintaining Quality and Safety

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Division Protected Cultivation and Soilless Culture

#ishs_dpro

Division Vegetables, Roots and Tubers

#ishs_dveg

The “V International Conference on Fresh-Cut Produce: Maintaining Quality and Safety” was successfully held in Foggia, Italy, under the aegis of the International Society for Horticultural Science (ISHS). In the last 20 years, the research group led by Prof. Maria Luisa Amodio and Prof. Giancarlo Colelli at the University of Foggia has been among the most active groups in R&D, training and networking related to fresh-cut products. Hosting this symposium provided another opportunity to promote the activities of this research group and to share with industry the latest results on the topic.

The symposium revolved around seven oral sessions dedicated to “Physiological responses to damage and post-cutting behavior”; “Pre-harvest factors affecting quality and post-cutting performances”; “Innovative technologies to extend shelf-life of cut products – I and II”; “Modified atmo-



› Prof. Milena Corredig (Aarhus University, Denmark) delivering the opening lecture.

sphere advances and packaging solutions”; “Product safety”; and “Green technologies and product innovation”.

In addition, two special sessions were included in the program: “Project POFACS: shelf life, quality and safety of high-convenience fresh produce”, which discussed the results obtained from a 4-year national project funded by the Italian Ministry of Research and Education (PON ARS01_00640) and the 12 scientific institutions and industry partners, and “CIRCUL-A-BILITY: re-thinking packaging for circular & sustainable food supply chains of the future”, dedicated to the EU-funded COST Action project involving scientists from more than 30 countries (CA19124).

The opening lecture on “There is no food without a package – redefining sustainable products” was given by Milena Corredig from Aarhus University, Denmark, who described the imbalance between food and plastic



› Participants of the conference.

waste, with only 5% of food packaging in the EU being recycled in a closed loop. She described the ambitious goals of the EU Circular Economy Action Plan for reducing packaging waste by 2030-2040, pointing out that packaging is crucial for food safety, although the environmental costs remain high. She emphasized the need for balanced, innovative approaches to sustainability, possibly through multidisciplinary collaboration in order to design packaging that is economically viable while reducing its carbon footprint. Throughout the symposium, seven invited keynote presentations were delivered. Sunil Parek (National Institute of Food Technology Entrepreneurship & Management, India) presented a talk on “Physiological responses to damage and post cutting behavior”. He focused on the main mechanisms of deterioration, the factors significantly impacting post-cutting quality, the management of physiological responses, and emerging technologies and proper handling techniques to minimize quality loss in fresh-cut produce. The keynote address delivered by Francesco Orsini (University of Bologna, Italy) was entitled “Cultivating tomorrow: how indoor vertical farming will bring a revolution in fresh-cut leafy greens and herbs”. Francesco highlighted the environmental and economic benefits provided by vertical farming, such as energy and water savings (e.g. LED lighting, advanced climate control, and dynamic planting systems) along with the reduction of food loss and waste, and shorter food transportation distances. However, energy costs and technological inefficiencies still persist. Qingguo Wang (Shandong Agricultural University, China) talked on “Current and future strategies for enzymatic browning control”. His presentation covered various methods for controlling browning, including physical techniques, chemical inhibitors, and biological approaches, pointing out their limitations and presenting future possibilities based on natural inhibitors, improved treatment effectiveness, and biotechnological solutions like RNA interference and CRISPR/Cas9 for better controlling enzymatic browning. Fatima Poças (Portuguese Catholic University, Portugal) discussed “Integration of decay indexes and food waste potential in LCA studies of fresh product packaging”. This talk focused on the crucial role of packaging in sustainability, protecting food and avoiding losses, therefore optimizing resource use, while promoting efficient business practices. Looking at five alternative packaging systems for cherry tomatoes, a comparative life cycle assessment was presented to assess how each met the new targets foreseen by the EU Packaging and Packaging Waste Directive.



› A view of the audience during one of the parallel sessions.



› Industry Forum on “The state of the fresh-cut sector: weaknesses, opportunities and possible scenarios”. From left: Mirko Aldinucci (www.freshcutnews.it), Evette Hammond (PrepWorld, UK), Antonio Salvatore (Ortofrutta Italia, Italy), Drew McDonald (Taylor Farms, USA), Qingguo Wang (Shandong Agricultural University, China).

Ana Allende (CEBAS, Spanish National Research Council, Spain) presented a paper on “Produce safety systems from the field to the table: innovations in a changing world”, illustrating European regulations and highlighting the difficulties in implementing HACCP at the primary production level. She emphasized the need for innovative water treatments to reduce microbial contamination and improve safety, and discussed the need to monitor the environment, to improve labeling, to address new hazards, and to effectively inform consumers. Giovanni Attolico (Institute of Industrial Technologies and Automation – STIIMA-CNR, Italy) discussed the application of artificial intelligence (AI) with a presentation entitled “AI-empowered imaging in the supply chain

of agricultural products”. The talk described AI methods used for monitoring the quality of fresh-cut products, including machine learning and deep learning, focusing on the present challenges related to the need for large datasets, explainable AI, and systems adaptable to uncontrolled environments. He envisioned deeper human-AI collaboration for enhanced decision-making and transparency. Finally, the presentation by Francisco Artés Hernández (Universidad Politécnica de Cartagena, Spain) entitled “From waste to worth: by-products revalorization in the fresh-cut industry” discussed the sustainable valorization of horticultural by-products, focusing on the extraction of bioactive compounds using advanced techniques like ultrasound-assist-



› Technical tour: participants visiting a production facility of Bonduelle in Battipaglia.

ed extraction. He highlighted the importance of optimizing extraction conditions and the use of polysaccharides as carriers for encapsulation, and explored the potential applications of the extracts in fresh-cut produce and functional foods, underscoring the need for green technologies to minimize waste and improve the sustainability of the industry. In addition to these invited lectures, participants presented 53 oral papers and 75 posters. The symposium also included an Industry Forum and technical tour. The main topic of the Forum was “The state of the fresh-cut sector: weaknesses, opportunities and

possible scenarios”. It consisted of a round table where representatives of the fresh-cut industry from Italy, UK, China, and USA were interviewed by Mirko Aldinucci, Director of www.freshcutnews.it, on the situation of the industry in their respective countries, with reference to market volumes, marketing strategies, role of R&D, and points of weakness.

The technical tour included visits to production and processing facilities of Bonduelle and La Linea Verde in the area of Salerno, the “Baby Leaf District” and the home of the “Rucola della Piana del Sele PGI”, which is considered one of the most important areas for salad bag production in Europe.

Many scientists and industry representatives participated in and supported the event, creating a unique opportunity for interaction among people from different research fields. Moreover, networking was encouraged during coffee and lunch breaks, and the many cultural and social events included in the program. Participation was very high in comparison with previous symposia, with more than 160 people present from 18 countries.

From the 23 young scientists who were nominated for the ISHS Young Minds Award, Akshay Sonawane (Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany) was awarded for the best oral presentation entitled “A model integrating physiology, perforation, and scavenger for prediction of ethylene accumulation in fresh produce package”. The award for the best poster, entitled “The influence of different packaging on the flavor of fresh-cut chives (*Allium schoenoprasum* L.) during storage”,

was received by Dan Wang (Beijing Academy of Agriculture and Forestry Sciences, China). The ISHS business meeting, chaired by Giancarlo Colelli, Chair of ISHS Division Post-harvest and Quality Assurance, covered several topics. Most notably, discussion led to the selection of Francisco Artés-Hernández (Universidad Politécnica de Cartagena, Spain) as the host for the next symposium to be held in Spain in 2028. In addition, Maria Luisa Amodio was elected as the Chair of ISHS Working Group Fresh-cut Produce for the next four years.

The most important outcome of this symposium was confirmation of the high level of the research activity related to fresh-cut quality and safety. It was evident, given the number of attendees from industry, that they also gained something from their participation. ●

Maria Luisa Amodio and Giancarlo Colelli



› Maria Luisa Amodio (left) and Giancarlo Colelli (right), Symposium Conveners, presenting the ISHS Young Minds Award for the best oral presentation to Akshay Sonawane.

› Contact

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> VII International Symposium on Tomato Diseases

Division Vegetables, Roots and Tubers

#ishs_dveg



> Participants of the symposium.

The VII International Symposium on Tomato Diseases: a Global Perspective (71STD) was held from October 1-4, 2024, in Brasília, Brazil, at the auditorium of Embrapa Headquarters under the aegis of the International Society for Horticultural Science. The 71STD brought together 62 participants from 17 countries and featured three days of plenary sessions and a one-day field trip. The plenary sessions were well attended and the audience had stakeholders from both the fresh and processing tomato industry, scientists from both governmental and private institutions, business managers, technical staff from tomato producing farms, seed company representatives, technical personnel from agrichemical and nursery companies, and students. Most noteworthy was the participation of young scientists and professionals associated with the tomato pathology community. Their attendance will be key to the future of the Society and the ISHS Working Group Tomato Diseases.

During the Opening session, Dr. Warley Nascimento, Head of the Embrapa Vegetables center, which is the main agricultural research and dissemination institution of the Brazilian government, welcomed the participants and in a well-articulated presentation, outlined the main activities of Embrapa Vegetables.

Prof. Ferdinando Branca, Chair of ISHS Division Vegetables, Roots and Tubers, presented the Society to the participants, actively promoting the next International Horticultural

Congress (IHC2026) to be organized in Japan. Finally, the Co-conveners of the 71STD, Prof. Eduardo Mizubuti, from the Universidade Federal de Viçosa, Dr. Alice Kazuko Inoue-Naga-



> Local organizing committee and supporters. Back row, left to right: José Luiz Pereira, Cynthia Sabino, Jonas Rafael Vargas, Douglas Felix, Eduardo S.G. Mizubuti and Ivair Morais Jr. Front row, left to right: Nadson Pontes, Valdir Lourenço Jr., Natália Faustino and Alice K. Inoue-Nagata.



› The steering committee of ISHS Working Group Tomato Pests and Diseases. From left to right: Alice K. Inoue-Nagata, Chair of the Working Group; Ferdinando Branca, Chair of ISHS Division Vegetables, Roots and Tubers; and Jessica Chitwood-Brown, coordinator of the Working Group's Forum.



› Ferdinando Branca, Chair of ISHS Division Vegetables, Roots and Tubers, presenting the ISHS Young Minds Awards to A) Cíntia Sabino de Oliveira for the best oral presentation, B) Hiago Antonio Silva for the best poster presentation.

gata, from Embrapa Vegetables, Prof. Dr. Nadson Pontes, from the Instituto Federal Goiano - Morrinhos, and Dr. Valdir Lourenco Jr, also from Embrapa Vegetables, presented the program for the symposium.

The 7ISTD symposium covered a wide range of tomato diseases caused by fungi, oomycetes, bacteria, nematodes and viruses. Twelve invited speakers presented very interesting key topics, addressing both fundamental biological aspects and applied disease management strategies. Additionally, six oral sessions featured presentations from selected abstracts, offering new insights into pathogen biology, disease epidemiology and diagnostic tools, climate change impacts on disease management, and emerging control

strategies. In total, 26 abstracts were submitted, of which 22 were presented orally and 4 as posters. The quality and diversity of the presentations highlighted the complexity and importance of tomato diseases within regional and global horticulture. The meeting emphasized both scientific advances and practical solutions, with discussions pointing towards future research that may directly impact disease control practices in agriculture.

Two students were awarded the ISHS Young Minds Awards, in recognition of their outstanding oral and poster presentations. Ms. Cíntia Sabino de Oliveira is a second-year doctorate student at São Paulo State University, Brazil, working on geminiviruses. She

gave an oral presentation on “Interactions between begomovirus and *Bemisia tabaci* Mediterranean and survey of virus in tomato greenhouses in São Paulo state”. Dr. Hiago Antonio Silva, recently graduated from the Federal University of Viçosa, Brazil, presented a poster on the biological control of tomato early blight entitled “*Clonostachys* spp. secondary metabolites in the control of tomato early blight”. Their work showcased innovative approaches and methodologies, contributing to the ongoing dialogue on sustainable disease management.

Under the radiant Brazilian sun, participants of the 7ISTD embarked on a fascinating field trip beyond the conference halls. Venturing to the outskirts of Brasília, they immersed



› Field trip to Malunga farm, a high-tech organic farm near Brasília.

themselves in the world of tomato production, witnessing firsthand the diversity of approaches employed in the region. From the meticulously managed rows of a high-tech organic farm to the plots of a small-scale fresh tomato producer, the attendees gained valuable insights into various cultivation techniques and challenges. The day culminated with a visit to a sprawling, industrial operation, where processing tomatoes flourished under center-pivot irrigation. This immersive experience transcended mere scientific observation, promoting cross-cultural exchange as researchers from around the globe connected with Brazilian practices, fostering a deeper understanding of tomato production in a different context. Important topics were discussed during the ISHS business meeting such as the venue for the next symposium. Two proposals were put forth by Canadian and Chinese research

groups as potential hosts. The next symposium should take place within the next 3-4 years, but the venue has yet to be confirmed. In addition, it was decided to establish a permanent forum among researchers, grower associations, breeders and seed companies, for discussion of the main topics related to tomato diseases. The forum should meet virtually once or twice a year. The objectives of the forum are to facilitate the fast dissemination of news about emergent and re-emergent tomato diseases spreading around the

world. Another recommendation during the ISHS business meeting was to change the name of the Working Group to “Tomato Pests and Diseases”.

The success of 7ISTD demonstrates the critical importance of continuous research and international collaboration in managing tomato diseases and advancing horticultural science and networking. ●

*Eduardo S.G. Mizubuti and
Alice Kazuko Inoue-Nagata*

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> XIII International *Vaccinium* Symposium

Division Vine and Berry Fruits

#ishs_dvin

Division Horticulture for Human Health

#ishs_dhea

Division Protected Cultivation and Soilless Culture

#ishs_dpro

Commission Agroecology and Organic Farming Systems

#ishs_cmor

The XIII International *Vaccinium* Symposium was held on August 24-29, 2024, 57 years after the first symposium in Venlo, The Netherlands. Hosted by Dalhousie University in Nova Scotia, New Brunswick, and Prince Edward Island, Canada, under the auspices of the International Society for Horticultural Science (ISHS), the symposium attracted 270 participants including presenters, staff, researchers, industry representatives, and government agents from over 40 countries. With some 200 oral and 70 poster presentations, the symposium provided an opportunity for participants to share their knowledge and experiences on a wide range of topics involving *Vaccinium* species and to participate in the accompanying trade show. The symposium commenced with a pre-symposium tour to the Annapolis Valley on August 24, with a morning visit to the Terra Beata cranberry operation near Aylesford. Participants were provided with a taste of

Nova Scotia cuisine during the lunch held at the Long Table Social Club, located at the scenic Scots Bay. The afternoon was spent at the Blueberry Acres located in Centreville, where an overview of the new highbush blueberry plantings and fresh packing operations were provided.

Attendees also had an opportunity, prior to the formal start of the symposium, to participate in the Genome Database for *Vaccinium* (GDV) and Breeding Information Management System (BIMS) workshop. Organized by Jodi Humann, Sook Jung, Dorrie Main and Massimo Iorizzo, the workshop provided the opportunity to use the integrated data and tools in GDV to gather information for research and breeding and use the BIMS (www.breedwithbims.org) to manage private breeding program data.

The symposium formally commenced on August 26 in the Marion McCain Building of Dalhousie University. Five keynote speakers

spoke at the symposium, with Jeff LaFleur (Vice President of Grower Relations, Ocean Spray, USA) providing the first presentation entitled “Tasty little puckers,” which included an overview of the cranberry sector, followed with Cort Brazelton (Co-CEO of Fall Creek, USA) giving a presentation entitled “Blueberries: where have we been and where are we going”. David Yarborough (Emeritus Professor of Horticulture, University of Maine, USA) provided an overview of the history and present status of the wild blueberry sector. The symposium was also very appreciative of the marketing and health insights provided by Kasey Cronquist (President) and Leslie Wada (Senior Director of Nutrition and Health Research) of the North American Blueberry Council, USA, during their keynote presentation entitled “Strategies for blueberries in an increasingly global economy.” An insight into blueberry cultivar development activities was provided by James Olmstead (Global



› Participants of the symposium.

Blueberry Breeding Director, Driscoll's Inc., USA) with a presentation entitled "The pulse of blueberry breeding activities," with additional information involving new breeding technologies provided by Massimo Iorizzo (Associate Professor and Faculty Scholar, North Carolina State University, USA) during his presentation entitled "Building a collaborative framework to advance breeding tools for blueberry and cranberry."

Over the course of the three days, oral and poster presentations were made across a diverse range of disciplines including breeding, genetics, genomics and phenomics; berry composition, quality and postharvest physiology; pest management; production systems and sustainability; germplasm and propagation; soil fertility, plant physiology and plant nutrition; and precision agriculture. Session moderators ensured that the presentations proceeded efficiently and effectively. We acknowledge the assistance of Maxime Paré (University of Quebec, Canada), Philip Fanning (University of Maine, USA), Laura Jaakola (Arctic University of Norway/NBIO, Norway), Christie Almeyda (North Carolina State University, USA), Amanda Davis (Oregon State University, USA), Susan McCallum

(James Hutton Institute, United Kingdom), Nesibe Ebru Kafkas (University of Cukurova, Türkiye), Paulina Palonen (University of Helsinki, Finland), James Polashock (United

States Department of Agriculture, USA), Jodi Humann (Washington State University, USA), Richard Espley (Plant and Food Research, New Zealand), Nahla Bassil (National Clone



› Convener David Percival (right) and Philip Fanning (left) presenting the ISHS Young Minds Award for the best oral presentation to J. Martin Zapien-Macias."



› Convener David Percival (right) and Rhea Lumactud (left) presenting the ISHS Young Minds Award for the best poster presentation to Sara Knowles.



› Getting prepared for the unmanned aerial vehicle demonstration during the field tour research and demonstration day.



› Visiting the Blueberry Acres highbush blueberry operation in Centreville, Nova Scotia.



› Technical sessions at the Prince Edward Island Convention Center.

Germplasm Repository, USA), Leslie Holland (University of Wisconsin, USA), Martin Jensen (Aarhus University, Denmark), Renee Holland (Corteva, USA), Inger Martinussen (NIBIO, Norway), Massimo Iorizzo (North Carolina State University, USA), and Marion Tétégan Simon (Valores, Canada).

Numerous oral and poster presentations were made by participants as part of the ISHS Young Minds Awards Competition. The symposium acknowledges the efforts of Philip Fanning and Rhea Lumactud (Co-Chairs of the Young Minds Awards Competition) and members of the competition committee in assessing the numerous oral and poster presentations. The caliber of the presentations was excellent and the Organizing Committee extends our gratitude to those who participated. The ISHS Young Minds Award for the best oral presentation was awarded to J. Martin Zapien-Macias from the Horticultural Sciences Department of University of Florida, USA, for the presentation entitled “Increasing canopy light interception to improve fruit ripening duration and uniformity of southern highbush blueberry.” The ISHS Young Minds Award for the best poster presentation was awarded to Sara Knowles from the Depart-

ment of Plant Biology of Rutgers University, USA, for the presentation entitled “Unusual leaf and fruit morphology in a cranberry population bred for low fruit acidity.”

Over the six day duration of the symposium, attendees had opportunities to engage in many social activities that included a lively musical tour of the Halifax Harbor on the tall ship *Silva*; a tour of berry crop sectors in Nova Scotia and New Brunswick; a visit to the Fort Beausejour-Cumberland historic site, and the opportunity to participate in a traditional seafood supper and entertainment on the beach at the Rodd Crowbush resort on Prince Edward Island.

Attendees also had the opportunity at the Prince Edward Island Convention Centre to engage with international and local companies, producer associations, and professional societies that participated in the trade show. Situated in the same room as the poster presentations, this helped facilitate cooperation and dissemination of the latest knowledge and technology-based products, processes, and services involving *Vaccinium* species.

The Business Meeting for ISHS Working Group *Vaccinium* Species and Management occurred on the last day of the symposium.

The patience, hard work, and perseverance of numerous people contributing to the symposium was acknowledged. A presentation was made by Qilong Zeng and Hong Yu on behalf of the Institute of Botany, Jiangsu province, and Chinese Academy of Sciences (JIB) to host the XIV International *Vaccinium* Symposium in 2028. Attendees were provided with insight into the proposed scientific program, hotel and meeting venues, and social programs. This proposal was supported. ●

David Percival

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> XV International Citrus Congress

Division Tropical and Subtropical Fruit and Nuts

#ishs_dtro



> Congress participants at the closing ceremony.

The XV International Citrus Congress (ICC2024), a landmark event in the global citrus industry, took place from November 10 to 15, 2024, at the International Convention Center in Jeju, South Korea. Under the theme “Health, Sustainability and Productivity,” this prestigious gathering attracted 559 participants from 46 countries, including scientists, industry professionals and policymakers, to share the latest developments and challenges in citrus science. Organized by the International Society of Citriculture (ISC) and the Korean Society for Citrus and Subtropical Fruits, in collaboration with the International Society for Horticultural Science (ISHS), the congress was supported by leading domestic and international sponsors. These included government agencies, universities, research

institutions, and private companies, reflecting the broad interest and investment in the citrus industry.

Jeju, known for its vibrant citrus culture and breathtaking natural scenery, provided an ideal setting for the congress. The event not only served as a scientific platform but also highlighted the importance of regional expertise in addressing global challenges. With its focus on fostering collaboration and innovation, ICC2024 set the stage for discussions on improving citrus production while ensuring sustainability in the face of climate change and market demands.

The academic program at ICC2024 was diverse and impactful, featuring seven keynote speeches, 17 scientific sessions, and four workshops, amounting to a total of

401 presentations. These included 230 oral presentations, of which 79 were delivered by invited speakers, and 159 poster presentations. Sessions covered a wide range of topics, ensuring representation of both foundational and cutting-edge research.

Among the most popular sessions were:

- Plant physiology (47 presentations): Research in this session highlighted strategies to mitigate the impact of climate change on citrus crops. Studies presented innovative techniques to improve citrus growth stability and resilience under abiotic stress conditions.
- Huanglongbing (HLB) (37 presentations): Known as one of the most significant challenges in the global citrus industry, HLB was a major focus. Presentations



> Keynote speech by Prof. Kwan Jeong Song: “Historical journey and challenges of the Korean citrus industry.”



> Stefania Bennici, winner of the ISHS Young Minds Award for the best poster presentation.



› Technical visit to Jeju soil mulching system orchard.



› Visit to 2024 Jeju International Citrus Expo.

provided insights into developing disease-resistant citrus cultivars and advanced management techniques to combat this destructive disease.

- **Cultivars and breeding (36 presentations):** A highlight of this session was the introduction of cutting-edge research using CRISPR technology. Researchers showcased its potential to overcome self-incompatibility issues and accelerate the development of high-quality, disease-resistant citrus cultivars.

Additionally, workshops such as the Asian Citrus Initiative Network and sessions on cultivar protection and commercialization underscored the importance of regional and international collaboration in advancing citrus research.

One of the standout studies presented at ICC2024 focused on improving the citrus

rhizosphere microbiome using humic acid amendments. This research demonstrated significant potential to enhance soil health, improve nutrient uptake, and ultimately increase citrus productivity in a sustainable manner. Such approaches are vital as the citrus industry seeks to reduce its environmental footprint while meeting global demand. The application of gene-editing technologies such as CRISPR also garnered considerable attention. Researchers discussed its use in tackling genetic bottlenecks in citrus breeding, including improving resistance to pests and diseases and enhancing fruit quality. These advancements have the potential to revolutionize citrus cultivation and support the industry's long-term viability in the face of increasing environmental challenges.

A distinguishing feature of ICC2024 was its emphasis on cultural exchange, experiential learning, and networking. Participants visited Jeju's soil mulching system orchards, gaining firsthand insights into sustainable farming practices that have been honed over generations. The field visits also included a tour of the Jeju Citrus Expo, where local innovations and traditional techniques were showcased.

Social programs further enriched the congress experience. These included the Global Summit Round Talk, which fostered meaningful discussions among global citrus leaders, and specialized networking activities such as the Asian Citrus Networking Program and the Women Scientist Networking Group, offering a platform for diverse voices to collaborate. Though details of the Global Summit were limited in post-event reporting, its inclusion highlighted the importance of international cooperation in advancing citrus research.

The welcome party and closing ceremony provided a warm introduction to Korean culture, featuring a traditional tea ceremony and a performance of Korean folk music, which captivated the international audience. These activities allowed participants to con-

nect beyond academic discussions, fostering a sense of community and shared purpose.

The ISHS Young Minds Awards honored the contributions of emerging researchers, highlighting their innovative work and encouraging further excellence in the field of citrus science.

- Emma Dawson from the University of Florida, USA, received the award for the best oral presentation entitled "Short- and long-term effects of humic acid amendments on the citrus rhizosphere microbiome." Her work offered new insights into improving soil health and citrus productivity.
- Dr. Stefania Bennici from the University of Catania, Italy, received the award for the best poster for her study on "S-genotyping and genome editing to investigate the genetic basis of self-incompatibility in citrus." This groundbreaking research showcased the potential of gene-editing tools in overcoming breeding challenges.

These awards not only recognized individual achievements but also underscored the importance of fostering young talent in shaping the future of the citrus industry.

The XV International Citrus Congress was a resounding success, bringing together a diverse group of stakeholders to address the pressing issues facing the citrus industry. Through its blend of academic rigor, cultural exchange, and networking opportunities, the congress provided a comprehensive platform for collaboration and innovation. As the citrus industry navigates the challenges of the 21st century, the insights and connections forged at ICC2024 will undoubtedly play a pivotal role in shaping its sustainable future. ●

Kwan Jeong Song



› Prof. Kwan Jeong Song, President of ISC and Convener of ICC2024 (left) and Dr. Karin Hannweg, Chair of ISHS Division Tropical and Subtropical Fruit and Nuts (right) presenting the ISHS Young Minds Award for the best oral presentation to Emma Dawson.

› Contact

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From the
Secretariat

> New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Australia: Mr. Jack George, Michele OBrien, Dr. Jason Smith, Mr. Daniel Weddell; **Austria:** Gregorio Grassi, Robert Hack; **Belgium:** Dr. Steffi Pot, Ms. Evelien Rosiers, Prof. Guy Smagghe, Ms. Elise Tardy, Mr. Daniel Truyts, Mr. Francois Truyts, Ms. Pauline Truyts, Dr. Ado Van Assche, Yasmin Vanbrabant; **Brazil:** Ms. Eduarda Dorigatti Gargioni, Dr. Everlan Fagundes, José Aildo Sabino de Oliveira Júnior; **Bulgaria:** Assist. Prof. Kaloyan Kostov; **Canada:** Dr. Adnan Rasheed; **Central African Republic:** Ms. Isabelle Cuisenier-Kouzou; **Chile:** Mr. Danilo Ignacio Arellano González, Mr. Abel Gonzalez Gelves, Dr. Patricio Mejias-Barrera, Pabla Rebolledo Gonzalez, Ignacio Urra; **China:** Dr. Changxi Chen, Dr. Li Chen, Ms. Rongmei Fu, Bingguang Han, Mr. Yunpeng Hu, Zhengjin Huang, Prof. Xinqiang Jiang, Assoc. Prof. Luyang Kang, Prof. Dr. Guitong Li, Mr. Weijian Liang, Dr. Ying Liu, Luyu Shau, Prof. Dr. Jun Sun, Dr. Weituo Sun, Dr. Shumao Wang, Wei Wang, Xiaoming Wei, Dr. Chuanbao Wu, Ms. Sihui Wu, Dr. Yaqiong Wu, Fulin Xia, Dr. Rui Yang, Mr. Weicong Yang, Ms. Chen Yunyi, Peiyuan Zeng, Prof. Yanning Zhai, Dr. Zicheng Zhan, Feng Zhang, Ms. Xuemei Zhang, Ms. Meichun Zhou; **Colombia:** Prof. Dr. Hermann Restrepo-Díaz; **Czech Republic:** Dr. Barbara Tunklová; **Ecuador:** Ms. Lilita Villao; **Ethiopia:** Assoc. Prof. Kiros-Meles Ayimut, Dr. Tesfay Belay Reda; **France:** Mr. Michel Chauvet, Ms. Ludivine Coinceot, Ms. Claire Garcia, Dr. Emmanuelle Jacquín-Joly, Ms. Victoire Jaulin, Mr. Alan Keraudren, Dr. Alice Malivert, Dr. Mme Thomas, Mr. Yao Hervé Yao; **Germany:** Dr. Diaaeldin Daghma, Manh Hung Doan, Dr. Ehsan Fatemi, Mr. Seung Woo Jin, Ms. Aicha Mallouki, Ms. Annina Marxen, Shouvik Sarker, Dr. Tim-Pascal Schlie; **Ghana:** Dr. Franklin Avornyo, Mr. Robert Boham; **Greece:** Ms. Ioanna Chatzigeorgiou, Ms. Maria Ravani; **India:** Dr. Gandeeep Kaur Chahal, Ms. Sukhpreet Kaur, Dr. Chhngpuii Khawlhing, Dr. Jiffinvir Khosa; **Indonesia:** Ms. Aulia Fitriana Ardhyatul Jannah, Mr. Harryanto Harryanto, Ms. Rahma Wati Lestari, Ms. Linda Nursalma, Dr. Sari Nurulita, Ms. Gita Mairizky Ramadhani, Mr. Ibrahim Adamy Sipahutar, Efi Toding Tondok, Dr. Arif Wibowo; **Ireland:** Dr. Eoghan Corbett, Ms. Yvonne Grace; **Israel:** Dr. Amnon Cochavi, Prof. Orly Sarid; **Italy:** Dr. Giorgia Batelli, Simone Bregaglio, Alessandro Dabek, Dr. Giacomo Dito, Ms. Federica Fulcini, Luciana Gaccione, Dr. Giacomo

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> In memoriam

Prof. Dr. Moshe Arie Flaishman (1956-2024)



Prof. Dr. Moshe Arie Flaishman passed away peacefully on December 7, 2024, after a three-month battle with cancer. He left us with his love of science, horticulture and orchards. Moshe was a fig breeder and molecular biologist. He led the ISHS Working Group Figs from 2009-2019 and successfully united researchers and growers from different continents with different cultural backgrounds. He took care of young scientists and especially supported those from developing countries, and was a regular contributor to ISHS International Symposia on Fig. Moshe was also an amateur mountain climber and marathon runner. He lived a sound and great life, and is survived by his family, colleagues and friends. His publications will continue to guide future research and development work and unveil many new findings. For and on his behalf, we will continue our research and development efforts on figs.

*Huiqin Ma, Chair of ISHS Working Group Figs
Uygun Aksoy, former ISHS Board member*

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Year 2025

- March 16-21, 2025, Yancheng city, Jiangsu Province (China): **X International Strawberry Symposium**. Info: Dr. Jian Sun, Institute of Forestry and Pomology, Beijing Academy of Agriculture and Forestry, NO.12, Ruiwangfen Jia, Xiangshan, Haidian, Beijing, 100093, China. Phone: (86)10-82598882, E-mail: sjroad@126.com or Dr. Yuntao Zhang, BJ Academy Forestry & Pomology Sciences, Rui Wang Fen, Xiang-Shan, Hai Dian District, Beijing 100093, China. Phone: (86)1082598882, Fax: (86)1062598882, E-mail: zhytao1963@126.com or Prof. Mizhen Zhao, 50 Zhongling Street, Nanjing, Nanjing, 210014, China. Phone: (86)25-84390219, Fax: (86)25-84390218, E-mail: njzhaomz@163.com or Prof. Jiajun Lei, Shenyang Agricultural University, Shenyang, China. E-mail: jiajunleisy@163.com Web: <https://www.iss2025.org.cn>
- March 30 - April 4, 2025, Temecula, CA (United States of America): **XV International Protea Research Symposium**. Info: Kenneth W. Leonhardt, Dept of Horticulture, University of Hawaii, 3190 Maile Way, Rm 102, Honolulu, HI 96822-2232, United States of America. Phone: (1)8089568909, Fax: (1)8089563894, E-mail: leonhard@hawaii.edu E-mail symposium: protea2025@gmail.com Web: <https://www.proteaconference2025.org>
- May 5-9, 2025, Rimini (Italy): **International Symposium on Biotechnological Tools in Horticulture**. Info: Dr. Silvia Sabbadini, Via Breccie Bianche 10, Ancona, Italy. E-mail: s.sabbadini@staff.univpm.it or Dr. Luca Capriotti, Dept Agric., Food & Environmental Sciences, Università Politecnica delle Marche, Via Breccie Bianche 10, Ancona, Italy. Phone: (39)3662844234, E-mail: l.capriotti@staff.univpm.it or Dr. Angela Ricci, Dept Agric., Food & Environmental Sciences, Università Politecnica delle Marche, Via Breccie Bianche 10, Ancona, Italy. E-mail: angela.ricci@pm.univpm.it E-mail symposium: info@symposiumbiotechinhort.com Web: <https://symposiumbiotechinhort.com/>
- May 6-9, 2025, Adeje, Tenerife (Spain - Canary Islands): **XI International Congress on Cacti as Food, Fodder and Other Uses**. Info: Prof. Dr. M. Pilar Cano, Nicolás Cabrera, 9, 28049 Madrid Madrid, Spain. Phone: (32)910017937, Fax: (34)910017905, E-mail: mpilar.cano@csic.es or Dr. M. Gloria Lobo, Carretera del Boquerón s/n, 38270 Valle de Guerra, Spain - Canary Islands. Phone: (34) 922923316, E-mail: globo@icia.es Web: <https://www.cactuscongress2025.com/>
- May 10-15, 2025, Beijing (China): **IX International Symposium on Rose Research and Cultivation**. Info: Prof. Junping Gao, China Agricultural University, Beijing, 100193, China. E-mail: gaojp@cau.edu.cn or Prof. Dr. Nan Ma, Department of Ornamental Horticulture, China Agricultural University, No.2 Yuanmingyuan West Road, Haidian District, Beijing, 100193, China. Phone: (86)-10-62733603, Fax: (86)-10-62733603, E-mail: ma_nan@cau.edu.cn E-mail symposium: Roses2025@163.com Web: <https://www.rose2025.cn/>
- May 18-22, 2025, Wenatchee, WA (United States of America): **XIV International Controlled and Modified Atmosphere Research Conference - CAMA2025**. Info: Dr. Carolina A. Torres, Washington State Univ, 1100 N. Western Ave, Wenatchee, WA 98801, United

NEW

States of America. Phone: (1)206 331 4780, Fax: (1)509 848 2231, E-mail: ctorres@wsu.edu E-mail symposium: info@cama2025.com Web: <https://cama2025.com>

NEW

May 28-31, 2025, Mazatlán, Sinaloa (Mexico): **XIV International Mango Symposium**. Info: Prof. Dr. Sergio Marquez-Berber, 4ta Cda Huautla 3A, San Luis Huexotla, Texcoco, Mexico, 56220, Mexico. Phone: (52)15951070500, Fax: (52)15959521642, E-mail: sermarber@gmail.com E-mail symposium: info@mango2025.com Web: <https://mango2025.com/>

NEW

June 1-5, 2025, Richland, WA (United States of America): **X International Cherry Symposium**. Info: Dr. Matthew Whiting, Washington State University, IAREC, 24106 N. Bunn Road, Prosser, WA 99350, United States of America. E-mail: mdwhiting@wsu.edu Web: <https://www.xishscherrysymposium.com/>

June 2-6, 2025, Thessaloniki (Greece): **IX International Symposium on Seed, Transplant and Stand Establishment of Horticultural Crops and III International Symposium on Vegetable**

Grafting. Info: Athanasios Koukounaras, Aristotle University of Thessaloniki, Alamanas 33, 55 132 Kalamaria, Thessaloniki, Greece. E-mail: thankou@agro.auth.gr Web: <https://sest-vg2025.com/>

June 22-27, 2025, Almería (Spain): **GreenSys2025 - International Symposium on Advanced Technologies and Management for Sustainable Greenhouse Systems**. Info: Prof. Dr. Diego L. Valera, Dpto. Ingeniería, Universidad de Almería, Ctra Sacramento sn, 04120 Almería, Spain. Phone: (34)950015546, E-mail: dvalera@ual.es or 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 E-mail symposium: greensys2025@ual.es Web: <http://www2.ual.es/greensys2025/>

NEW

June 23-26, 2025, Chicago, IL (United States of America): **XV International Symposium on Plant Bioregulators in Fruit Production**. Info: Todd Einhorn, Michigan State University, Horticulture, 1066 Bogue Street, Plant & Soil Sciences Building A338, East Lansing, MI 48824, United States of America. Phone: (517) 353-0430, Fax: (517) 353-0890, E-mail: einhornt@msu.edu or Prof. Dr. Randolph M. Beaudry, Michigan State University, Department of Horticulture, A22 Plant& Soil Sci. Building, East Lansing, MI 48824-1325, United States of America. Phone: (1)517355-5191ext303, Fax: (1)517353-0890, E-mail: beaudry@msu.edu or Dr. Steven McArtney, 1910 Innovation Way Suite 100, 870 Technology Way, Libertyville IL 60048, United States of America. Phone: (1) 847-968-4722, E-mail: steve.mcartney@valentbiosciences.com or Peter Petracek, 2045 East 8th Street, Grayslake MN 60030, United States of America. E-mail: bppetr@gmail.com Web: <https://www.canr.msu.edu/hrt/2025FruitBioReg/>

NEW**NEW**

July 8-10, 2025, Melaka (Malaysia): **III International Symposium on Tropical and Subtropical Ornamentals**. Info: Prof. Dr. Asmah Binti Awal, Faculty of Plantation and Agrotechnology, UiTM Cawangan Melaka, Kampus Jasin, 77300 Melaka Merlimau, Malaysia. E-mail: asmah138@uitm.edu.my E-mail symposium: tso2025.secretariat@gmail.com Web: <https://tso2025.org/>

NEW

August 3-8, 2025, Fort Collins, CO (United States of America): **IV International Symposium on Germplasm of Ornamentals**. Info: Mengmeng Gu, Dept. Horticulture & Landscape Architecture, Colorado State University, 1173 Campus Delivery, Fort Collins CO 80523, United States of America. Phone: (1)9792299683, E-mail: mengmeng.gu@colostate.edu or Dr. Youping Sun, Department of Plants, Soils & Climate, Utah State University, 4820 Old Main Hill, Logan Utah 84335, United States of America. Phone: (1)4357972972, E-mail: youping.sun@usu.edu Web: <https://agsci.colostate.edu/hortla/isgo/>

NEW**NEW**

August 4-8, 2025, Beijing (China): **XI International Congress on Hazelnut**. Info: Prof. Jianguo Zhang, Research Institute of

Forestry, Chinese Academy of Forestry, Dongxiaofu 1, Haidian District, Beijing, China. E-mail: chinahazelnut2025@163.com E-mail symposium: chinahazelnut2025@163.com Web: <https://rif.caf.ac.cn/chinahazelnut2025/>

August 25-31, 2025, Naples and Alba (Turin) (Italy): **I International Symposium on Temperate Tree Nuts: from Agroecologically Sustainable to Organic Production**. Info: Prof. Dr. Chiara Cirillo, Dept. Agricultural Sciences, University of Napoli Federico II, Via Università, 100, 80055 Portici NA, Italy. Phone: (39)081-2539381, Fax: (39)081-7755114, E-mail: chiciril@unina.it or Prof. Roberto Botta, DISAFA - University of Torino, Largo Paolo Braccini 2, 10095 Grugliasco (TO), Italy. Phone: (39)0116708800, Fax: (39)0116708658, E-mail: roberto.botta@unito.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 Web: <https://ttn2025.it/>

September 7-12, 2025, Freising (Germany): **II International Symposium on Growing Media, Compost Utilization and Substrate Analysis for Soilless Cultivation**. Info: Dr. Dieter Lohr, Weihenstephan-Triesdorf University, Institute of Horticulture, Am Staudengarten 14, 85354 Freising, Germany. E-mail: dieter.lohr@hswt.de or Dr. Elke Meinken, Am Staudengarten 14, 85354 Freising, Germany. E-mail: elke.meinken@hswt.de or Prof. Dr. Nazim Gruda, University of Bonn, INRES Horticultural Sciences, Auf dem Hügel 6, 53121 Bonn, Germany. E-mail: ngruda@uni-bonn.de Web: <https://www.growingmedia2025.com/>

September 16-19, 2025, Bogor (Indonesia): **IX International Symposium on Edible Alliums**. Info: Prof. Awang Maharijaya, Pakuan Regency, cluster Lingga Buana, Blok E6 no 24, 16680 West Java Bogor, Indonesia. E-mail: awangmaharijaya@apps.ipb.ac.id E-mail symposium: allium2025@apps.ipb.ac.id Web: <https://allium2025.ipb.ac.id/>

September 22-24, 2025, Bari (Italy): **VI International Symposium on Pomegranate and Minor Mediterranean Fruits**. Info: Assoc. Prof. Giuseppe Ferrara, Università di Bari, Dpt. Scienze Suolo, Pianta e Alimenti, Via Amendola 165/a, 70126 Bari, Italy. Phone: (39)805442979, Fax: (39)805442979, E-mail: giuseppe.ferrara@uniba.it or Prof. Dr. Stefano La Malfa, Di3A, Catania University, Via Valdisavoia 5, 95123 Catania, Italy. Phone: (39)095-354641, Fax: (39)095-234406, E-mail: stefano.lamalfa@unict.it E-mail symposium: info@pomsym2025.com Web: <https://www.pomsym2025.com/>

September 22-26, 2025, Yunnan (China): **II International Symposium on Botanical Gardens and Landscapes**. Info: Prof. Yongping Yang, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Menglun, Mengla, Yunnan, 666303, China. Phone: (86)6918716681, Fax: (86)6918715070, E-mail: yangyp@xtbg.ac.cn or Prof. Fuchuan Wu, Xishuangbanna Tropical Botanical Garden, Yunnan, China. E-mail: wfc@xtbg.org.cn or Prof. Dr. Kanchit Thammasiri, Department of Gardening and Horticulture, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Science, Menglun, Mengla, Yunnan 666303, China. E-mail: kanchitthammasiri@gmail.com E-mail symposium: bgl2025.china@gmail.com Web: <https://bgl2025.casconf.cn/>

October 8-10, 2025, Arusha (Tanzania): **International Symposium on Artemisia**. Info: Mr. Arnaud Nouvion, 12 rue d'Ouessant, Paris, France. E-mail: anouvion@suricate.org or Assist. Prof. Emmanuel Sulle, AKU-ACER, TRPI Road, P O Box 499, Arusha, Tanzania. Phone: (255)742333575, E-mail: emmanuel.sulle@aku.edu Web: <https://www.artemisia-symposium.com/>

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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 (≥ 300 pixels per inch). Send articles or ideas for articles to:

Peter J. Batt, Editor, peterjbatt@gmail.com
Kelly Van Dijck, Associate Editor, kelly.vandijck@ishs.org

