A publication of the International Society for Horticultural Science

Chronica Horticulturae

Horticultural highlights

Metro nature for mental health and wellness: horticulture secondary benefits • Multifunctional rooftop horticulture: a promising strategy for intensifying horticulture production in cities • *Isatis tinctoria* L.: an ancient dye plant of interest as multifunctional crop • New geophytes from Turkey

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

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› Ryutaro Tao

Ryutaro Tao, ISHS Treasurer

Expanding the ISHS activities to all corners of the world

At the ISHS Council meeting in Fortaleza, Brazil, in 2012, the Rules of Procedure for Board elections were changed so that at least one Board member was to be elected from each of the geographical regions: (1) Africa-Oceania, (2) The Americas, (3) Asia, and (4) Europe. This decision by Council meant that there is one more Board member than on previous Boards. However, Council decided that it was important to ensure that the Board covered a wide range of experiences and knowledge from around the world. I was elected as the first ISHS Board member from Asia under these new rules. Right now, the ISHS Board consists of six elected Board members, two from Europe, two from Oceania, one from North America, and one from Asia, plus the Executive Director and the IHC2018 President, both from Europe. Although more ISHS Board members come from European countries, the responsibility of the ISHS Board, of course, is to serve all ISHS members from around the world. All ISHS Board members have a worldwide perspective of horticultural research and business when it comes to managing and operating the ISHS. I, as one of the ISHS Board members, work to promote ISHS from the Far East with the help of ISHS members, not only located in Asian countries, but also worldwide.

ISHS membership numbers and actions to increase benefits to members

From 1997 until 2007, there was a strong and steady increase in individual memberships, after which the numbers plateaued (Figure 1). Since 2013, individual memberships, the base of the Society, have been shrinking from over 7000 members. The number of paid-up individual ISHS members today is a little over 6000 (Figure 1).

What has caused this turn-around? The survey of members organised in 2012 by Prof. Errol Hewett, Board member at that time, highlighted some important reasons why members valued ISHS (see *Chronica Horticulturae* 53(1)). The key points of this survey were:

- Symposia, congresses and publications were highly valued by members.
- Less than 5% of respondents were under 30 years of age, and only 23% were less than 40 years old. Further, mentoring of young people was seen as an additional service ISHS could offer.
- Most members were from academia, whereas few were from industry.
- Under the heading of Additional Services, respondents felt that it would be useful to have increased awareness and transparency of ISHS and increased advocacy for horticulture.
- The main reasons for joining ISHS were to network with colleagues, for personal professional development, to attend ISHS symposia at a discounted rate and to obtain free on-line *Acta Horticulturae* articles.

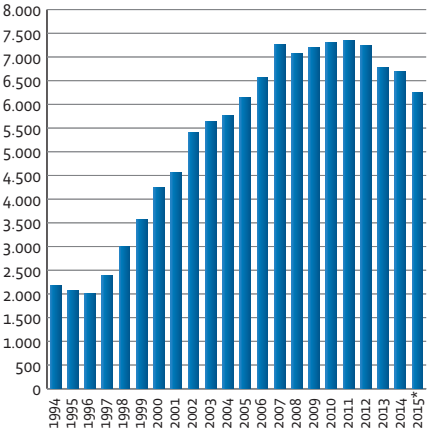


Figure 1. Membership statistics over the past 20 years. *Number for 2015 estimated.

In response to the survey and in particular the demand to increase awareness and advocacy for global horticulture, the Council instructed the previous ISHS Board to introduce new initiatives and additional services to members. This resulted in the development of new tools for publication, the purchase of a new peer reviewed journal eJHS and the publication of "Harvesting the Sun" (http://www.harvestingthesun.org/). These new initiatives were introduced at the request of the membership and were intended to promote the profession of horticulture and to promote membership. It should be noted that all new activities were realized whilst inflation continued to increase costs, yet without any substantial increase in revenue. In fact, there has been a decrease in core funding because fewer members means there is less income from membership fees.

Yet, despite the reduction in revenue, new urgent challenges have to be faced. The new Board needs to continue to complete some of the initiatives of the previous Board and focus on new ones, such as improving symposia (Symposia 2.0, see Editorial in *Chronica Horticulturae* 55(3)) and improving benefits to young members and industry (see Editorial in *Chronica Horticulturae* 55(2)).

Financial situation of ISHS and membership fee increase

As the Board member responsible for ISHS finances, I feel I should report in my editorial that the current financial figures are not as positive as the Council and Board expected. During their first Board meeting held at the ISHS headquarters it was realized that there are "clouds" on the ISHS financial horizon. The 2014 financial results closed with a negative balance of 100,000 euros and we face a probable negative result in 2015, although the deficit should not be as great as in 2014. The ISHS Board has carefully analyzed the current financial situation and has decided to take action accordingly, to secure the future of the ISHS. After extensive discussion of the options available to correct the situation, we have decided to increase the ISHS membership fee.

The ISHS Board realized that the budget for the year 2016, initially prepared in 2014, and approved by Council in Brisbane, had to be revisited. The ISHS Board members carefully monitored costs and identified those that will be higher than budgeted for. They include a continual increase in mailing costs, moderate increases in traveling expenses for the Board because of inflation and one additional Board member, increased meeting expenses for the Executive Committee and Council, and the cost of continuing new initiatives. These increases in costs are concerning in light of the decrease in revenue from fewer members. Considering these factors and the urgent need for correction, the ISHS Board has decided to increase the individual membership dues by 20 euro as of 1 January 2016. The increase for students and members in developing countries is pro rata, taking into account the regular discounts and biennial invoicing for the latter

■ Table 1. What you get from your ISHS membership.

Membership benefits for networking in the horticulture world
• a free copy of the annual ISHS membership list and Sections/Commissions directory in electronic format (print copy optional) • unlimited searching in the ISHS interactive online membership directory • a quarterly copy of the magazine *Chronica Horticulturae* in electronic format (print copy optional) • 20% discount on *Acta Horticulturae* orders (both ActaHort CD-rom or print). (Institutional Members: 30% discount) - Membership discount does not apply to orders received through booksellers or subscription agents. • a 250 EUR discount when publishing in the European Journal of Horticultural Science (eJHS), the ISHS open access journal • a limited number of free *Acta Horticulturae* full text article downloads • a limited number of free full text article downloads from selected third party publications at www.pubhort.org. Titles include: Journal of Horticultural Science and Biotechnology, Fruits, Journal of the American Pomological Society, Journal of the International Society for Mushroom Science, etc. • 50% discount when purchasing *Acta Horticulturae* and/or PubHort full text article downloads • access to ISHS ListServ mailing lists • discount registration fee at ISHS symposia (ISHS membership number required when registering) • participation in ISHS Working Groups, Sections and Commissions and networking with fellow researchers • entitlement to a vote at the ISHS General Assembly For more details about ISHS membership benefits, please visit **http://www.ishs.org/ishs-membership-benefits**

■ Table 2. Country ranking for membership numbers, decreased membership numbers from 2012 to 2014, and increased membership numbers from 2012 to 2014.

Rank	Top 10 countries		
	Members	Decreased membership	Increased membership
1	United States (914)	United States (-157)	Chile (+65)
2	Australia (363)	Italy (-90)	New Zealand (+36)
3	China (351)	The Netherlands (-79)	Kenya (+29)
4	Japan (302)	India (-77)	Trinidad and Tobago (+25)
5	Italy (285)	Canada (-63)	Australia (+18)
6	Spain (240)	Germany (-53)	Slovak Republic (+15)
7	New Zealand (177)	United Kingdom (-48)	Turkey (+15)
8	Germany (162)	South Africa (-41)	Indonesia (+7)
9	The Netherlands (160)	Brazil (-38)	Korea (+7)
10	Chile (148)	Spain (-38)	Nigeria (+6)

(see www.ishs.org). In accordance with the ISHS bylaws, the Board has informed Council members of this issue and discussed it by e-mail. We will further discuss this issue in the joint Executive Committee and Council meeting in Quebec in August, 2016. Although the ISHS membership fee has been unchanged for more than 7 years, since the last membership fee rise in 2008, this was a tough decision. The Board felt it was necessary to ensure that new initiatives can be achieved in order to improve the benefits to members. With the increased membership fee, we will end the year 2016 with sufficient funds to make provisions for these new initiatives in the year 2017, such as the introduction of a Youth Task Force and the development of Symposia 2.0.

Is the membership fee too high?

How you feel about the 80-euro membership fee depends on how you value your ISHS membership and how much you are involved in horticultural research and/or business. When you consider the benefits received during 12 months of membership (Table 1), and how quickly that same amount of money can be spent, it is very good value. The decrease in membership is higher in the more developed countries, however, their increase of 20 euros is a small amount of money for members in these countries. We think that the ISHS membership is very reasonable and valuable, and it lasts for a whole year! It is much lower than many other societies, which range up to 150 euros per annum, e.g. Entomological Society of America: 130 euro, International Plant Propagators Society (Europe): 100 euro, International Society for Microbial Ecology: 114 euro, International Society of Cancer Metabolism: 150 euro. Importantly, students will pay only 40 euros per year. Membership for citizens from developing countries (countries with a classification other than "high income" or "upper middle income" on the country classification list by The World Bank) is valid for two years.

Reaching out to all corners of the world and all generations

Horticultural research activities and industries have developed rapidly over the last few decades, including in regions where ISHS was less active in the past. Looking at the 10 countries with most ISHS members, you could conclude that the situation has remained almost the same (Table 2). However, if we list the top 10 countries with increased and decreased memberships, you can see that new countries and regions are becoming more active and membership is diminishing mostly in countries where ISHS activity has traditionally been very high. This might be expected if you consider the changes in horticultural research development and funding in different countries. For instance, recent rationalization in some countries since the 2008 financial crisis has translated into even greater cuts in research budgets, and laying-off of many scientists. It is only now that these conditions are being reflected in our membership. There are still many very active ISHS members remaining in countries that are decreasing in membership, whilst many members are joining ISHS in emerging countries. It is crucial, therefore, that we reach out to horticultural researchers and industries in the emerging countries to enable them to network with others around the world. Although our membership numbers have decreased, we obviously must reach out wider than ever before. The new symposia 2.0 will include a focus on training and workshops, which will assist in reaching out and providing benefits to new members in many countries where horticulture is developing rapidly.

So what about the new generations? We need to value young members more and work to become an attractive society to young horticulturists in the future. The ISHS Board has decided to hear the ideas of younger scientists and postgraduate students on future management and activities of the ISHS at the joint Executive Committee and Council meeting in Quebec. In addition, other initiatives have been planned to encourage younger members, such as new awards at symposia (see Editorial in *Chronica Horticulturae* 55(3)). I am confident that by working closely with all generations and members from all corners of the world as we develop our strategic plans, we are ensuring a bright future for ISHS.

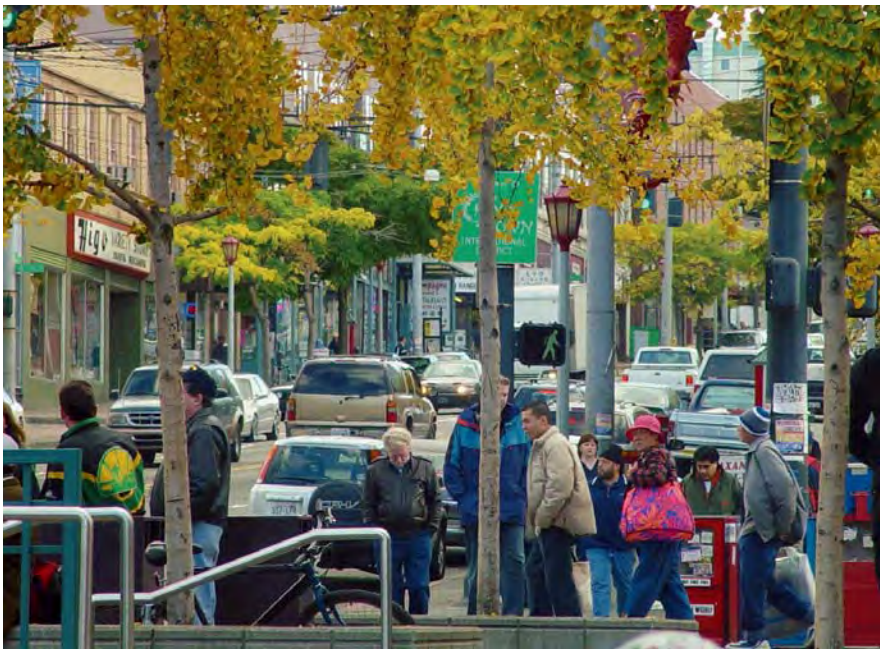
Metro nature for mental health and wellness: horticulture secondary benefits

Kathleen L. Wolf

Challenges of urban life

More than 50% of the world's population now live in cities, and in some nations, such as the United States, the proportion is above 80%. Further concentration in urban areas is forecast. Cities are the centers of economic activity, innovation, and complex social networks. People have to be at their best to compete, even survive, in the urban context.

As more people move into urban centers, they live within places and conditions that impose demands that can compromise health, including mental health and function. This includes such challenges as daily commuting and work tasks, digital connections that link one to the world 24/7, and money worries. Urban life is complicated and includes many stressors. In addition to the health consequences of major stress events (such as loss of a job or loved one), the medical community now recognizes that the constant pressure of urban life generates chronic stress and anxiety, with potentially debilitating effects. Everyday stressors, combined with other factors, can lead to both physical and mental health issues.



› The constant pressures of urban life can elevate chronic stress and anxiety, with potentially debilitating mental health effects. Photo by Guy Kramer.

Mental health significance

Mental health is fundamental to good health and quality of life, is an essential personal resource, and contributes to effective functioning of individuals, families, communities, and society. The International Mental Health Research Organization claims that one in five people is afflicted by a mental health disorder, and that mental illness is the number one cause of adult disability worldwide. It is estimated that by the year 2020 mental health disorders will rise to 15% of the global burden of disease, and depression will constitute one of the largest health problems worldwide (Murray and Lopez, 1996). The World Health Organization has recognized the need to address mental health as an integral part of improving overall health and well-being throughout the world, noting that 'there is no health without mental health' (Barry, 2009).

Mental health literature has traditionally focused on the study and treatment of mental disorder. There is increasing interest in exploring positive mental health as a notion that is distinct from, and more than the absence of, mental disorder. An emerging focus on positive mental health is aligned with other health promotion perspectives that focus on preventive approaches for wellness rather than responding only to illness (Barry, 2009).

Health promotion

The biomedical approach to health has tended to concentrate on the individual's genetic and biological makeup, and their personal lifestyle choices and safety practices as causal underpinnings of health problems. The focus is thus on what an individual can do to reduce or eliminate problems. A more recent health promotion outlook considers the physical and (especially) social factors that may be beyond the individual's control yet contribute to their level of well-being. Health promotion programs encourage key factors for positive health, while reducing risk factors for poor health. Such programs aim to improve the full range of personal, social, economic, and environmental determinants that influence the health status of individuals and populations.

Both social and physical environments play a role in a person's response to daily challenges. Recent research acknowledges the importance of social determinants in health, functioning, and quality-of-life outcomes. Social determinants include: availability of resources to meet daily needs, such as educational and job opportunities, living wages, and healthful foods; lack of exposure to crime, violence, and social disorder; social support and social interactions; and viable transportation options. Physical determinants include productive spaces such as worksites, schools, and offices; the built environments of housing, homes, and neighborhoods; the degree of exposure to toxic substances or physical hazards; and amenities such as lighting, public parks, and walkable streets.

Metro nature experience and mental health

Everyday spaces and places within cities are important for improved public health. In addition to meeting basic needs like clean air and water, a rapidly expanding research literature indicates that metro nature promotes the state of mind that can both help people cope with the complexities of urban living and be more productive (Wolf and Rob-

bins, 2015). Metro nature is an inclusive term describing the diverse expressions of nearby nature in cities, including parks, gardens, street trees, native ecosystem patches, community gardens, and engineered nature, such as green walls and green roofs.

The horticulture sciences and associated industries support improved development of food, ornamental, and ecological plant materials. The practices and products of horticulture contribute directly to metro nature, as plants appear to be an essential element in outdoor settings that heal, restore, and support urban residents. A recent research review and benefits analysis evaluated the health promotion role of landscape and plants in many urban settings, and concluded that metro nature can potentially reduce national and local health care costs (Wolf et al., 2015).

The purpose of this article is to provide a brief overview of the research literature concerning metro nature experiences and mental health promotion. One perspective is that nearby nature experiences may alleviate diagnosed disorders or illness. In addition, having nature in one's everyday environment potentially supports general functioning and productivity. Having quality landscaping and vegetation in and around the places where people live, work, learn, and play is a low cost investment for disease prevention and health promotion.

State of the science

Natural systems in cities, if well planned and designed, generate a wide range of environmental services that are the foundation for healthy urban living, such as clean air, clean and plentiful water, climate stabilization, and reduced hazards. Social and public health scientists are now partnering with biophysical scientists to learn more about the socio-ecological systems of cities. This evolution of scale and outlook includes research engagement concerning questions of environments, nature, and human response. The integrated research employs the science conventions of research design, sampling, data collection or secondary data use, evaluating confounds, and statistical analysis or modeling, as well as social qualitative methodologies.

› A rapidly expanding research literature, presented in the Green Cities: Good Health web site (www.greenhealth.washington.edu), provides evidence that metro nature can help people to cope with the complexities of urban living and be more productive.

The result is an extensive scientific literature about the multiple, somewhat intangible co-benefits and urban ecosystem services provided by metro nature. Green Cities: Good Health is a web portal that summarizes thousands of scientific studies that have been published internationally about the human health benefits associated with views of nature and activities within green spaces (Wolf, 2015). A critical mass of scientific evidence suggests that nature in the city is not just nice to have, but is essential for quality human habitat.

Scientific methods have evolved. Several general trends are observed. In the 1970s to 1980s numerous studies of landscape preference and perception, and self-reports of mood and reduced stress, initiated the realization of subconscious nature dependence. Soon to follow was the emergence of evidence-based theories, including Attention Restoration Theory and Stress Reduction Theory. In the 1990s through the first decade of the century 'big data' studies combined vegetation remote sensing and public health records to establish population level correlations between nature presence (e.g. trees, parks) and health outcomes (e.g. physical activity, stress response, infant birth weight, cardiovascular and respiratory events).

In recent years all methods are in use, plus experimental research about inequitable distribution of urban natural resources with health consequences; understanding causal mechanisms, such as neurology, cognition, allergy and inflammatory response, endocrine origins, immune function, and bioaccumulation; and efforts to determine nature dose response (e.g. experience frequency, nature type and character, demographic variability). Greater understanding of causal mechanisms is a key interest at this time.

› Children with attention disorders may benefit from spending more time in green settings on a daily basis. Photo by Guy Kramer.

■ Table 1. Activities judged as best and worst for ADD symptoms by parents (from Taylor et al., 2001).

Likely setting	Best	Worst
Green (e.g. fishing, soccer)	85% (17)	15% (3)
Ambiguous (rollerblading, playing outside)	56% (43)	44% (34)
Not green (video games, TV)	43% (53)	57% (69)

Numbers in parentheses indicate the number of respondents by category for outcomes.

Illness or disorders and nature response

Several topics about mental illness and disorders are presented here, each represented by several to tens of studies in the scientific

› Physical activity is linked to improvements in mental health and stress, and studies connect urban park use to decreased stress levels and improved moods. Photo by Kathleen Wolf.

literature about the experience of nature as a healing or therapeutic influence. When looking across such collections of studies there appears a life cycle trajectory of nature benefit. From 'cradle to grave' metro nature can be the source of salutary effects.

Attention Deficit Disorder (ADD)

As of 2011, approximately 11% of children 4-17 years of age (6.4 million) in the U.S. have been diagnosed with attention disorders, conditions that have detrimental effects on social, cognitive, and psychological growth. Childhood Attention Deficit Disorder (ADD) symptoms can be reduced through activities in green settings and "green time" may be an important supplement to established drug-based and behavioral treatments. In a U.S. national study parents recorded that children with Attention Deficit Hyperactivity Disorder (ADHD) who played regularly in green play settings had milder symptoms than children who played in built outdoor and indoor settings. This was true for all income groups and for both boys and girls (Faber Taylor and Kuo, 2011).

The discovery was consistent with an earlier finding that the "greenness" of a child's home did not significantly affect ADD expression, but "greenness" of play setting was related to a reduction of symptom severity (see Table 1) (Taylor et al., 2001). Activity was not solely the source of benefit, as children with ADHD concentrated better after a walk in a park than after a downtown walk or a neighborhood walk, and twenty minutes in a park setting was sufficient to elevate attention performance relative to the same amount of time in the other settings (Faber Taylor and Kuo, 2009). Children with attention disorders may benefit from spending more time in green settings on a daily basis, and during attention demanding activities (for instance, while in school or doing homework).

Illness and cognition

As people get older they may be more inclined to experience serious illnesses. Clinical reports have noted the loss of ability to concentrate and increased distractibility in adult patients experiencing serious illness. A diagnosis of cancer is a life-changing event. Studies have tested the correlation between stress and cognitive function under various conditions in women diagnosed with breast cancer. Cognitive impairment (including memory and ability to process information) may be experienced even before the start of a cancer treatment (Cimprich et al., 2005). This is likely due to the mentally-demanding and stressful nature of diagnostic tests and treatment planning. Participation in activities and/or interacting with natural environments has been shown to ameliorate and help improve mental fatigue both before and after breast cancer treatment or surgery (Cimprich and Ronis, 2003).

Stress relief

Stress is a combination of physiological responses and self-perceptions about life situations. Stress can be experienced at any time in life; however, such responses are especially prominent at later age due to physical, psychological, and social changes, for example, in response to chronic disease, disability, death of loved ones, or financial hardship (Orsega-Smith et al., 2004). Stress can also negatively affect people's perceptions of their well-being, including a poor perception of their own mental health. Both chronic and peak stress can contribute to depression, schizophrenia, anxiety, exhaustion, and fatigue syndromes (Grahn and Stigsdotter, 2010). Physical activity is linked to improvements in mental health and stress (USDHHS, 1996) and many studies connect urban park use to decreased stress levels and improved moods. In one study, the longer participants stayed in a park, the less stress they exhibited (Hull and Michael, 1995). Multiple studies have shown that relaxation and stress reduction are significant benefits associated with spending time in green areas (Davis, 2004). Given the consistent findings, how much nature is enough? A dose-response study revealed a positive, linear association between the density of urban street trees (ranging from 2 to 62% canopy cover) and self-reported stress recovery, so every tree matters (Jiang et al., 2014).

Depression

Depression also occurs at any age, but the rate of diagnosis and drug-aided treatment appears to increase in older people. The experience of depression can be helped through improved social connections (to decrease the feeling of isolation) and exercise, both of which are promoted by having nearby green outdoor spaces. In one study, adults with major depression were asked to take a 50 minute walk in either a park setting or a built setting in a city. Participants walking in the park setting exhibited significantly greater increases in memory span and mood, suggesting that interacting with nature may be useful as a supplement to clinical depression treatments for major depression disorder (MDD) (Berman et al., 2012). Another study investigated MDD and found that an exercise program can be just as effective as antidepressants in reducing depression among patients (Blumenthal et al., 1999). The presence of green spaces as a motivator to encourage exercise is promising in treating depression symptoms.

Alzheimer's and dementia

As people age, they are more prone to loss of cognitive function, including Alzheimer's disease. People with Alzheimer's and other

■ Table 2. Post construction observations of dementia patient behaviors in residential care facilities (from Mooney and Nicell, 1992).

Type of incident	Facilities with added gardens			Control-facilities with no gardens		
	pre	post	% change	pre	post	% change
Violence	0.3333	0.2678	19↓	0.06750	0.4594	681↑
All incidents	2.6274	2.5357	3.5↓	0.74320	2.3698	319↑

Morning and afternoon paired observations were conducted by nursing staff across facilities.

› Well-designed outdoor environments and healing gardens can provide ambient support for older adults having reduced cognitive capabilities. Photo by TKF Foundation.

› Experiences of natural environments provide opportunities for directed attention restoration for office workers. Photo by Guy Kramer.

dementia disorders experience memory impairment, intellectual decline, temporal and spatial disorientation, impaired ability to communicate and make logical decisions, and decreased tolerance to high and moderate levels of stimulation. Studies have found that nature experiences can be of particular benefit. Exposure to gardens can improve quality of life and function of dementia patients by reducing negative behaviors up to 19% (Table 2) (Mooney and Nicell, 1992). Those patients who have access to gardens that are designed to positively stimulate the senses and promote positive memories and emotions are less likely to express negative reactions and fits of anger. After gardening activities, dementia and stroke patients have exhibited improved mobility and dexterity, increased confidence, and improved social skills (Rappe and Kivelä, 2005; Ulrich, 2002). The value of healing gardens is evidenced by numerous studies: reduction in behavioral disorders such as agitation, aggressive behavior, and aimless wandering; improvement in appetite; better sleep, and increased regular sleep patterns; as well as improved general health and nutritional status (Jonveaux et al., 2013).

Well-designed outdoor environments and healing gardens can provide prosthetic support for dementia patients to compensate for reduced cognitive capabilities (Mooney and Nicell, 1992). For example, spaces that have dead-ends or are crowded can increase frustration and anxiety in Alzheimer's-diagnosed residents. Supportive outdoor spaces include these design features: looped pathways; tree groves or sites to act as landmarks for orientation; non-toxic plants; even, well-lit paths with handrails; seating areas with the suggestion of privacy; and use of low-key fragrances and colors to soothe rather than negatively stimulate users of a space.

Everyday function and needs

In addition to the health benefits associated with disease or disorder, having a nature backdrop for everyday life is important. Both visual access and being within green space helps to restore the mind's ability to focus. Encounters with nearby nature help alleviate mental fatigue by relaxing and restoring the mind. Within built environments, parks and green spaces are settings for cognitive respite, as they encourage social interaction and de-stressing through exercise or conversation, and provide calming settings.

Attention fatigue and recovery

In today's lifestyles and work, we must focus our attention on critical information or tasks. To accomplish tasks and complete projects, a person must suppress mental distractions and impulses. More generally, urban environments heavily tax the voluntary attention control that is used to filter urgent but largely irrelevant stimuli as we go about our daily lives (such as paying attention at a crosswalk or dealing with smart phone texts). In no other time in human history has there been an equivalent demand on cognitive resources. A person's psychological ability to sustain directed attention can be depleted. The result can be feelings of irritability and frustration and an inability to stay on task or bring up key ideas from memory.

Attention Restoration Theory describes the power of nature to replenish the capacity for attention through unconscious, cognitive processes in response to natural landscapes (Kaplan and Kaplan, 1989). Green spaces that are rich in certain qualities allow directed attention to recover. The inherent characteristics found in green spaces can provide stimulation that places little demand on a person's ability to maintain concentration. The experience of interacting with natural environments provides opportunities for the restoration of one's mental capabilities.

Ongoing research continues to test for the nature conditions that support cognitive restoration. The attributes of certain natural environments provide opportunities for involuntary attention. It is important to note that the restorative power of nature can play out in a matter of a few minutes and can be gained by simply viewing a green space as well as moving within it (Berman et al., 2008; Bratman et al., 2015). The best places have a sense of "fascination", "being away", "extent", and "compatibility", conditions that are rarely experienced in highly-built hardscapes (Kaplan and Berman, 2010). One doesn't have to leave the city and travel to dramatic parks or landscapes to experience the cognitive enhancement that nature provides. Unless one is aware of the research, the dynamic interplay of attention fatigue and the restorative potential of metro nature may be below consciousness.

Work and school

Office workers may spend entire days indoors and at desks and computer screens. Some find that plants make for more attractive, pleasant, and healthy work environments (Grinde and Patil, 2009; Bringslimark et al., 2007), but what impact do plants and nature views have on work performance? Studies show improved employee morale, decreased absenteeism, and increased worker efficiency result from such workplace enhancements (Lohr et al., 1996). Having plants within view of workstations decreases both illness incidence (Fjeld et al., 1998), and the amount of self-reported sick leave (Kaplan, 1993). One study found that workers with workstation views that included green elements were more satisfied at work and had more patience, less frustration, increased enthusiasm for work,

› Horticulture co-benefits are possible if landscapes are designed for multiple functions within urban settings. Photo by Kathleen Wolf.

› Nature settings support mindfulness, as plants enable 'soft fascination' and help one to maintain focus. Photo by Guy Kramer.

and fewer health problems (Kaplan, 1993). Not having nature views or indoor plants is associated with higher levels of tension and anxiety in office workers (Chang and Chen, 2005). Such responses may be expressions of the connections between attention fatigue and nature-aided cognitive recovery.

Learning, like tasks at work, requires focused, directed attention and high-level cognitive functioning. When plants were added to a college computer lab, the study participants were more productive (with 12% quicker reaction times on tested computer tasks) and showed less stress – though there was no difference in number of errors made on the test. Additionally, participants reported feeling more attentive and better able to concentrate in the presence of plants (Lohr et al., 1996). College students with more natural views from their dorm windows scored higher on tests of capacity to direct attention (CDA) and rated themselves as able to function more effectively (Tennessen and Cimprich, 1995). In another study of college students, those who participated in a nature walk performed higher on a subsequent CDA test than those who went on an urban walk or relaxed in a comfortable room with magazines and light music prior to the test (Hartig et al., 1991).

Meditation and mindfulness

Increasingly, as people are feeling overwhelming demands in their lives, there is a growing interest in meditation and mindfulness. Benefits of meditation include improved cognitive functions, longer attention spans, and improved perceptual ability, memory, intelligence, and empathy (Slagter et al., 2011; Desbordes et al., 2012). Practicing meditation may also reduce stress-induced immune system decline and behaviors (Pace et al., 2009). Scientists are not yet sure why these responses occur, but generally agree on the benefits.

Meditation is an act of intentional focus on any number of things, including repetition of a word or phrase, an object in the visual field, sensations, or specific thoughts or personal reflections. Nature offers unlimited opportunities as both setting and focal point for meditation and mindfulness.

Mindfulness exercises include similar strategies of focus to rein in the wandering mind (James, 2015). In addition, mindfulness is the condition of 'being attentive to and aware of what is taking place in the present' with resulting benefits. Mindfulness enhances self-regulated functioning; that is, mindfulness sensitizes individuals to inner feedback signals, allowing people to better regulate and guide themselves toward meeting their needs (Brown and Ryan, 2003). Mindfulness enhances the richness and vitality of moment-to-moment experiences. Mindfulness training may also improve attention-related activities, such as work or study, by enhancing some specific brain areas that support attention (Jha et al., 2007). In one study, just four sessions of mindfulness meditation training significantly improved visuo-spatial processing, working memory, and executive functioning; study participants had greater ability to sustain attention (Zeidan et al., 2010).

Nature settings support meditation and mindfulness activities. Studies of Attention Restoration Theory find that nature is inherently interesting and supports "soft fascination", thereby helping one to maintain focus with a low level of mental exertion. Nature, which is filled with intriguing stimuli, modestly grabs attention in a bottom-up fashion, allowing top-down directed-attention abilities a chance to replenish (Berman et al., 2008). Within even the smallest spaces, one can find a living thing, clouds, rustling leaves, or flitting birds that one can calmly observe. Often a bit of nature invites one to settle in and develop an appreciation as one begins to notice remarkable details.

Creativity

Creativity is another potential benefit of metro nature experiences. For instance, in one study people performed better on creative tasks in rooms having foliage plants, versus those without, and the authors proposed that nature may provide inspiration and a source of stimulation for creativity (Shibata and Suzuki, 2002). In a study of creative professionals in Denmark, it was found that experiences of nature enhance creativity. How? Nature can evoke creative ways of thinking by making a person more curious, inspiring new ideas, and introducing more flexibility in how one thinks about a problem. It was found that nature contact may be especially helpful in two early phases of the creative process (Plambech and Konijnendijk van den Bosch, 2015). Creative individuals reported finding novel ideas in the project preparation phase by observing the patterns and visual structures in nature. People used nature in the incubation phase as a space to reflect and develop more definition for a project or to take a break and regain perspective. Feelings of peace, quietness or serenity, and beauty within nature, enhanced by the suggestion of mystery, were the landscape traits that creative people identified.

Horticulture for health

Horticulture, at its core, is about selecting, growing, and managing intensively-produced plants for a wide range of human uses and benefits. The applications of horticultural science and best practices are endless, and have improved lives, places, and ecosystems. As the world's population continues to concentrate in cities there are greater needs for plants

and the many benefits and services that they provide, from food to shelter to aesthetics. Plants and landscapes are also penultimate multi-taskers; while selected and installed for one purpose, careful design of a site or collection of plants can generate co-benefits. Examples are permaculture or urban forestry.

Scientific understanding of the relationship between public health and nearby nature is growing rapidly, adding another level of purpose to horticulture applications in cities. Within certain therapy or clinical situations, having quality landscapes may ease symptoms, perhaps even causes, of mental illness and disorders. And for the general populace of urban settings, it seems that having access to nearby nature may be necessary in order to cope with the demands of urban lifestyles and achieve the intentional thought processes needed to achieve one's goals. Nature restores when the mind is depleted, and enables intentional, mindful focus that is becoming recognized as a need in high-performance jobs and careers.

A professional guild of horticulture therapists intentionally use plants and gardening to address diagnosed health needs in hospitals and clinics. Recent science from public health, psychology, and numerous other disciplines indicates that a backdrop of metro nature, when of quality design and well-managed, serves all people. The visual and experiential products of horticulture offers salutary effects for even those healthy individuals who simply must manage the everyday complexities and challenges of urban lifestyles. Horticulture *is* therapy, and in a variety of ways that have only recently been revealed by scientific study.

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Multifunctional rooftop horticulture: a promising strategy for intensifying horticulture production in cities

Francesco Orsini, Marielle Dubbeling and Giorgio Gianquinto

In our urbanizing society, urban horticulture is gaining relevance due to its potential to increase resource efficiency, contribute to city food security and enhance associated ecosystem and social services. In cities, however, spaces available for cultivation are limited, thus leading to the need to explore innovative growing solutions, for instance, plant cultivation on building rooftops. While rooftop horticulture experiences are "sprouting" all over the world, scientific evidence on the most suitable growing solutions, policies and potential benefits is growing. The present review will address the main features of rooftop horticulture, providing an interdisciplinary assessment of different approaches for development and the multi-faceted forms that rooftop horticulture may assume in different contexts, bringing together existing experiences as well as suggestions for planning of future sustainable cities.

Rooftop horticulture: status and challenges

With the urban population now surpassing the rural one (Batty, 2015), the relevance of urban food production is today commonly recognised among national and international bodies (Orsini et al., 2013; De Zeeuw and Drechsel, 2015). Given the scarcity and high cost of land in cities, different agricultural and horticultural production and value chain intensification strategies are being explored in a number of cities and towns across the world. These include: (1) Optimising land/space rent of agricultural/horticultural production by intensifying soil-based cropping and animal husbandry, developing non-soil based production systems (hydroponics, containers) and/or switching to above ground, building-borne systems (like rooftop gardening); (2) Optimising income-adding value to horticultural production (including processing and direct producer-consumer relationships); (3) Optimising multiple urban functions of horticultural value chains (including recreation, landscape management and other functions); and (4) Optimising resource utilisation – improving the spatial connectivity of horticultural activities (promoting waste-water re-use in horticultural production; better linking waste management, production, processing and marketing-promoting food hubs) (Mougeot, 2015).

This article will specifically look into the first strategy and the possibility of supporting cultivation over existing paved surfaces, specifically in the form of rooftop horticulture. Rooftop horticulture may convert unused spaces such as building covers into food-producing units, providing a number of benefits for city dwellers (Eigenbrod and Gruda, 2015). Rooftop farming generally differs in the Global North and Global South of the world with regards to the growing systems used, as well as the main functions associated with it (that range from food production to a number of social and ecosystem services) (Viljoen and Howe, 2012). As rooftop farming experiences expand across the world, scientific information and evidence is being collected by a number of research institutions about the ways to integrate current cultivation technologies in urban buildings (recently referred to as "Zero-Acreage Farming", or "ZFarming") and how to maximise benefits associated with the different functions of urban horticulture (Thomaier et al., 2015). In developing countries, rooftop horticulture started to be adopted in the late eighties, mainly through the adoption of simplified low-depth soil and soilless systems (e.g. in wooden containers and using rice hulls or coir as growing substrates) (Marulanda and Izquierdo, 1993). Today, successful income-generating rooftop horticulture experiences have been reported in a number of countries, including Senegal (Saydee and Ujereh, 2002), Peru (Mezzetti et al., 2010), Egypt (Gertel and Samir, 2000), China and India (Doshi et al., 2003). Common features of these experiences are the low technical skills of the farmers involved, the use of low-cost materials and lower water-using production systems; the limited start-up and maintenance costs of the garden, the scarcity of regulatory standards (e.g. both in terms of produce quality and safety, as well as on the building structure/safety/load) and the strong orientation toward informal and community-based marketing options. Nonetheless, more high-tech and commercial rooftop gardens are being promoted on top of supermarkets, restaurants or office buildings in some situations, e.g. in China.

At the same time, the growth of rooftop horticulture in western countries is facing its own challenges. As the food production and marketing sector is strongly regulated, urban actors are required to adhere to standards that were created for rural environments and horticulture. Also, further development and innovations of the required technologies is needed, in order for rooftop farms to become financially sustainable. Furthermore, as the sector emerges, starting costs for such commercial and intensive systems are high, while profit or time for return on the investment are still uncertain. In addition, a main factor limiting the wider uptake and up-scaling of rooftop horticulture turns out to be the lack of coherent interdisciplinary policy frameworks, which should guide practitioners and investors into the sector. These should take into consideration policies for food security, climate change adaptation, comprehensive planning legislation, building regulations and overall the multi-functionality of rooftop horticulture (Specht et al., 2014).

Rooftop crop production

The main distinction amongst different rooftop horticulture projects relates to the technologies applied. Most widely used are the low-level technological systems such as those found on the rooftops of women's associations in Trujillo, Peru (Mezzetti et al., 2010), but also on social housing buildings in the city of Bologna, Italy (Marchetti et al., 2015) (Figure 1). These systems, first developed as a way to promote urban horticulture in the dense urban and low-income areas of developing countries, are characterised by the following features (Orsini et al., 2014):

Figure 1. Rooftop gardens in Dakar, Senegal (top left, Photo: M. Dubbeling), Cairo, Egypt (top right, Photo: Neveen Metwally), Trujillo, Peru (bottom left) and Bologna, Italy (bottom right), bottom two photos: F. Orsini.

- Growing containers are made from recycled materials (e.g. plastic bags or boxes, wooden containers, PVC pipes, bricks) (Figure 2).
- Growing media is either made out of compost (no fertilisation supplied) or by easily available and cheap materials (e.g. rice hulls, coir, sawdust, peat). Water cultures may be also used (in the form of simplified Nutrient Film Technique or floating system), although generally with reduced automation (e.g. manual water circulation and oxygenation control).
- Production is highly diversified (monoculture is rare), and mainly occurs under open air (although shade nets are used in hotter climates).
- Growers are living nearby (often in the same building), and generally cultivate as a family or a community (e.g. neighbourhood, women's groups) (Figure 3).
- Rooftop horticulture is promoted not only as a response to lack of alternative space on the ground, but also for safety issues (e.g. against theft) or social purposes (improvement of the environment, community management of joint resources, creation of a multi-purpose family space).

Alternatively, more sophisticated and technological systems present the following characterising features:

- Production mainly occurs in hydroponic systems, with the root system constantly or periodically wetted by a nutrient solution composed of water and dissolved mineral nutrients.
- Greenhouses are used in order to guarantee year-round harvests or to intensify production (Figure 4).
- Production is mainly sold through defined marketing channels, trade promotion strategies (social/eco labels) and a relevant rate of income is associated to non-horticultural services (events, courses, catering, etc.).
- Professional skills are involved in agronomic and financial management and in promotion/dissemination activities. Voluntary workers are often present.
- Particular care is given to the use of alternative/renewable energy sources (e.g. solar, wind) and energy/resource use efficiency (e.g. composting, rainwater collection from greenhouse or waste water re-use, LED lighting, residual heat recovery).

Rooftop greenhouse and high-tech cultivation systems share many features with conventional greenhouses. Nevertheless, most of the available technology (greenhouse structure and covering materials, heating and cooling systems, soilless cultivation systems), must be adapted to urban and rooftop environments. In this specific context, the main challenges include optimising the use of available resources (residual heat use, rainwater or grey water use for irrigation, CO_2 exchange, etc.), as well as conflicts between building and greenhouse requirements (e.g. weight and wind load, compatibility with a building's equipment and compliance with architectural codes, fire resistance and safety/access requirements).

Managing plant cultivation on rooftops

As plant cultivation enters the city and is conducted on top of buildings, a number of agronomical, ecological and environmental issues arise. Specific challenges are associated with nutrient and water management, environmental conditions shaped by the urban environment (e.g. exposure to wind, sunlight, rain), the relationship with beneficial fauna and pests, and safety measures required to obtain high quality products.

When container cultivation is adopted, the integration of compost (either prepared individually by the garden user or obtained from community composting) is advisable, since it also reduces the urban ecological footprint (Grard et al., 2015). Alternatively, when

Figure 2. Simplified soilless systems for rooftop farming. Simplified Nutrient Film Technique on PVC pipes (top), container cultivation in pallets (center), and simplified floating system (bottom). Photos: F. Orsini.

plants are grown in hydroponics (e.g. nutrient film technique or deep water culture), mineral fertilisers need to be dissolved directly into the water. As compared to traditional commercial cultivation, problems may arise in finding adequate fertilisers (not commonly distributed within cities) and in overall meeting of plant nutritional needs whilst avoiding salinity. This may be exacerbated by the fact that water used is generally obtained from municipal distribution systems, and, although drinkable, may not be optimal for irrigating plants (mainly due to high chlorine concentration). Other drawbacks of tap water usage are its high cost, that may represent up to 80% of the total cultivation costs, excluding labour (Sanyé-Mengual et al., 2015) and competition with the use of water for drinking, especially in water-scarce areas. Possible alternatives are provided by either rainwater harvesting or greywater treatment. Rainwater is often used because of its optimal microbiological and biochemical features (care should be taken when acid rain is common) and the absence of legal limitations on its use. It is often easy to collect rain on rooftops. Retaining rainwater on rooftops has additional benefits in terms of storm water management, related reduction of flood risks and a decrease in water volume going to waste-water treatment facilities and their associated energy and environmental costs (Cohen and Wijsman, 2014). However, constraints in relying on rainwater may include the uncertainty of replenishment of the reservoirs (and therefore the need for possible alternative water sources), and the additional weight load on the building if the water is stored on the rooftop. Greywater treatment is another option that can involve the re-use of the building water. When greywater is used for irrigation of edible crops, however, care needs to be taken in order to respect regulations and standards for both chemical and microbiological quality (by including and properly maintaining filtration devices). Furthermore, greywater may have unwanted concentrations of sodium, chloride and carbonates, which may result in lower crop yields. Periodic water analyses and mixing with alternative water sources prior to distribution are recommended.

Controlling pests in rooftop horticulture also demands specific management techniques different to those commonly practiced in rural horticulture. Urban environments lack the biodiversity commonly found in the surrounding countryside. On the one hand, pest pressure is generally reduced because of the low presence of alternative host crops/plants throughout the year. On the other hand, use of closed production systems (greenhouses), may result in combinations of high moisture and temperature levels that increase pest and disease incidence. In addition, the low horticultural skills of urban farmers, together with the application of wide-spectra pesticides may not only be harmful for human health, but also seriously threaten the beneficial fauna that otherwise would find a suitable environment in rooftop green infrastructures. In order to promote biodiversity, the use of perennial plants and flowering at different times of the year will be important to offer a permanent source of food and shelter for beneficial insects. The inclusion of small ponds may enable the creation of aquatic habitats that attract water-loving insects, although care would need to be taken to avoid the creation of mosquito breeding grounds.

Sustainable cultivation management in cities should also consider how air pollution may affect produce safety. Air pollutants (including heavy metals and particulate matter) may pose a risk to the edibility of the products. Recent reports have addressed the problem of how heavy metals may accumulate in soils, in plant tissue and on plant surfaces, drawing attention to the potential risks associated with urban agriculture and horticulture (Säumel et al., 2012; Jean-Soro et al., 2015). However, when urban products were compared to those obtained in concurrent experiments in horticultural production zones (where pollution from industrial use or intensive fertilisation existed), differences in accumulation were negligible (Vittori Antisari et al., 2015). Furthermore, by using soilless systems rather than soil and moving the cultivation from the ground to a building rooftop, heavy metal risk was dramatically reduced, for example, in both rosemary and eggplant (Vittori Antisari et al., 2015).

Multi-functional rooftop horticulture

The most immediate function associated with rooftop cultivation is obviously the production of food. A study comparing different urban cultivation systems in Cleveland (Ohio, USA) showed that hydroponic systems produced an average of 19.5 kg m^{-2} $year^{-1}$ versus 1.3 kg m^{-2} $year^{-1}$ obtained in conventional on-ground urban gardens (Grewal and Grew-

Figure 3. Community rooftop garden and bee keeping at Dakakker project, Rotterdam, The Netherlands. Photos: G. Silvestri.

al, 2012). Other studies report yields ranging from 18 (Altieri et al., 1999) to 50 (Drescher, 2004) kg m^{-2} $year^{-1}$. At city level in Toronto (Canada), Peck (2003) estimated that from 65 ha of "greened" rooftops growing vegetable crops, a yield of 4,700 t $year^{-1}$ could be generated, based on a mean yield of 7 kg m^{-2} $year^{-1}$. Kaethler (2006) stated that in Vancouver (Canada), it was easy to find rooftop gardens producing food above supermarkets, restaurants and social housing. Likewise, in Bologna (Italy), it was estimated that if the 82 ha of available rooftops hosted simplified soilless gardens, a potential yield of 12,500 t $year^{-1}$ could be obtained, covering more than three quarters of the city's vegetable requirements (Orsini et al., 2014). In the same case study, other potential benefits were estimated, including the creation of green corridors for biodiversity (up to 94 km of green corridors and a density of 0.67 km km^{-2}). Additional studies on the same pilot garden enabled identification of the overall environmental and financial sustainability of the proposed growing systems (Sanyé-Mengual et al., 2015). According to the survey, cultivation technique, crop yield and crop period strongly affected the environmental and economic outputs. For all types of production, irrigation was the element that had the greatest impact on the environment, thus supporting the recommendation to implement rainwater harvesting systems or to integrate greywater regenerating units. In addition, the utilisation of re-usable elements (like building or waste materials) and the intensity of garden use improved the sustainability performance. The financial viability of the production of vegetables was maximised for eggplant (0.13 € kg^{-1}) and tomato (0.16 € kg^{-1}) grown on substrate. Consistently, rooftop farming production proved to be an environmentally-friendly option to further develop urban local food security.

Beyond food production, the presence of greened infrastructures in urban environments may contribute not only to the mitigation of the urban heat island (Rosenzweig et al., 2006) but also to a wide range of ecosystem services, such as improving air quality (Speak et al., 2012), providing resilience to exceptional meteorological events (Gregoire and Clausen, 2011), improving storm water management (Cohen and Wijsman, 2014) and improving urban biodiversity and urban greening (Madre et al., 2014).

Micro-climate/temperature effects of rooftop farms can be high, as they:

- Protect the roof from direct solar radiation and thus reduce transfer of heat into the building mass below the green surface. This reduces both temperatures on rooftops themselves (comparing a green with a dark roof) and helps improve thermal comfort in apartments just below the roof;
- By evaporation, green roofs contribute to "cooling-off" ambient temperatures;
- Absorb pollution/dust particles.

By covering and protecting the roof from direct solar radiation (directly shading the building surface, which would otherwise absorb heat), rooftop gardens can reduce heat flux into the building, thus increasing – in periods of high temperature – thermal comfort for rooms located directly under the rooftop. Green and horticultural roofs thus reduce heat transfer through the roof and also reduce ambient temperatures on the roof surface, because a concrete building mass also radiates the stored heat again to the environment. Earlier research done in Durban (South Africa) showed that the air temperature above a bare roof was indeed higher than above a green roof. The average ambient air temperature above the green roof and bare roof from 24 March 2009 to 24 November 2009 was 22 and 41°C, respectively, thus showing an 18°C temperature difference. On average, there was a 2.7°C fluctuation in ambient temperatures above the green roof habitat with a maximum difference in temperature between the lowest and highest reading of 17.6°C. In contrast, the average fluctuation in ambient temperatures above the blank roof was 9.8°C, with a maximum difference in temperature between the lowest and highest reading of 45.6°C (Van Niekerk et al., 2011).

Apart from having a direct impact on building temperature comfort and on ambient temperatures above the rooftop, rooftop gardens may also contribute to cooling the city. Hard surfaces in urban environments, such as concrete, brick, asphalt and roofing, have a high thermal mass, collecting the sun's heat during the day and re-radiating it slowly back into the atmosphere. This contributes to a rise in the ambient temperature in cities. The degree to which temperature can be affected depends on the growing medium used (degree of evapotranspiration), soil depth, proportion of rooftop coverage, and the use of vertical space (e.g. also use of rooftop building facades, use of multi-layered tables). For rooftop horticulture involving greenhouses, the overall impact on climate change adaptation and temperature effects is hard to estimate. Greenhouses will reduce direct solar radiation on rooftop surfaces and thus help reduce rooftop and building temperatures. However, compared to open rooftop farms there will be no open air evaporation and cooling, so impacts on overall ambient air temperature is estimated to be lower. There has been promotion of greenhouse rooftop gardens in temperate climates for reduction of cold temperatures (and thus heating requirements), rather than for use in more tropical climates to help lower summer temperatures (and thus cooling requirements).

Figure 4. Gotham Greens rooftop greenhouse on the Whole Foods Market in Gowanus, New York City. Photos: K. Specht.

Greenhouses will not directly contribute to public greening (instead roofs will be covered with glass) and high investment costs may limit the potential for larger application.

Ambient cooling effects on a city (or neighbourhood) level can be expected only if larger areas of (preferably geographically-concentrated) rooftops – and other open spaces – are covered with vegetation. A scenario study implemented in 2009 in Melbourne (Australia), indicated that Average Summer Daily Maximum (ASDM) temperatures would be reduced by 0.3°C by doubling the density of vegetation in the central business district, or by 0.4°C with green roofs (green roof vegetation was 0.5 m high and covered 50% of building rooftops completely). Increasing vegetation density both at ground level and with green roofs reduced ASDM temperatures by 0.7°C. The same relative effect of vegetation on ASDM temperatures was predicted for 2050 and 2090 scenarios following expected climate change trends (Khare and Beckman, 2013). A 2005 study in Toronto, Canada, modelled the effect of implementing green roofs on low-rise buildings with low slope and flat roofs of areas greater than 350 m^2, and concluded that green roofs, implemented as a city-wide strategy, could mitigate the heat island effect by reducing local ambient temperatures by 0.5 to 2°C (Banting et al., 2005).

Green and horticultural roofs can improve the living environment in cities, by bringing nature back to often densely build-up spaces. Horticultural green roofs offer opportunities for relaxation and physical exercise close to people's homes. Rooftops can also contribute to the creation of a network of green spaces (green mosaic), connecting to other green open areas in the city (e.g. gardens, parks, public green spaces, water bodies). Plants can also act as noise buffers, reflecting and absorbing some sound. For example, dense vegetation can reduce noise levels by up to 5 dB for every 30 m of vegetation, up to a maximum reduction of 10 dB. Green roof habitats could therefore play an important role in absorbing and dampening the ambient noise levels in the city centre, as well as in office complexes, dense housing developments, and industrial zones (van Niekerk et al., 2011). Noise reduction is dependent on the thickness of the roof and the amount of (permanent) vegetation cover.

Finally, green infrastructures may also have social (e.g. recreational, educational, etc.) and financial functions (e.g. by increasing property values) (Thomaier et al., 2015).

Concluding remarks

This article summarises the different models and various advantages associated with rooftop horticulture. Taking into account the multiple challenges cities are faced with to provide enough food, environmental surfaces, and green and liveable areas for their citizens, rooftop horticulture is one form of urban horticulture that has specific potential in dense urban neighbourhoods and in areas where land is scarce/polluted or highly priced.

Based on the many economic, social, environmental and ecological benefits, and the large amount of open rooftop space available, the conversion of paved rooftops into urban green infrastructures seems a suitable strategy for most of our cities. However, further technological and policy development is required to design efficient rooftop horticulture systems that optimise space and their different benefits.

Transforming rooftops into horticultural land may be seen, not only as a way to provide a function for these urban vacant spaces, but also as a feasible strategy to return horticulture and green areas to spaces that have been turned into grey, hot and built-up areas during rapid, and often ill-planned, urbanisation processes.

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Spotlight on Honoured ISHS Members

› Dan Cantliffe

› Dan and Biological Scientist, Nicole Pratt, looking at their Beit alpha seedless cucumber crop.

Position or previous position

Distinguished Professor Emeritus, University of Florida, USA

ISHS honour

Fellow and Honorary Member

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

I was raised in River Edge, New Jersey, a suburban community about 10 miles outside of New York City. After attending undergraduate school at Delaware Valley College in Doylestown, Pennsylvania, then graduate school at Purdue University in West Lafayette, Indiana, I did a post doctorate at Cornell University in New York. I then accepted a position with Horticultural Research Institute of Ontario (HRIO), in Simcoe, Ontario, Canada working as a horticulturist at the Simcoe Research Centre. Four years later we moved to Gainesville, Florida and the University of Florida, where I worked for 42 years, going through the ranks from Assistant Professor to Distinguished Professor. I also served as Chairman of the Vegetable Crops Department, then as Chair of the combined Fruit and Vegetable Crops Departments (the equivalent to a Horticultural Sciences Department) for 27 years. I maintained an extremely active Research, Teaching and Extension program during this time as well.

My wife, Beth, and I were married two weeks after graduation from undergraduate school. Our family has loved living in Gainesville, a true University town. We raised four daughters there, who all went to college and were married in Gainesville. We now have nine grandchildren, and three of the four daughters live within three miles of our home. I have had numerous hobbies through the years, but continue with UF Gator athletics, especially football and basketball, antique collecting and now, once again, vegetable gardening. I am involved with many volunteer projects, spending quite a bit of time working with The Florida Parks Service as a volunteer at the Marjorie Kinnan Rawlings Farm in Cross Creek, Florida. I am presently President of the Four Winds Condo Association Board in Crescent Beach, Florida.

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

My career in horticulture started because I didn't want to go to college in the first place. I had no clue what horticulture was when I started college, and in fact I couldn't even spell it! I was fortunate to be pushed by, yes, my mother, to attend college and to apply to Delaware Valley College, a very small college (at the time only 400 male students, now renamed Delaware Valley University and a much larger institution) specializing in agricultural studies. As Freshmen, we were required to take a general course that surveyed the various agricultural curricula taught at the college. One of those tracks was Horticulture, and that's where I met Dr. Joshua Feldstein. He tuned me into the fascination of working with plants, watching them grow and studying how they function. By the end of my Freshmen year I had already decided that this was going to be my career and that I wanted to go to graduate school so that I could become a Professor of Horticulture.

3. Give a brief overview of your career/achievements

My CV gives an overview of my career and is over 125 pages in length, thus what can be considered achievements includes many different areas. In the area of research I published over 900 papers, over 200 refereed, and many in *Acta Horticulturae*. In the teaching area I was major advisor to some 70 graduate students, and I taught courses in both the graduate and undergraduate areas (while Chair I was teaching five courses in alternate years). My Extension duties consisted of state-wide Extension Administrative Leadership for Vegetables, working with growers, giving talks with growers and writing publications for growers. I was the County Extension Director in St. Johns County for several years. I was President of the Florida State Horticultural Society (FSHS), the American Society for Horticultural Science (ASHS) and Section Chair for Vegetables in ISHS, a position I held for eight years. I have been awarded numerous honours including Honorary Member and Fellow of ISHS, Fellow of ASHS, Distinguished Agricultural Alumni at Purdue University, ASHS Outstanding Researcher, ASHS Outstanding Graduate Educator, and ASHS and UF Outstanding International Horticulturalist, Seed Scientist Award from the Crop Science Society of America and about 25 other awards and honours. Being vetted and then approved by the University Faculty Tenure and Promotion Committee as Distinguished Professor was a highlight of my career.

› Dan working with undergraduate student, Rachel Ben-Avraham, looking at seed production in greenhouse peppers.

4. What do you consider were your greatest achievements?

Raising a family while working all this time, raising four beautiful daughters and maintaining a happy marriage for over 50 years.

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

Life is a test, so difficulties are merely test questions or test problems. Getting into undergraduate college was no easy chore for me as I forgot to study in high school. Once there and involved in my studies, college was easy and fun. When attending graduate school, my interests in plant science and horticulture really blossomed, so much so that I didn't finish my degree, but had two job offers. I decided that doing a post-doctoral study at Cornell University would be best for me. That was a great decision, unfortunately one of my Graduate Committee members (A. Carl Leopold) felt that my dissertation was not the best I could personally do. He was correct, but both my Committee and the faculty at Cornell felt that I could finish my degree while working on the post doc. So my wife, two kids, and I went to Cornell to learn what life was all about. Shortened story, I threw out all my previous degree research and completely started a new program on surfactants and foliar absorption of nutrients, did a post doc on nitrate pollution, and started a relationship with Dr. Dick Robinson related to growth hormonal effects on cucurbits. This could never happen today, and most folks would quiver at just the thought of completing a research degree away from their home University in 18 months while holding down a full time job. This experience is what groomed me for what was to come, how to balance my time and get the job done with excellence. My experience at Cornell and Geneva turned out to be nothing but fun. And how did I pull all that off? Gerry Marx, George MacDonald, and Dick Robinson, to mention but a few, cared about some hybrid cross graduate student/post-doctoral student. I also learned what scholarship and excellence in science were. I was able to publish over two dozen publications from all that work in three very different areas of science, including one publication in the Journal of Science.

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

This is an easy answer: doing a sabbatical leave at the University of Hawaii. The whole family went and we almost couldn't find a place to live, but once we did we had many friends and family visits as they had a free place to stay. I got the experience of tropical horticulture, living on an island, having every day a beautiful day, and having our kids experience a new culture. We made many friends while there, some keeping in touch to this day. We also visited all the Hawaiian Islands, some multiple times.

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

I attended my first ISHS meeting in 1977 at the University of Nottingham, in England. My wife and parents came along for the ride and it proved to be more fun than I could ever imagine. I enjoyed the interactions with people at the international level and immediately became a totally active ISHS member. I went to many subsequent meetings, always introducing my graduate students to the fun and excellence in attending an ISHS meeting. I hosted numerous ISHS symposia, the first one in 1985 in Tampa, Florida, and edited numerous Actas, from symposia both in the USA and overseas. In order to give back to ISHS, I was a USA Council member for 24 years, and was elected to two terms as Section Chair of Vegetables. ISHS helped me see the real horticulture as a global science. ISHS introduced me to hundreds of exciting people and brought me to dozens of new countries.

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

The best advice that I can give is the advice that I have followed for my entire career: have fun, enjoy what you do and strive for excellence. Also, know when to let go, know when and how to change directions in what you do. Most of all stay connected; this through professional societies like ISHS. Attend its meetings, participate as much as you can, get to know new people and learn new ideas. Always study hard, it doesn't stop when you leave the classroom. Learn new things, don't let anything alter your direction when you know you are going in the right direction. Don't be afraid to work, but be sure to balance your life, always have fun at what you do.

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

Obviously feeding the world. There has never been a greater need for trained horticulturists, to help grow the crops, look for new production and postharvest ideas, to better understand plants, and to train the next generation of horticulturists. There has never been a greater need for new ideas, new ways to produce more with less and to better understand a global economy. This is how and why I became so connected with horticulture, working closely with a global society like ISHS.

Horticultural Science Focus

› *Isatis tinctoria* L.: an ancient dye plant of interest as a multifunctional crop

Ferdinando Branca

The history of the use of *Isatis tinctoria*

Isatis tinctoria L. is an ancient crop that has been used as forage to feed animals, as a dye by extracting the indigo color from the leaves and also as a medicinal crop (Epstein et al., 1967; Hamburger, 2002; Heinemann et al., 2004; Spataro and Negri, 2007; Bratt-ström et al., 2010). There are about 30 species belonging to the *Isatis* genus, all of which exhibit yellow flowers, winged seeds and indehiscent fruit called *silicula*. *I. tinctoria* L. is an out-bred biennial, probably native to south west Asia and south east Europe and it has been cultivated since prehistoric times in Europe (Spataro and Negri, 2007).

I. tinctoria is a tetraploid species (2*n*=4*x*=28) of the tribe *Isatideae* (Al-Shehbaz et al., 2006), and is known also by the name woad in the United Kingdom, *guède* in France, *guado* in Italy, *hierba pastel* in Spain, *pastel-dos-tin-tureiros* in Portugal, *färberwaid* in Germany and *vejde* in Sweden (Al-Shehbaz et al., 2006). In the past, to use it as dye, the leaves were crushed and fermented in an alkaline medi-um by an empirical method in a long complex procedure, which required great skill of the dyers. The "powdered paste" obtained from this process was used all over Europe for dyeing (Guarino et al., 2000).

Classical literary sources show that by the first millennium B.C. woad was extensively used in south west Asia, in the Mediterra-nean basin, and in temperate Europe (Korber Gröhne, 1987). The earliest woad dyed textiles in Europe have been found in a salt mine in Hallstatt (Austria) and are up to 3500 years old, dating from the Bronze (1500-1100 B.C.) and Iron (850-350 B.C.) ages (Hofmann-de Keijzer et al., 2013). Egyptians have used woad to pro-duce indigo to color bandages for mummifi-cation since the 14th century B.C. in the Fayum province (Bauman, 1960). Initially, they utilized *Indigofera argentea,* which was widespread as a wild species in Nubia, Kordofan, Semar and Abssynia, and later, in pre and early Chris-tian times, they started to use *Isatis tinctoria,* which was grown all across western Asia, southern Europe and England (Pfister, 1935; Lucas, 1962). A new archaeobotanical find on the site of Roissy "Zac Demi Lune", depart-ment of Val d'Oise, north of Paris, France, confirmed the use of *I. tinctoria* during the *Tène* A/B1 phase (430-380 B.C.) (Bauman, 1960; Zech-Matterne and Leconte, 2010).

The Greeks and the Romans used this plant for the prevention of scurvy and the oil-seeds have often been used in manufacturing cos-metics. They were aware that a mysterious blue dye existed in India and they called it *indikon* or *indicum,* which was probably obtained from *Indigofera tinctoria,* and was similar to the blue dye of *Isatis tinctoria*. According to Pliny the Elder and Ovid, the primitive Britons used this pigment to dye their bodies, and in the *De Bello Gallico,* Cae-sar told how the Celtic populations used it for tattoos (Giarretta, 1989). Woad was intro-duced as a crop in Italy by the Romans and it thrived in the central and southern parts of the peninsula, such as in Pompei, which was considered an important center of indigo production (Guarino et al., 2000).

I. tinctoria was largely cultivated from the 12th to the 17th century in England (Somerset, Lincolnshire), France (Normandy, Somme, Languedoc), Germany (Jülich, Thuringia) and Italy (Piedmont, Tuscany), to extract the important dye for use as a source of the color indigo (Clark et al., 1993; Hurry, 1930; Oberthür et al., 2004). During the Middle Ages, the Normans in northern Europe extracted indigo to dye the dresses of the nobles (Mills and White, 1994). Then, in the 12th centu-ry in Italy and France, indigo started to be used only by painters. The first use of blue *pastel* (indigo extracted from woad) was in France around the year 1515, to colour eyes in portraits.

In the Renaissance century in France, Occi-tania gave life to the legendary Cockaigne city and Toulouse became the heart of Euro-pean "blue commerce". Those who became the most famous in the *pasteliers* history settled there, accumulating extraordinary fortunes. Olivier de Serre, who was a French agronomist, wrote in his book "Theatre d'Ag-riculture" in the year 1600, "on this side of the whole kingdom, pastel doesn't come as good as from Lauraguais". The European woad was widely marketed until the 17th century, after which it was replaced by the tropical indi-go (i.e. *Indigofera* spp.) because the pigment could be extracted more easily and econom-ically than from *I. tinctoria*. It wasn't until the 19th century that Napoleon I brought the culture of the woad crop back again. They discovered a faster way to extract the indigo color, from eight months to a few days, by creating an experimental school in Albi to extract indigo from *I. tinctoria* plants. During this period, all the soldiers' clothes were blue (VV. AA., 1833).

The woad industry started to decline in the late 17th century as a consequence of the importation into Europe of cheaper indigo extracted from *Indigofera suffruticosa* Mill. and from *Polygonum tinctorium* Ait. The crop was abandoned at the end of the 19th century when synthetic dyes were widely utilized and the woad crop disappeared (De Gasparin, 1818). In 1883, the German chemist, Adolf von Baeyer, discovered the chemical structure of the indigotin molecule, and after 14 years he established a process for synthetic indi-go production (Cardon, 2007). In 1897, pure indigo started to be commercialized by Badi-sche Anilin und Soda Fabrik (BASF), which spent about 18 million gold marks on related research over 18 years of work (Cardon, 2007). During the last few decades, interest in natu-ral dyes to replace synthetics has increased, and plant dyes are now used for several appli-cations, including dyeing foods, textiles, cos-metics and pharmaceutical preparations. The current demand for natural dyes is very large, reaching about 33 million kg annually. This is mainly because of the popularity of blue jeans, which are dyed using indigo. The reduc-tion of indigo to leuco-indigo represents an important type of industrial process, which is operated worldwide on a considerable scale (Roessler and Jin, 2003; Roessler and Cret-tenand, 2004; Palmeri et al., 2013).

The species, *Isatis tinctoria* L.

The genus *Isatis* is represented by 30 annu-al-biennial and perennial (*I. tinctoria* ssp. *canescens*) species, most of which are believed to produce indigo (Ball and Akeroyd, 1991). Under natural conditions, the seeds of *I. tinctoria* germinate in summer, the plant produces leaf rosettes during autumn and winter, and it produces flower stems and seeds for reproduction the following spring (Angelini et al., 2005). The plant is usually

› Different stages of plant development of *Isatis tinctoria* L. A) Seeds, B) Young plantlets in the field, C) Young inflorescences, D) Inflorescences slightly more developed, E) Young infloresences of *I. tinctoria* ssp. *canescens* being harvested for use as vegetables after cooking, F) Plants in full flower. Photos A and B by Science and Technology Park of Sicily, C-F by Ferdinando Branca.

harvested for indigo production in winter. The plant prefers an open structured and well-drained, deep soil, rich in humus and minerals.

I. tinctoria is a very variable species and there have been disagreements regarding the limits of the species itself and the taxonomic status of subspecies that have been identified. Within this intra-species phenotypic diversity (Spataro et al., 2007), Gilbert et al. (2002) identified a high degree of genetic diversity within a selection of 28 woad landraces using amplified fragment length polymorphism (AFLP). More recently, Spataro and Negri (2007) extended this work using AFLP and Selective Amplification of Microsatellite Polymorphic Loci (SAMPL) primers to characterize 15 accessions collected in central Asia and in different parts of Europe. A wide phenotypic and genetic diversity over a wide range of altitudes was detected, although they were clustered mainly in relation to their geographic origins. The bio-morphological traits of plant branching, growth habit, length and width of rosetta leaves, leaf pubescence, and onset and end of flowering, showed large variability, both in wild populations and domesticated cultivars (Spataro and Negri, 2007). Three accessions collected in Kazakhstan, Hungary and Sicily were very different from each other and from any of the other accessions. The accession from Sicily was later identified as belonging to *I. tinctoria* ssp. *canescens* (DC.) Arcang., largely distributed in Southern Italy and in Sicily. It is a perennial hemicryptophyte similar to *I. tinctoria* and is characterized by a densely tomentose siliqua. The pre-anthesis inflorescences of ssp. *canescens* are traditionally utilized as a vegetable in the Mt. Etna area, where they are appreciated after they have been cooked to reduce the bitter taste (Galletti et al., 2013, 2015). The inflorescences in the pre-anthesis phase are considered beneficial for their health effects because they represent a good source of antioxidants, especially glucosinolate for the high glucobrassicin content. Their availability for a restricted period of the year has resulted in the suggestion to dry them or use them to produce a dried standardized extract as a potential dietary supplement (Galletti et al., 2013, 2015).

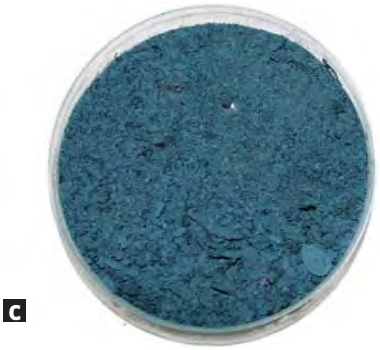
I. tinctoria is also considered a medicinal species and has been used in traditional Chinese medicines for hundreds of years (Liau et al., 2007). It is utilized for treating skin inflammation and its root polysaccharides inhibit allergen-induced airway inflammation and hyperreactivity in mice (Epstein et al., 1967; Hamburger, 2002; Heinemann et al., 2004; Brattström et al., 2010). Horticulturists have become interested in utilizing woad plants as ornamentals because of their tolerance to heat and water stresses, long flowering period and attractive inflorescences.

Technological processing

Up until the 19th century, indigo was obtained by extraction from *I. tinctoria* leaves containing the precursors isatan B (indoxyl-β-ketogluconate) and indican (indoxyl-β-d-glucoside) (Fischer et al., 1990; Wouters and Verhecken, 1991; Gilbert et al., 2000, 2004; Gilbert and Cooke, 2001; Oberthür et al., 2004; Angelini et al., 2007). Indican takes its name from *Indigofera tinctoria,* and it was identified and characterized in 1899 by Hoogewerff and ter Meulen, whereas isatan B is the main indigo precursor of *Isatis tinctoria*, characterized in the same year by Beijerinck (Cardon, 2007). Synthetic indigo replaced the natural product for large-scale dyeing because it was not only cheaper but standardized and pure (Perkin and Bloxam, 1907).

The traditional method for producing indigo dye from woad consisted of crushing the leaves to a pulp, which was kneaded into balls and then dried for several weeks. The balls were then couched (crushed into power and wetted) and allowed to ferment for several weeks in water (Kokubun et al., 1998). The amount of indigo precursors was strictly related to the cultivar, the harvesting time, the light radiation and the temperature (Sales et al., 2006; Palmeri et al., 2013).

The yield from this dye extraction process from woad was low and the indigo obtained was very impure. For these two reasons it



› Extraction of dyes. A) Indigo precipitation in laboratory, B) Natural dyes obtained from *Isatis tinctoria* and *Carthamus tinctorius*, C) Indigo produced by *Isatis tinctoria*, D) Dyeing test of indigo on wool and silk tissues. Photos A-C by Science and Technology Park of Sicily, D by Ferdinando Branca.

was replaced by synthetic indigo, which was over 90% pure (Garcia-Macias and John, 2004). Indigo purity has been reported to be 20-40% for woad indigo, up to 12% for *P. tinctorium* and between 50 and 77% for *Indigofera indigo* (Perkin and Everest, 1918; Bechtold et al., 2002). The interaction between the indigo produced by woad leaves and particulate impurities arising from soil and plant materials, determined its purity. To exclude these impurities from the process, it is very important to rinse the leaves in cold water before beginning the extraction process. A need to improve this washing process has arisen because of increasing commercial demand for naturally sourced indigo that meets the purity standards set by the synthetic product.

Indigo production is an artefact of secondary metabolism. *I. tinctoria* contains isatan B as a major indigo precursor and indican as a minor indigo precursor. However, both *Indigofera tinctoria* and *Polygonum tinctorium* leaves contain only indican, which serves as a starting material for indigo production (Epstein et al., 1967; Maier et al., 1990). Of these two known precursors of indigo in woad, isatan B is relatively unstable and is difficult to quantify separately from indican. The free precursors are broken down by hydrolases when the leaves are damaged and indoxyl is spontaneously oxidized by oxygen. The condensation between indoxyl and isatin produces indirubin, which is the by-product of bio-synthetic indigo production. A minor precursor named isatan C was identified in *I. tinctoria* leaves, but its role in indigo production was not clarified (Maugard et al., 2001). Extraction and HPLC analysis enable the pigments (indigo, indirubin and isoindirubin) and the related indigo precursors to be identified and quantified (Palmeri et al., 2013).

The efficiency of the extraction, parameterized by the theoretical yield of indigo formation from indoxyl molecules, is about 20-40%, meaning that about 60-80% of the indoxyl is lost during the process because of soil impurities, which produce isatin and indirubin and other by-products of the reaction (Garcia-Macias and John, 2004). The extraction process is very important for indigo yield and purity, and it is possible to reach 90% purity if the leaves contain a high content of indigo precursors, the leaves are rinsed in water free of soil, and sedimentation of indigo occurs in an acid medium (Garcia-Macias and John, 2004).

Indigo is a derivate form of the colorless glucosides of the enol form of indoxyl (indican-indoxyl-β-D-glucoside). In the fermentation process, indoxyl-β-D-glucoside pairs react rapidly, producing an indoxyl radical that first forms leuco-indigo and is then oxidised to the insoluble blue indigo (Russell and Kaupp, 1969; Ensley et al., 1983; Clark et al., 1993).

The modern extraction method of indigo from woad uses the water solubility of the indigo precursors by steeping the leaves in hot water. The precursors are broken down to indoxyl and sugar moieties by enzymes in the plant, but in the extraction method, this step is carried out by alkali with aeration (Minami et al., 1996; Stoker et al., 1998).

The use of enzymes is a potential strategy for increasing the yield of indigo (Palmeri et al., 2013). The degradation of plant cell walls is of major importance for indigo production. The enzymatic degradation of these polymers seems to represent a more attractive alternative to chemical and mechanical processes because it could increase the efficiency of indigo extraction and its yield. The use of *Aspergillus* spp. for the production of polysaccharide-degrading enzymes from their purification, and for cell wall enzymes, such as pectinases, cellulases and hemicellulases, may

be possible to promote the extraction process (De Vries and Visser, 2001). β-glucosidase activity catalyses the release of indoxyl from indigo precursors without the addition of alkali. An exogenous β-glucosidase has been utilized for the hydrolysis of indigo precursors in *P. tinctorium* leaves and *Aspergillus niger* seems to be a good producer of β-glucosidase. It could be an eco-friendly solution for the production of natural indigo with high purity (Angelini et al., 2005; Palmeri and Spagna, 2007).

In reality, indigo is not present as such in any plants but it is produced in some plants when they are crushed or macerated in water, reacting on exposure to oxygen in the air. It is insoluble in its blue form, and a mordant is necessary to fix it in textile fibers (Cardon, 2007). The processes utilized to produce indigo from a number of plants, including woad, and to fix it to textile fibers, has continued to progress over many centuries.

New research and results related to *I. tinctoria* have stimulated renewed interest in natural dyes, and new uses, such as a nutraceutical product and as an ornamental plant, have identified new opportunities for its exploitation in the future.

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The International Symposia on Tropical and Temperate Horticulture

20-25th November 2016, Cairns, Australia

It is my great pleasure to invite delegates from all sections of the horticultural industry worldwide to Cairns, Australia, for a series of ISHS symposia on tropical and temperature horticulture. Cairns is arguably the best tourist destination in Australia. Close by to the east is the Great Barrier Reef. To the west is the Australian outback and nestled around this small city is tropical rainforest. Much of Australia's unique flora and fauna can be experienced in and around Cairns.

The International Society for Horticultural Science (ISHS), the Australian Institute for Horticulture (AIH) and the Australian Society of Horticultural Science (AuSHS) are proud to host in Cairns, the first of the new style of ISHS Symposia, i.e. Symposia 2.0 (see Editorial in *Chronica Horticulturae* 55(3)). This format clusters together new symposia with larger, established ones, as well as combining related symposia in a concurrent one-week program. The theme of the meetings is "Now is the Era for Tropical Horticulture". From November 20-25, 2016, the world's leading horticulturists, horticultural scientists, resource managers, conservationists, economists, educators, landscape architects, planners, and students will meet together in Cairns to address the changes that are necessary in our priorities for development, research and education to secure a safe, adequate and secure food supply in both tropical and temperate climate zones.

Horticulture is fundamentally important in our world, both now and in the future. By the 2040s the world population will exceed 9 billion and by 2050 half of the world's population will reside in the tropics. Already, most of the fastest growing cities in the world are located in the tropics. The symposia will address the environmental, social, economic and health aspects of horticultural science, and the urgent need to make effective use of horticultural crops to sustain lives in a rapidly increasing world population.

The Scientific Program will feature seven new ISHS symposia in addition to two established symposia. The conveners and scientific committees for these symposia represent the leading scientists in their respective fields worldwide. There will also be special meetings and workshops hosted by the AuSHS and AIH. The new symposia are:

› Cairns, host city for ISTTH2016.

- First International Symposium on Beverage Crops
- First International Symposium on Urban Landscapes in Tropical Cities
- First International Symposium on Protected Cultivation in Tropical and Temperate Climates (incorporating the X International Symposium on Protected Cultivation in Mild Winter Climates)
- First International Symposium on Tropical Plant Breeding
- First International Symposium on Tropical Plant Genomes
- First International Symposium on Tropical Plantation Crops
- First International Symposium on Poverty, Hidden Hunger and Horticulture

The two established symposia are:

- Second International Symposium on Tropical Horticulture under the theme "Now is the Era for Tropical Horticulture"
- Fourth International Symposium on Guava and Other Myrtaceae

In collaboration with the Global Horticulture Initiative (GHI), we are convening the First International Symposium on Poverty, Hidden Hunger and Horticulture. Horticulture and horticultural products have a significant role to play in addressing many of the world's poverty, hidden hunger and malnutrition problems. This is an area worthy of our focused attention. We are expecting a high level of industry involvement in our symposia. Our keynote speaker for the opening session on 20th November will be Mr. Hein Deprez who is the Executive Chairman of the Board of (UNIVEG) Greenyard Foods, which is one of the world's leading fruit and vegetable companies. Morning plenary sessions will feature other world renowned speakers. An exhibition of horticultural products and industries featuring Australian and international companies will be part of the program and will incorporate a competition for horticultural producers to exhibit their horticultural products. This will form part of the larger exhibition of horticultural products and industries. François Laurens, President of IHC2022 in Angers, France, and currently the Deputy Director of The Institute of Research on Horticulture and Seeds, will speak on "The Link between Fundamental Research and Plant Breeding Programs: Bottlenecks and Progress". Since March 2011 he has been the coordinator of the large collaborative European project FruitBreedomics, which aims to improve

the efficiency of apple and peach breeding programs by filling the gap between basic research studies and applied breeding.
The symposia will be held in the Cairns Convention Centre, which was awarded the "World's Best Convention Centre" by AIPC in 2014 in recognition of the highest client rating received by a convention centre.
On behalf of the Organising Committee, I encourage you to reserve the dates of November 20-25, 2016 in your diary. Come 'down under' and join us, participate in and enjoy the large and inter-related program, and experience the relaxed and friendly hospitality of Tropical North Queensland, Australia. Please consult our website for further details: www.ISTTH2016.org. Call for abstracts will commence on 1st January, 2016.

Rod Drew

› Contact

Professor Emeritus Rod Drew, Co-Chair, Organising Committee ISTTH2016, and President ISHS, President AuSHS, Registered Horticulturist AIH, Chair Board of Directors GHI, e-mail: r.drew@griffith.edu.au or stth2016@griffith.edu.au, web: www.ishs.org/symposium/589

› Cairns Convention Centre, venue for ISTTH2016.

› Cairns is the gateway to the Great Barrier Reef.

› World famous Cairns Skyrail Cableway that runs from the tropical rain forest to the coast. It was twice awarded Australia's best major tourist attraction.

› Dr. Chris Hale received a New Zealand Queen's Birthday Honour

Dr. Chris Hale recently became an Officer of the New Zealand Order of Merit (ONZM) for services to horticultural science and the summerfruit industry. Appointments to the New Zealand Order of Merit are made for meritorious service to the Crown or to New Zealand and to those who have become distinguished in their particular field of endeavour. Dr. Hale is a plant pathologist with particular expertise in bacterial diseases, and has made significant contributions to the horticultural industry in New Zealand and internationally. He co-authored the International Society for Horticultural Science book 'Harvesting the Sun' (*Scripta Horticulturae* 14, http://www.harvestingthesun.org/), an overview of the impact of horticultural science on global nutrition and food supply. He was Chair of the ISHS Commission Plant Protection from 2006 to 2014 and has been convener of several symposia and editor/co-editor of subsequent *Acta Horticulturae* volumes. He has managed the research and development portfolio of Summerfruit New Zealand since 2003. Dr. Hale is a Fellow of the New Zealand Society for Horticultural Science and he has also received a Royal Society of New Zealand Bronze medal.

› Chris Hale with his wife, Linda, at Government House, Wellington, New Zealand, after receiving his New Zealand Order of Merit medal from the Governor General, Lieutenant General The Right Honourable Sir Jerry Mateparae.

New geophytes from Turkey[1]

Erdal Kaya and Neriman Özhatay

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Ten geophyte species have been identified as new species, based on the material collected from Anatolia, Turkey, between 2001 and 2014 within the framework of a large national project entitled, "*The collection, characterisation, cultivation and industrialisation of the natural ornamentals*", which was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) and the General Directorate of Agricultural Research and Policy (TAGEM) of the Ministry of Food Agriculture and Livestock of Turkey.

In the "*Turkey's Geophytes*" book based on the outcomes of the above mentioned project, 10 new species have been described in detail including photos and potential uses. Nine of these new species for science are: *Allium aksekiense* (Akseki Onion) and *Allium kayae* (Saimbeyli Soğanı) collected from South Anatolia and belonging to *Allium* section of the genus *Allium*; *Bellevalia undulatifolia* (Manavgat Sümbülü) collected from Antalya; *Colchicum erdalii* (Eğin Acıçiğdemi) collected from Erzincan province in East Anatolia; *Colchicum osmaniyense* (Osmaniye Acıçiğdemi) from Osmaniye province in South Anatolia; *Muscari artvinense* (Artvin Sümbülü) from Artvin province in Northeastern Anatolia; *Muscari erdalii* (Erdal Sümbülü) from Mersin province; *Muscari ufukii* (Uzun Sümbül) from Gaziantep province and *Ornithogalum adanense* (Adana Akyıldızı) from Adana province in South Anatolia. It was determined, however, that the *Paeonia* samples gathered from Çanakkale province were natural hybrids, named as *P.× kayae* (Ebruli Şakayık), and were subsequently added as a new taxon.

All of these recently discovered natural taxa are endemic to Turkey's flora, and intensive studies are being undertaken now for culturing and breeding objectives. They have already been shown to have very high potential as ornamentals or for medicinal and aromatic plant industries.

Introduction

Turkey is one of the most important centres of biodiversity because of its geographical location on the crossroads of three important gene centres of the world, its geomorphological structure and its diverse ecology. There are about 12,000 flowering plant taxa in Turkey's flora and approximately 4,000 of them are endemic (Davis et al., 1984, 1988; Güner et al., 2000; Kaya, 2014).

Turkey has become very attractive for collecting native ornamentals for both local and international markets, because of the presence of more than 1,000 taxa of geophytes (Kaya, 2014).

In addition to uprooting wild ornamental bulbs for export, many foreign breeders have been gathering parental material from Turkey for successful breeding within their national programmes. However, Turkey's own national programme for cultivation, cultivar development and commercialisation of native plants has not realised its potential.

In order to accelerate national efforts in this field, a national project supported by the Scientific and Technological Research Council of Turkey (TUBITAK) and the General Directorate of Agricultural Research and Policy (TAGEM) of the Ministry of Food, Agriculture and Livestock, was established in 2000. Within the framework of this large project, intensive collection and development of an inventory of natural geophytes has been achieved, whilst propagation, release and commercialisation of these new species is still in progress. This project has enabled a significant step to be taken towards the effective evaluation of the biodiversity of this country (Kaya, 2014).

Currently, the genus *Allium* is represented by about 970 species in the world (Anonymous, 2015). Within all 14 sections of the genus *Allium*, some 200 species have been found to be naturally-occurring in Turkey. The new species introduced to the scientific world are from the section *Allium*. There are about 120 species worldwide in the section *Allium*, and the country with the greatest number reported is Turkey with 58 species, 50% of which are endemic (Davis et al., 1984, 1988; Güner et al., 2000; Koyuncu, 2012). The *Allium* species in this section are easily recognised by the following morphological properties: well developed, sometimes reticulated bulb structure; leaves on the trunk instead of the base; large umbels that generally have many flowers; characteristic spathe, filaments unequal, outer usually simple, rarely dentate to 3-cuspidate, inner with a broader basal lamina, usually 3-cuspidate, rarely with 5-7 cusps, median cusp anther-bearing, usually shorter than sterile lateral cusps. Turkey could be considered a gene centre for this section because a high number of taxa are found here, many of which are endemic.

The genus *Bellevalia* has a total of about 70 taxa worldwide (Anonymous, 2015). Twenty-four *Bellevalia* species are grown in Turkey. Thirteen of them are endemic (Davis et al., 1984, 1988; Güner et al., 2000; Persson, 2006; Uzunhisarcıklı et al., 2013). Tugay (2012) listed 24 species in a checklist, by taking the synonyms and questionable records into consideration. In this checklist, *B. glauca* is replaced by *B. chrisii* (Yıldırım et al., 2014). After publication of the discovery of *B. pseudolongipes* (Karabacak et al., 2014), *B. koyuncui* (Karabacak et al., 2015), *B. pseudofominii* and *B. undulatifolia* (Gürdal et al., 2014), the number of species increased to 27, 16 of which are endemic.

Colchicum is one of the most difficult genera among petaloid monocotyledons in terms of taxonomy. One of the facts causing difficulty in classification is the flowering period. Flowers and leaves appear together (*synanthous*) on some species that flower in spring. However, on the autumn-flowering species, there are no leaves when flowering occurs; they will appear in spring when fruits are ripening (*hysanthous*). Because all plant parts are important in identification, these various properties of this genus complicate its taxonomy. The species grown in northern and higher altitude locations are generally spring-type species. Sixty per cent of species grown in Turkey are autumn-type species, and the majority of them show polyploidy, which also complicates the classification. The region with the most species recorded is the Balkan Peninsula, and Turkey has the

[1] Based on the final reports of "The collection, characterisation, cultivation and industrialisation of some natural ornamentals" (Project Nr: 105G068), and "The cultivation of Turkey's geophytes and contributing new species and cultivars to the relevant industries" (Project Nr: 110G007) projects supported by the Scientific and Technological Research Council of Turkey (TUBITAK), and implemented between 2001 and 2014.

Figure 1. *Allium aksekiense* N. Özhatay, M. Koyuncu and E. Kaya (Sect. *Allium*) (*Akseki Soğanı*).

Figure 2. *Allium kayae* N. Özhatay and M. Koyuncu (Sect. *Allium*) (*Saimbeyli Soğanı*).

Figure 3. *Bellevalia undulatifolia* N. Özhatay, B. Gürdal and E. Kaya (*Manavgat Sümbülü*).

most species of any country. In Turkey, 52 taxa are found growing naturally. Of them 26 (50%) are endemic, and the type specimens of six species have been cited from Turkey.

In Turkey 62 *Ornithogalum* species (30% endemic) and 30 *Muscari* species (19% endemic) are grown (Anonymous, 2015; Bağcı et al., 2009; Eker and Koyuncu, 2008; Güner et al., 2000). During the project, one new species in the genus *Ornithogalum*, and three new species in the genus *Muscari* were evaluated. The new species are: *Ornithogalum adanense* collected from Adana province, *Muscari artvinense* collected from Artvin province, *Muscari erdalii* from Mersin province, and *Muscari ufukii* from Gaziantep province in Anatolia.

The genus *Paeonia* is represented by nine taxa in Turkey (Davis, 1965; Davis et al., 1988; Güner et al., 2000; Hong, 2000; Özhatay and Özhatay, 1995). Recently *Paeonia* × *kayae*, discovered in the Çanakkale province, was identified as a new natural hybrid.

Materials and Methods

Plant material was collected from throughout Turkey during the 2001-2014 period within the framework of various research projects such as: "*Studies on the determination, breeding and growing techniques of the Paeonia species existing in Turkey's flora*" project supported by TAGEM; "*Cultivation of some natural plants and adding new species and cultivars to the ornamentals sector*", supported by TUBITAK and TAGEM (Pr. Nr: 105G068) and "*Cultivation of Turkey's geophytes, and giving new species and varieties to the relevant sector*", supported again by TUBITAK and TAGEM (Pr. Nr.: 110G007). This material was planted in "Turkey's Geophytes Garden" established at Atatürk Central Horticultural Research Institute, Yalova. Flowering herbarium samples of these plants were also collected and housed at the Herbarium of the Faculty of Pharmacy of Istanbul University (ISTE). The identification of specimens was undertaken on both living material and the herbarium samples. Identification studies of the living samples were undertaken between 2013 and 2014 at the research facility established in the Geophytes Garden in Yalova. The outcomes of this identification were compared with the specimens at the ISTE Herbarium. In identifying the species, in addition to "*Flora of Turkey*" by Davis et al. (1984, 1988), reports of various projects implemented in this field (Koyuncu and Güvenç, 1994; Özhatay, 1985) and academic theses (Koyuncu, 1978; Özhatay, 1977) were also utilised.

New species and their properties

Allium aksekiense N. Özhatay, M. Koyuncu & E. Kaya (Sect. *Allium*) (*Akseki Soğanı*)

Location: (Turkey) C3 Antalya; between Manavgat and Akseki, E. Kaya 2952; July 2013 ISTE 100217 (holotype).

Identification: *A. aksekiense* is allied to *A. phanarantherum* Boiss. et Hausskn., *A. proponticum* Stearn et N. Özhatay and *A. stearnianum* Koyuncu, N. Özhatay et Kollmann. However, it differs from the first two because they have caducous spathes and very long thread-like lateral cusps. *A. stearnianum* also differs because it occurs in East Anatolia, has straight stems, sub-equal pedicels and different flower colours (greenish at the base and up to pinkish purple) and *A. aksekiense* distribution is in S. Anatolia not E. Anatolia. This new species was named after its geographical area. It is known only in this locality (Özhatay et al., 2014).

Flowering time: June-July.

Habitat and altitude: Rocky slopes, 700-800 m a.s.l.

Potential utilisation: This could be an important species in the ornamental sector because of the following properties: being greenish or cream-green in the early stage, converting to sugar-pinkish colour later; pleasant fragrance of the flower; later flowering compared to other species, and stem length up to 80 cm (Figure 1). Furthermore, it could be used as a kind of edible garlic. Additional studies are being undertaken.

Allium kayae N. Özhatay & M. Koyuncu (Sect. *Allium*) (*Saimbeyli Soğanı*)

Location: (S Turkey) C5 Adana: Doğanbeyli-Hanyeri plain, under the oak grove near to Çatalcam village, 22.07.2012, *M. Koyuncu 16318*, ISTE 104 802 (holotype). Kayseri: Tufanbeyli-Develi, STE 104804. Adana: Saimbeyli-Tufanbeyli, Develi junction, ISTE 104807.

Identification: *A. kayae* is closely related to *A. cappadocicum* Boiss. but it has rosy pinkish flowers, dense inflorescences, conspicuous silver-white persistent involucrum-like bracteoles and white exserted filaments. The new species is named after Erdal Kaya, coordinator of the project (Özhatay et al., 2014).

Flowering time: June-July.

Habitat and altitude: Among oak trees, 1400-1500 m a.s.l.

Potential utilisation: This new endemic species, found in Adana province, has great potential for the ornamentals industry because it has a very attractive shape and flower colour. Studies aimed at cultivation methods are currently being carried out (Figure 2).

Bellevalia undulatifolia N. Özhatay, B. Gürdal & E. Kaya (*Manavgat Sümbülü*)

Location: (SW Turkey) C3 Antalya; Antalya; Manavgat - İbradı yolu, Oymapınar Barajı yanı, 51 m a.s.l., 31.03.2012, *E. Kaya 3247* ISTE 102 823 (Holotype).

Identification: The new species is similar to *B. tauri* Feinbrun (also *B. clusiana* Griseb. and *B. mathewii* Özhatay & Koçak). However, in *B. undulatifolia*, the perianth is 5.5-6 mm (in *B. tauri* 6-7 mm), pedicels are shorter than or as long as the perianth (in *B. tauri* pedicels are as long as the perianth). *B. undulatifolia* is distinctly different because of its patent, undulating leaves and the margin of the leaves is smooth with a purple line. In addi-

tion, the valves of the capsule are approximately 8-10(-14) mm wide in *B. undulatifolia* (in *B. tauri* c. 20 mm) (Gürdal et al., 2014).
Flowering time: April-May.
Habitat and altitude: Meadows, calcareous rocks, c. 50-100 m a.s.l.
Potential utilisation: This new endemic species, found in Manavgat-Antalya province, is considered to have great potential in the ornamentals industry because of the very attractive colours of its flowers and its wavy leaves (Figure 3). A study of cultivation techniques is now underway.

Figure 4. *Colchicum erdalii* N. Özhatay (*Eğin Acıçiğdemi*).

Colchicum erdalii N.Özhatay (*Eğin Acıçiğdemi*)

Location: (E Turkey) B7 Erzincan: Kemaliye, across Sırakonak village, 1739 m a.s.l., 27.06.2008, E. Kaya-591, ISTE 96117 (holotype). Kemaliye, ISTE 96117a.
Identification: The new species, *Colchicum erdalii*, is an endemic species found only in the area where it was collected. It is similar to *C. serpentinum*, which has a more wide-spread distribution. The new species flowers in spring with synanthous leaves and the corm has a typical shape. Its short perianth tube begins on the soil surface, has a broad base and has narrowly triangular perianth segments with acute-acuminate tips. In addition, *C. erdalii* has 2*n*=14 chromosome counts, diploid and basic chromosome number *x*=7. In comparison, the chromosome number of *C. serpentinum* is 2*n*=18, basic number *x*=9. This new species is named after Erdal Kaya, who contributed greatly towards understanding Turkish *Colchium* taxa (Özhatay and Kaya, 2014).
Flowering time: February-March.
Fruiting time: May-June.
Habitat and altitude: Rocky, slopes, steep screen, 1700-1800 m a.s.l.
Potential utilisation: This endemic species, found in Kemaliye-Erzincan province, could be utilised as a new ornamental plant because of its fast propagation behaviour and interesting flower shape (Figure 4). It may also have potential as a medicinal plant because of a high colchicine content.

Colchicum osmaniyense N. Özhatay & E. Kaya (*Osmaniye Acıçiğdemi*)

Location: (S Turkey) C6 Osmaniye: Hasanbeyli, Kemiklikayatepe district, *E. Kaya* ISTE 104799 (holotype). Hasanbeyli, Kemiklikayatepe Mahallesi, 900 m a.s.l., 12.12.2014, *S. Demirci, B. Kayıran, T. Hastürk*, ISTE 104 805'; Hasanbeyli, Kemiklikayatepe district at 876 m a.s.l. on 12.11.2007, ISTE 104805, *ibid*, ISTE 104806.
Identification: *Colchicum osmaniyense*

Figure 5. *Colchicum osmaniyense* N. Özhatay and E. Kaya (*Osmaniye Acıçiğdemi*).

from South Turkey has been illustrated and described as a new species. It is endemic to Turkey. The species is a synanthous and winter-flowering species. It morphologically resembles *C. stevenii*, which grows further west and at lower altitudes. They have the same number of chromosomes, 2*n*=54, but their flower colour and shape, and their flowering times are different. This species is recognized by its very dark green leaf colour, corm shape, winter flowering and the base of the perianth segment being darker deep pinkish or yellowish.
The new species is named after its natural distribution area, Osmaniye province of Turkey (Özhatay and Kaya, 2014).
Flowering time: November-December.
Fruiting time: April.
Habitat and altitude: Rocky places, 600-900 m a.s.l.
Potential utilisation: There are currently no plans for utilising this species (Figure 5).

Muscari artvinense S. Demirci and E. Kaya (Subgen. *Botryanthus*) (*Artvin Sümbülü*)

Location: (NE Turkey) A9 Artvin: Found in Murgul, Korucular Village gardens of Artvin Province at 796 m a.s.l., on 06.05.2011, *E. Kaya 2132*, ISTE 99472 (holotype).
Identification: This new species closely resembles *M. aucheri* (Boiss.) Baker, but differs from it mainly in its dense raceme (40-60 flowers), and its large, broad and numerous leaves. *M. artvinense* is also similar to *M. aucheri*, but can be distinguished by the following characteristics: 1-3.5 cm diam. bulb (not 1-3 cm); 6-10 leaves which are 2-4 cm wide, large and erect (not 2-3, 0.2-1.5 cm wide and erect-patent); 40-60 flowers per raceme and dense (not 20-40 flowers per raceme that are loosely packed). This new species is named after its geographical area, Artvin province of Turkey, where the new *Muscari* species is located (Demirci et al., 2014).
Flowering time: April-May.

Figure 6. *Muscari artvinense* S. Demirci and E. Kaya (Subgen. *Botryanthus*) (*Artvin Sümbülü*).

Habitat and altitude: Meadows, gardens, c. 800 m a.s.l.
Potential utilisation: This endemic species, collected from Artvin province of Turkey, is considered to have great potential as an ornamental plant because of the presence of large, erect leaves that are very different from other species, and because of its rather attractive and mostly sterile flowers (Figure 6).

Muscari erdalii N. Özhatay and S. Demirci (Subgen. *Leopoldia*) (*Erdal Sümbülü*)

Location: (S Turkey) C4 Mersin: Mut-Kırobası, 18 km of Mut, open lime soil, 1280 m a.s.l., 15.06.1990, N. and E. Özhatay, Iter Anatolicum ISTE 61829 (holotype) between Mut and Kırobası, around Kırca village, (ISTE 96672); ibid (ISTE 96673).
Identification: *M. erdalii* is closely related to *M. tenuiflorum* and *M. babachii*, but differs by having a glaucous habit, shorter scape (15-20 cm), scabrid leaf margins, glaucous greenish ivory fertile flowers (9-11 mm), whitish-pale violaceous sterile flowers (3-9 mm), pedicels of fertile flowers (12-15 mm) longer than 1.5-2 × perigone, pale violaceous pedicels of sterile flowers (10-20 mm) and a larger capsule (12-18 mm). Named after Erdal Kaya, who is coordinator of the geophyte project and collector of the specimens (Demirci et al., 2013).

Figure 7. *Muscari erdalii* N. Özhatay and S. Demirci (Subgen. *Leopoldia*) (*Erdal Sümbülü*).

Figure 8. *Muscari ufukii* E. Kaya and S. Demirci (Subgen. *Leopoldia*) (*Boylu Sümbül*).

Figure 9. *Ornithogalum adanense* S. Demirci and E. Kaya (Subgen. *Beryllis*) (*Adana Akyıldızı*).

Flowering time: April-May.
Habitat and altitude: *M. erdalii* is endemic to Turkey and distributed in the Mediterranean phytogeographical region. It grows on rocky slopes between the elevations of 1100 and 1700 m.
Potential utilisation: It is envisaged that this endemic species, collected from Mersin province of Turkey, will have potential as an ornamental plant because the flower has an attractive double colour and compact morphology (Figure 7). Additional work has been initiated to develop cultivation methods and undertake breeding.

Muscari ufukii E. Kaya and S. Demirci (Subgen. *Leopoldia*) (*Boylu Sümbül*)

Location: (SE Turkey) C7 Gaziantep: On the Gaziantep-Nurdağı road, 1096 m a.s.l., 7.07.2011, *E. Kaya 2471*, ISTE 96978 (holotype).
Identification: *M. ufukii* differs from *M. longipes* and *M. tenuiflorum* because it has a long scapus, large bulbs and erect leaves. This new species has similarities to *M. longipes*, however, it differs with respect to the following characteristics: the bulb is 8-13 cm in diameter (instead of 1.5-4 cm); light brown tunica (instead of ivory-light pinkish colour); scapes 70-100 cm (not 20-60 cm); raceme is cylindrical (not conical); the pedicels of fertile flowers are 20-30 mm and flat after fertilisation (not 50-80 mm and bent towards downward-curled); leaves are erect, green, up to 15 mm wide, without a spout and are not curled (instead of spreading and touching the soil, waxy, up to 30 mm wide, have a spout and are curled). *M. ufukii* can be distinguished from *M. tenuiflorum* because of its long scapus, many-flowered raceme, larger bulbs and long pedicels. This new species is named after Ufuk Rastgeldi, one of the collectors in the geophyte project (Demirci et al., 2014).
Flowering time: May-June.
Habitat and altitude: Fields, 1000-1800 m a.s.l.
Potential utilisation: This new species has the longest stem of the *Muscari* species and may therefore have potential as a new ornamental. A breeding program has been initiated using this species as a tall parent, with the objective of developing new cut flower types (Figure 8).

Ornithogalum adanense S. Demirci and E. Kaya (Subgen. *Beryllis*) (*Adana Akyıldızı*)

Location: (S Turkey) C5 Adana: Between Saimbeyli and Tufanbeyli of Adana province, Güzelim village outlet, 1427 m a.s.l., flowered in the garden 15.04.2013, *E. Kaya 4386*, ISTE 104803 (holotype).
Identification: This new species is very similar to *Ornithogalum brachystylum* Zahariadi, which grows in the Greek Islands, Rhodos and Symi, and in the Turkish territory around Sarigerme (Mugla province). However, the green stripe on the perianth and the shape of the ovary are different. *O. adanense* also has similarities to *O. brachystylum*, but can be distinguished by the following characteristics: ovary yellow and ovate-lobed (not green, ovate); styles 1.5-2 mm (not 1.2-2.5 mm); 2-3 leaves, 2-3 mm wide and spiral curved (not 4-5, 0.5-1 cm wide, linear); raceme 5-10 flowers and loose (not 20-30 flowers and dense). This new species is named after the geographical area, Adana province (Turkey), where it occurs. It has only been found in this locality (Demirci et al., 2014).
Flowering time: May-June.
Habitat and altitude: Open pine forest, approximately 1500 m a.s.l.
Potential utilisation: It has parental properties for developing new ornamentals because it is the only *Muscari* species in Turkey that has upright spiral leaves (Figure 9).

Paeonia × kayae N. Özhatay (*Ebruli Şakayık*)

Location: (NW Turkey) B1 Çanakkale: Yenice, Kalkım, Aşağıçavuş village, Mursel district of Çanakkale province, 15.06.2005, *E. Kaya 1703* (holotype ISTE 84 834).
Identification: Four *Paeonia* taxa occur in this region. *P. mascula* subsp. *arietina*, *P. mascula* subsp. *bodurii*, *P. daurica*, and *P. peregrina*. This new discovery is a natural hybrid between *P. mascula* subsp. *arietina* (G. Anderson) Cullen & Heywood and *P. mascula* subsp. *bodurii* Özhatay. It is similar to subsp. *bodurii*, except that it is much bigger and has bicoloured flowers. It is allotetraploid, 2*n*=20. This new species is named after Erdal Kaya, who collected the specimens (Demirci et al., 2014).
Flowering time: March-April.
Habitat and altitude: Open forest, 1000-1100 m a.s.l.
Potential utilisation: A new cultivar has been released, named 'Kaya' and registered in 2011, from a single plant selection of the cultivated population of this natural hybrid species collected from Çanakkale. 'Kaya' has very attractive flowers (Figure 10). Furthermore, it has been used as maternal and paternal parents in the breeding program. In a collaborative study with Gazi University Faculty of Pharmacy, it was determined that this species has the highest phytochemical content among all of the species existing in Turkey's flora. For these reasons, it is likely to be very important for both the ornamental and medicinal plant industries.

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The authors would like to express their deep appreciation to the dedicated team from "The collection, characterisation, cultivation and industrialisation of some natural ornamentals" (Project Nr: 105G068) and "The cultivation of Turkey's geophytes and contributing new species and cultivars to the relevant industries" (Project Nr.: 110G007) projects for their great effort throughout the preparation, implementation, report writing and dissemination of the results of the project.
105G068 and 110G007 Project Team: Erdal Kaya and Kamil Erken from Atatürk Central Horticultural Research Institute; Neriman Özhatay from University of İstanbul, Faculty of Pharmacy; Ufuk Rastgeldi from GAP

Figure 10. *Paeonia* × *kayae* N. Özhatay (*Ebruli Şakayık*).

Agricultural Research Institute; Meral Aslay from Erzincan Horticultural Research Station; Yasemin İzgi Saraç from Black Sea Agricultural Research Institute; Murat Hocagil from Alata Horticultural Research Institute; Bilge Şener from Gazi University, Faculty of Pharmacy; and Tijen Oğraş from TUBITAK Marmara Research Centre (TUBITAK MAM).

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› Courses and Meetings

The following are non-ISHS events. Make sure to check out the Calendar of ISHS Events for an extensive listing of all ISHS meetings. For updated information log on to www.ishs.org/calendar

International Symposium on Sustainable Fruit Production, 21-24 March 2016, Donja Stubica, Croatia. Info: Prof. Tomislav Jemrić, Phone: +385 1 2393 612, E-mail: tjemric@agr.hr, Web: http://www.life-susafruit.eu/symposium.html

Course on Contemporary Approaches to Genetic Resources Conservation and Use, 4-22 April 2016, Wageningen, The Netherlands. Info: http://goo.gl/y2GpcJ

Advanced Course on Molecular Methods for Food Quality and Safety Control, 11-15 April 2016, Derio, Spain. Info: Mediterranean Agronomic Institute of Zaragoza (IAMZ) – CIHEAM, Avenida Montañana 1005, 50059 Zaragoza, Spain, Phone: +34 976 716000, Fax: +34 976 716001, E-mail: iamz@iamz.ciheam.org, Web: www.iamz.ciheam.org

Course on Horticulture Sector Development for Emerging Markets, 9-27 May 2016, Wageningen, The Netherlands. Info: http://goo.gl/xn3ZV3

AGRICONTROL 2016: The 5th IFAC Conference on Sensing, Control and Automation for Agriculture, 14-17 August 2016, Seattle, Washington, USA. Info: Manoj Karkee, Washington State University, PO Box 641227, Pullman, WA 99164, USA, Phone: (509)7869208, E-mail: manoj.karkee@wsu.edu, Web: http://ifac.cahnrs.wsu.edu/

XV International Peat Congress, 15-19 August 2016, Kuching, Malaysia. Info: Conference Secretariat, Tropical Peat Research Laboratory Unit, Chief Minister's Department, Lot 6035, Kuching-Kota Samarahan Expressway, 94300 Kota Samarahan, Sarawak, Malaysia, Phone: +6082 662491, Fax: +6082 662497, E-mail: peat2016@gmail.com, Web: www.ipc2016.com

International Course on Bees and Pollination, 16-26 August 2016, Heredia, Costa Rica. Info: Prof. Dr. M.J. (Rinus) Sommeijer, E-mail: m.j.sommeijer@uu.nl or M.Sc. Luis Alejandro Sánchez Chaves, E-mail: luis.sanchez.chaves@una.cr, Web: web.science.uu.nl/sommeijer/cursus.html

II International Symposium on Pyrethrum

Section Medicinal and Aromatic Plants #ishs_seme
Commission Plant Protection #ishs_cmpp
Commission Plant Genetic Resources #ishs_cmgr

› Participants of the symposium.

› ISHS Board member Prof. Ryutaro Tao (left) handing out the ISHS medal to Symposium Convener Prof. Kazuhiko Matsuda (right).

The II International Symposium on Pyrethrum was held on August 6-9, 2015 in Kyoto, Japan, and attracted about 120 participants. The opening ceremony began with a welcome from the convener Prof. Kazuhiko Matsuda and after-addresses by Prof. Hisashi Miyagawa and Prof. Kazumitsu Ueda from Kyoto University (KU), Dr. Ryutaro Tao, ISHS Board member, introduced the Society's role in world horticulture. Thereafter, Mr. Naohide Ueyama, president of the Dainihon Jochugiku Co. (Kincho), gave a keynote lecture. Thanks to Mr. Eiichiro Ueyama, the first president, Japan became the No.1 pyrethrum producing country before World War II. Although *Tanacetum* production moved to other countries after the war, the company has expanded by developing other products to control household and agricultural pests.

Emeritus Prof. Hatanaka from Yamaguchi University gave a keynote lecture on green odor and its relationship with pyrethrins. He discovered that green odor was generated from linolenic acid (LA) and noted that the pyrethrin alcohol moiety is biosynthesized from LA, sharing a common pathway with the green odor.

Prof. John Pickett from Rothamsted Research lectured on the history of pyrethrum in the UK and showed the push-pull strategy in Africa and GM plants emitting (*E*)-β-farnesene for crop protection. Prof. John Clark from the University of Massachusetts gave a presentation on membrane transplantation to *Xenopus* oocytes to reconstitute mammalian voltage-sensitive sodium channels, showing successful evaluation of pyrethroid actions on the channels. Prof. Ke Dong from Michigan State University presented research on the mechanism of repellent effect of pyrethrum, showing the action of pyrethrum on olfactory sensory neurons. Dr. Maarten Jongsma from Wageningen University lectured on localization of pyrethrin biosynthesis enzymes in *Tanacetum* and isolations of some enzyme genes as well as on a new pyrethrin-synthesizing plant species.

In session 1, Mr. Brian Chung from Botanical Resources Australia (BRA), Mr. Eugene Murashi from Horizon Group and Mr. Zhong Lu Liang from Yunnan Nanbao Biotechnology Co. presented overviews on the current status of pyrethrum in Australia, Rwanda, and China, respectively.

In the second session on "Stewardship and pest controls", Dr. Thomas Osimitz from Science Strategies spoke about pyrethrum low adverse effects. Mr. Tomohisa Kawasaki from Kincho presented the development of mosquito coils effective on pyrethroid-resistant mosquitoes, while Dr. Tatsuya Mori from Sumitomo Chemical spoke about metoflu-thrin with extremely high mosquito knock-down efficacy in non-heating devices such as fan vaporizers, paper and resin emitters. Mr. Ryuta Miyaji from Earth Chemical Co. presented information on fumigants to control pyrethroid-resistant cockroaches. Dr. Hitoshi Kawada from Nagasaki University presented possible new controlling measures for pyrethroid-resistant malaria.

In session 3 on "Mosquito controls", Dr. Mutsuo Kobayashi from the National Institute of Infectious Diseases (NIID) presented a summary of the 2014 outbreak of Dengue fever in Tokyo and its management with pyrethroids, while Dr. Yoshinori Shono from Sumitomo Chemical presented technical details of the product Olyset® Plus, a mosquito net with long-lasting efficacy. Mr. Jim Jackson from MistAway Systems introduced a misting device to control mosquitoes in residential areas and Dr. Shinji Kasai from NIID presented results of studies on the mechanisms of target-based resistance in the *Aedes* vector.

In the fourth session on "Breeding and physiology", Dr. Kristin Groom from BRA presented management of pyrethrum production in Tasmania and Prof. Caiyun Wang from Huazhong Agricultural University (HAU) reported on their work on breeding for high pyrethrin content. Ms. Dilnee Suraweera from the University of Melbourne presented the effects of drought on pyrethrum production, while Dr. Alistair Gracie from the University of Tasmania talked about his work on the self incompatibility of *Tanacetum*.

In session 5 entitled "Biosynthesis I", Prof. Kenji Matsui from Yamaguchi University presented results of studies on hexenol conjuga-

› Toast at the banquet. From left to right: Kazuhiko Matsuda, John Clark, John Pickett, Maarten Jongsma and Akikazu Hatanaka.

› Participants in front of the Golden temple during the excursion “Cool Japan”.

tion and its role in plant defense against insect attacks, while Prof. Kaihei Koshio from Tokyo University of Agriculture discussed production of ethylene as a result of green odor reactions. Dr. Kazunori Okada from the University of Tokyo talked about the modulation of a transcription factor to change volatile emission from rice, Ms. JinJin Li from HAU presented findings on the natural enemy attraction of *Tanacetum* and Prof. Junji Takabayashi from KU presented results of wound-induced volatile actions on secondary metabolism.

In the sixth session entitled “Biosynthesis II”, Mr. Hu Hao from HAU presented information on dual functions of chrysanthemyl diphosphate synthetase, Dr. Hideyuki Matsuura from Hokkaido University talked about *cis*-jasmone biosynthesis studies using labeled precursors and Dr. Michael Birkett from Rothamsted Research presented results of studies on the mechanisms behind *cis*-jasmone activities on plants. Dr. Naoki Ono from Nara Institute of Science and Technology showed transcriptome analyses in *Tanacetum* and the author presented the current understanding of pyrethrin biosynthesis.

On the last day, participants fully enjoyed the excursion “Cool Japan”, visiting the world heritage Golden, Silver and Kiyomize temples. In conclusion, the symposium was successful and fulfilled its mission.

Kazuhiko Matsuda

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› III Balkan Symposium on Fruit Growing

Section Nuts and Mediterranean Climate Fruits #ishs_senu

› Participants of the symposium at the entrance hall of the “Crowne Plaza” hotel.

The III Balkan Symposium on Fruit Growing was held on September 16-18, 2015 in Belgrade, Serbia. It was organized by the Department of Fruit Growing, Faculty of Agriculture, University of Belgrade and under the auspices of the ISHS. The symposium was attended by 167 participants from 26 countries. In addition to participants from all Balkan countries (except for Montenegro), the symposium was attended by 45 participants from other countries: Russia, Brazil, Latvia, USA, Belgium, Czech Republic, Italy, Lithuania, Slovak Republic, Germany, Iran, Republic of Korea, Portugal and Norway. The aim of this symposium was

› Symposium participants at the technical tour in PIK "South Banat", Bela Crkva.

› Prof. Tiziano Caruso (left) presenting the ISHS medal to the Convener Prof. Dragan Milatović (right).

to promote communication and cooperation among researchers, companies and growers in the Balkan region and beyond.

The scientific program consisted of two invited lectures, 40 oral and 104 poster presentations divided into five sessions: Fruit breeding and biotechnology, Cultivar and rootstock evaluation, Physiology and ecology of fruit trees, Fruit growing technologies, Fruit quality, post-harvest and processing and Other topics. The symposium provided an overview of current research in all fields of fruit science. There was a wide diversity of research topics presented at the symposium. All participants learnt from the numerous presentations, took part in scientific discussions, found useful contacts and enjoyed meeting old and new colleagues.

At the opening ceremony, Prof. Dragan Milatović, Symposium Convener, and Prof. Predrag Pudja, Vice-Dean of the Faculty of Agriculture, gave welcome addresses on behalf of the host organization. Prof. Tiziano Caruso (Italy), Chair of the ISHS Section Nuts and Mediterranean Climate Fruits of ISHS, welcomed the participants and presented a brief introduction to the ISHS. Andeja Mladenović, Deputy Major of Belgrade City, also expressed his welcome to the symposium participants. On the first day of the symposium, the invited lecture "New cultivars of first quality cherries at Dresden-Pillnitz" was presented by Dr. Mirko Schuster, Julius Kühn-Institute (JKI), Dresden, Germany. On the second day, the invited lecture "Modern apple fruit production" was presented by Prof. Franci Štampar, Biotechnical Faculty, University of Ljubljana, Slovenia.

The third day was dedicated to technical and cultural visits. Participants first visited PIK "South Banat", Bela Crkva. This company occupies an area of 1,830 hectares, of which 230 ha are planted with apples, about 170 ha with peaches and nectarines, and about 100 ha with grapes. After the tour to apple and peach orchards, participants visited the fruit grading line and cold storage facilities.

› Dr. Mirko Schuster (left) and Prof. Franci Štampar (right) during their invited lectures.

The next stop was at Smederevo Fortress, a medieval fortified city built in the XV century. After lunch in a restaurant on the banks of the Danube River, the participants visited the plantation "Blueberry Land" in the village of Brestovik. There are three blocks of modern blueberry plantings, with a total area of 5 ha. The tour finished at the Experimental Farm "Radmilovac" of the Faculty of Agriculture. The total area of the farm is 86 ha of which 30 ha is planted with orchards and vineyards. It is a facility for practical education and training for students, as well as for carrying out research by the teaching staff. Participants had the opportunity to see the wine cellar and orchard, and finally enjoyed a cocktail and wine tasting.

Two social activities were organized during the symposium: the welcome party at the Faculty of Agriculture and the official dinner. The Faculty of Agriculture was founded in 1919 and currently has more than 4,000 students. After the presentation of the faculty, a welcome cocktail was organized, followed by a walk with a guide through the Zemun, an old part of Belgrade. An official music dinner at a restaurant on an island in the Sava River was one of the highlights of the symposium, where participants could enjoy the relaxed atmosphere for friendship, talk, singing and dancing.

The value of the symposium was positively recognized by the participants from various countries. The symposium was a good opportunity for participants to develop friendships, old and new. New networks were established between research scientists for knowledge sharing and for further cooperation.

Dragan Milatović

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› III International Conference on Quality Management in Supply Chains of Ornamentals (QMSCO2015)

Section Ornamental Plants #ishs_seop
Commission Quality and Postharvest Horticulture #ishs_cmph

› Conference Convener Dr. Mohammad Mahdi Jowkar (left) receiving the ISHS medal and certificate from ISHS representative Dr. J. Heyes (right).

› Conference participants, and the Organizing and Scientific Committees at the conference venue.

The III International Conference on Quality Management in Supply Chains of Ornamentals (QMSCO2015) was organized by the Islamic Azad University, Kermanshah Branch, under the auspices of the International Society for Horticultural Science (ISHS). The event was held on May 1-3, 2015, in the Anahita venue at the Parsian International Hotel, Kermanshah, Iran.
There were 113 papers received from 13 different countries, including: China, Finland, Germany, India, Iran, Kenya, Malaysia, New Zealand, Pakistan, Sri Lanka, Thailand, The Netherlands and USA. Several well-known ISHS and ASHS members presented keynote lectures, such as M. van Iersel (Univ. of Georgia, USA), J.A. Heyes (Massey Univ., New Zealand), E. Farshadfar (Razi Univ., Iran), S.M. Jain (Univ. of Finland), and U. van Meeteren (Wageningen Univ., The Netherlands).
The conference highlighted the most recent developments, innovations and scientific topics dealing with improving our understanding and sharing knowledge on various facts of ornamental production, application and marketing cycle with special emphasis on: A) Propagation techniques and innovations, B) Physiology and biology, C) Cultivation techniques and innovations, D) Harvest and postharvest, E) Biotechnology, and F) Economics and marketing. Several outstanding papers discussed issues in the fields of biotechnology, cloning and expression of various genes, consumer value, energy efficiency, in vitro breeding, phytoremediation, precision irrigation, programmed cell death, and water deprivation and stress.

■ Table 1. Student participation scholarships.

No.	Name	University	Country
1	Geert van Geest	Wageningen University	The Netherlands
2	Mahboubeh Davoudi Pahnekolayi	Ferdowsi University of Mashhad	Iran
3	Karemesi Maryane	Kenya Agriculture and Livestock Research Organization	Kenya
4	Mehran Kanani	Islamic Azad University	Iran
5	Mehrnaz Falaki Khalilsaraee	Bharati Vidyapeeth Deemed University	India
6	Morteza Soleimani Aghdam	University of Tehran	Iran
7	Sudarat Khunmuang	King Mongkut's University of Technology	Thailand
8	Marzieh Keshavarzi	Massey University	New Zealand

In order to promote and support the participation of young students, the Islamic Azad University, Kermanshah Branch, provided student participation scholarships to eight outstanding student oral papers from six different countries (Table 1). The student scholarship consisted of a registration fee waiver and accommodation in a 5 star hotel.

In addition to the conference sessions, a workshop on High Performance Liquid Chromatography (HPLC) was organized and presented by Knauer, Germany. During the field trip, participants visited a cut flower greenhouse complex producing various cut flowers such as: rose, alstroemeria, gerbera and anthurium. The tour also included a trip to Biseton, one of the world famous heritage sites, and to Tageh-e-Bostan, as well as an opportunity to experience the local cuisine.
More information and a photo gallery can be seen on the conference website available at http://www.ishs.org/symposium/404

Mohammad Mahdi Jowkar

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› Sightseeing tour to Tageh-e-Bostan.

› Students receiving scholarship awards from Dr. Nowzar Ghanbari, President of Islamic Azad University, Kermanshah Branch: a) Geert van Geest, b) Mahboubeh Davoudi Pahnekolayi, c) Mehran Kanani, d) Mehrnaz Falaki Khalilsaraee, e) Sudarat Khunmuang, f) Marzieh Keshavarzi (Karemesi Maryane and Morteza Soleimani Aghdam did not participate).

› X International Symposium on Modelling in Fruit Research and Orchard Management

Section Pome and Stone Fruits #ishs_sefr

The X International Symposium of the ISHS Working Group Modelling in Fruit Research and Orchard Management was successfully held at Agropolis International, Montpellier, France, on June 2-5, 2015. Dr. Evelyne Costes, from INRA Montpellier, convened this event that attracted about 100 people from 17 countries.
The symposium was opened by Dr. Bernard Hubert, President of Agropolis International, and Dr. Theodore DeJong, Chairman of the ISHS Section Pome and Stone Fruits, who gave an introduction on the ISHS. Dr. DeJong drew a large panorama on the "Opportunities and challenges in fruit tree and orchard modelling" with a number of stimulating ideas for future research and cooperation.
The scientific program comprised 55 oral and 33 poster presentations, covering 9 main themes:

- Tree 3D reconstruction
- Functional-Structural Plant Models (FSPM)
- Tree architecture and production
- Phenology
- Fruit growth
- Light interception
- Carbon partitioning
- Disease control
- Fruit quality

Presentations on these topics demonstrated a broad range of interest in using modelling approaches in fruit tree research and orchard management to integrate recently-acquired knowledge about fruit tree growth and functioning to predict outcomes under variable conditions, to study processes of interest and to promote new applications in horticulture. The models presented were very diverse. The first three sessions were dedicated to studies aimed at measuring or representing tree structures in FSPM and assessing their relationship with tree production. Model trans-

› Participants of the symposium.

› Experiment to screen the responses of 200 genotypes of an apple tree core collection to soil water restriction.

› Presentation of a drone equipped with visible and thermal cameras.

fers to new species, integration of genetic parameters and interfaces between existing models, illustrated how new technologies and models contribute to new applications, aimed at optimizing tree and orchard management and accounting for tree complexity and anthropogenic manipulations.

Tree interactions with climatic conditions was the main topic of the session on tree phenology, which welcomed the largest number of contributions. It was introduced by Dr. Garcia de Cortazar Atauri, from INRA Avignon, who presented the Perpheclim Accaf INRA Project dedicated to modelling perennial fruit crop and forest phenology evolution facing climatic changes. Other oral presentations demonstrated the need for new approaches to modelling tree dormancy and chill accumulation, to better predict flowering time in spring under diverse climatic regions and/or the evolution of adequate cultivation areas for the next decades. The session on light interception was introduced by Dr. Michael Cieslak from the University of Calgary (Canada), who presented a model called the shadow propagation model used in simulations of plant-light interactions. This session was followed by talks on carbon partitioning and transport during which very interesting new approaches to simulating the dynamics of carbohydrate movement from sources to sinks were presented. Two subsequent sessions were dedicated to fruit growth and quality during which new advances in 3D representations of internal fruit organization of cells and tissues, bio-physical modelling of fruit growth and novel modelling of fluxes of water, carbohydrates and anthocyanins were presented, all of which contribute to more precise predictions of fruit quality. The session on "Disease control" was introduced by Dr. Agnès Calonnec from INRA Bordeaux, who presented a sensitivity analysis of a grapevine/powdery mildew model that highlighted interactions between plant growth, pathogen, crop management and climate.

Two alternative field tours were offered during which high through-put phenotyping platforms at the INRA Phenome Network facilities were visited (https://www.phenome-fppn.fr/Plates-formes). The first facilities, at INRA Center La Gaillarde, enable researchers to study plant responses to soil water availability in greenhouse controlled conditions. In this PhenoArch platform, conveyors allow the movement of plants within the greenhouse, facilitating repeated measurements of soil water content (SWC) from pot weighing, as well as measurements of plant biomass and leaf area from processed images. Drs. Gerardo Lopez and Benoit Pallas presented the experiment they performed in 2014 to screen the responses of 200 genotypes of an apple tree core collection to soil water restriction.

The second platform, located at the INRA experimental unit Diascope, enables researchers to phenotype trees in open fields, based on aerial images. Drs. J.L. Regnard and M. Delalande presented the current facilities and applications to apple segregating populations, using a drone equipped with visible and thermal cameras.

These tours were complemented by a tourist visit to Aigues Mortes, one of the very well preserved historical places near Montpellier, and by a regional wine tasting.

During the concluding session of the symposium, the convener expressed her thanks to the organizing and scientific committees. Prof. Peter Braun who was the Chair of the ISHS Working Group on Modelling in Fruit Research and Orchard Management for 8 years asked to be replaced and the members of the Working Group nominated Dr. Evelyne Costes to be the new Chair. The members of the Working Group decided that the next symposium would be held at the International Horticultural Congress that is scheduled to be held in Istanbul, Turkey, from 12-16 August, 2018, to provide greater exposure of the activities of the Working Group to the wider international horticulture community.

Evelyne Costes

› Contact

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› XI International Mango Symposium

Section Tropical and Subtropical Fruits #ishs_sets

The XI International Mango Symposium was held in Darwin, Australia between 28 September and 2 October 2015 under the auspices of the ISHS and with the theme of "Science Supporting the Mango Industry". The symposium was co-convened by Dr. Ian Bally, Dr. Lucy Tran-Nguyen and Mr. Bob Williams and organised through the Northern Territory Department of Primary Industry and Fisheries at the Double Tree Hilton Esplanade in Darwin. It followed previous symposia held in the Dominican Republic (June 2013) and in China (April 2010). The last time the mango symposium was held in Australia was in September 1989.

› Outgoing Chair of ISHS Working Group Mango, Dr. Victor Galán Saúco (left), and incoming Working Group Chair, Dr. Ping Lu (right), awarding the ISHS medals to Symposium Conveners Mr. Bob Williams (second from left), Dr. Ian Bally (center) and Dr. Lucy Tran-Nguyen (second from right).

One hunded and eighty-eight delegates from 26 countries attended the symposium, which was comprised of 96 oral presentations, 42 posters, two field tours and two themed workshops/meetings. Presentations at the symposium were divided into 12 themes: genetics and breeding, botany and physiology, biotechnology, pathology, entomology, orchard management, product development, marketing and value chains, market access, postharvest physiology, postharvest management, and propagation and nursery practices. Two separate field tours of mango production districts were held on the final day of the symposium; one to the Darwin district and the other to the Katherine production district.

A major highlight was the announcement of the mango genome sequence. The genome-sequencing project was led by Horticulture Innovation Australia with the Queensland Department of Agriculture and Fisheries, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Beijing Genomics Institute (BGI). The sequence data will provide a platform on which scientists can improve the understanding of the structure, organisation and evolution of mango in areas such as anthracnose resistance, tree vigour, productivity, biennial bearing, shelf life, skin colour and flavour.

The symposium was well supported by breeders, genetic and genomic scientists. Dr. David Kuhn of USDA gave a very valuable keynote presentation on genomic developments and this was followed by other presentations on molecular markers and gene identification. Another highlight was the keynote address given by Dr. Frédéric Normand on new approaches to mango canopy management, where he outlined some of the basic principles and relationships between mango canopy elements and productivity and quality. This talk, along with several other presentations, stimulated much discussion on the transformation of low density, low productivity orchards to high density, high productivity orchard systems, as a concept that many countries are beginning to investigate.

› Participants of the symposium.

› Pakistan delegate, Dr. Nazim Labar Husain, examining mango roots during the Flowering and Plant Physiology Master Class.

› Symposium delegates photographing mango cultivars at the farm of Mr. Han Shiong Siah during the field trip.

The symposium also had a focus on research for development and capacity building of scientists and industries in the Asia-Pacific region. For the first time at an International Mango Symposium a series of six master classes were presented by specialist researchers in a range of disciplines to foster the development of mango-related scientific knowledge and skills in early career researchers and post-graduate students. Master classes were presented in entomology, plant pathology, experimental design and analyses, flower manipulation in mangoes, mango biotechnology and tools for precision mango culture. The master classes attracted sponsorship from development agencies such as the Australian Centre for International Agricultural Research (ACIAR) and The Crawford Fund. The master class initiative provided the opportunity for many scientists from developing countries to participate for the first time in an ISHS symposium and has widened the participation from some of the poorer nations in the international mango science community. Dr. Richard Markham (ACIAR) presented a keynote address that discussed the increasing impact of mango research internationally through

strategic planning and regional collaboration. Dr. Markham outlined many of the developments that have been a result of collaborative research partnerships between Australia and countries in the Indio-Asian-Pacific region over the past 30 years.
On the last day, delegates had the opportunity to see the Australian mango industry in action with a field tour of either the Darwin or Katherine districts. Delegates saw mango harvesting using harvest-aid machinery and the processing and packing operations in some of the largest farms in Australia, which grow between 30,000 and 150,000 trees. Delegates lunched at the NTG Katherine Research Station where they saw six new rootstocks being evaluated on current and new scion cultivars. At the Manbulloo farm, some of the latest mechanical harvesting and pruning equipment were demonstrated to delegates.
During the symposium, an ISHS business meeting was held and Dr. Ping Lu from Darwin, Australia, was elected as the new Chair of the ISHS Working Group Mango. Dr. Ping Lu thanked the outgoing Working Group Chair, Dr. Victor Galán Saúco, for his long-term contribution to world mango research and industry development. Members of the Working Group also voted for the XII International Mango Symposium to be held in Guangxi, China (July 2017). The first announcement of the symposium will be sent out soon. For updates on the Mango Working Group, please visit our webpage http://www.ishs.org/mango.

Ian S.E. Bally

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

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

The IX International Symposium on Artichoke, Cardoon and their Wild Relatives was held from September 29 to October 2, 2015 in La Plata, Argentina. The symposium was organized under the auspices of the International Society for Horticulture Science (ISHS) by the National University of La Plata (UNLP) and the National University of Rosario (UNR). The event provided an international platform for the exchange of information and knowledge about the species *Cynara cardunculus* L. and the spread of scientific and technological developments obtained by public and private institutions, both nationally and overseas. More than 100 people, including researchers, technicians, students, farmers, extension officers and traders, from different countries such as Argentina, Chile, Peru, Brazil, United States, Italy, Spain, Portugal, France, Saudi Arabia, Turkey and Korea, among others, attended the meeting.
This was the first time that this event had taken place in America, the eight previous editions having been held in Europe (Italy, Spain and France). The Region of La Plata was an ideal place to hold this event given the economic importance of the globe artichoke in this horticultural belt. During the last few years, globe artichokes have been grown on about 1,500 ha, with a production volume of 18,000 t (more than 50% of the total production of the country).

› Participants of the symposium.

The meeting lasted four days and included scientific sessions, two technical field trips and a technical workshop. The opening session included the presentation of the Conveners, a local government representative, a University representative and the ISHS representative, Prof. Dr. Daniel Leskovar – Chair of the ISHS Section Vegetables, Quality Production Systems, Leafy Green and Non-Root Vegetables. Afterwards, an excellent introductory plenary lecture, *"From Mediterranean Basin to the Andean Mountains, the long journey of the artichoke that unites different people and cultures"*, was given by Prof. Dr. Nicola Calabrese – Chair of the ISHS Working Group on Artichoke.
The scientific program included 15 oral presentations and more than 50 posters organized into four scientific sessions covering the following topics: Biodiversity and genetic resources management; Genetics, breeding and seed production; Production technolo-

› Organizing Committee: Claudia Kebat, Adriana Riccetti, Stella Maris García, Vanina Cravero, Enrique Cointry, Fernando López Anido (Gonzalo Villena is missing in the picture).

› Poster session.

gy; and Postharvest, quality and alternative uses. Two invited speakers presented keynote lectures to open each subject session.

The last day of the symposium was dedicated to a technical workshop, where eight speakers gave an overview of artichoke culture and markets in several American and European countries and trends in consumer perception. Then, ideas/experiences were shared in an open discussion, between the private plant breeding industry and academia.

The program also included two field trips during which two different production areas (La Plata and San Pedro) were visited. At both sites, open field trials were being conducted using more than 35 globe artichoke cultivars. Among the cultivars exhibited were some from seed propagation and others from asexual (offshoots) propagation, those belonging to private companies and those developed in the public sector. Landraces were also included. During the field trip, participants also visited a processing plant and enjoyed lunch prepared by local farmers who presented traditional artichoke dishes.

› Field trip.

Another important item among the symposium activities was the social program. Lunches and coffee breaks were propitious moments for establishing relationships and enjoying both academic-scientific discussions and socio-cultural discussions. The welcome cocktail and the gala dinner were also two relaxed moments where participants enjoyed several cultural shows. A friendly atmosphere throughout the meeting allowed participants to renew old and build new professional and personal relationships. During the ISHS business meeting, members of the Artichoke Working Group (WG) made a decision concerning the next Chair of the WG. The candidature of Prof. Mario Pagnotta (Tuscia University, Italy) was accepted unanimously. The host of the next symposium was also discussed. From the proposals received, the recommendation was to host the X International Symposium on Artichoke, Cardoon and their Wild Relatives in Spain (Valencia) during March 2019. A workshop to be held in conjunction with the IHC 2018 was also considered.

The Organizing Committee is pleased to thank the Scientific Committee and all participants for the high quality of posters, oral presentations and keynotes that greatly contributed to the success of the event. Furthermore, the Conveners would like to thank all institutions and private companies who provided sponsorship and financial support. We also wish to thank the members of our Organizing Committee for their assistance before, during and after the meeting.

Vanina Cravero and Stella Maris García

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› VII International Symposium on Edible *Alliaceae*

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

From 21 to 25 October 2015, almost 255 international scientists, growers and specialists met in Nigde, Turkey, and discussed the present and future developments of edible *Allium* crops. This symposium was jointly organized by Nidge University and the Republic of Turkey Ministry of Food, Agriculture and Livestock under the aegis of the International Society for Horticultural Science (ISHS). Previously, the International Symposium on Edible *Alliaceae* was organized in Argentina (1992), Australia (1996), United States of America (2000), China (2004), The Netherlands (2007), and Japan (2012). In the opening session, representatives from Nidge University, the Turkish Government, the Turkish Society for Horticultural Science, and ISHS were present.

Delegates from 33 countries exchanged their knowledge and the latest results from their research on onions, garlic and leeks. Important topics such as molecular breeding and genomics, agronomy, storage and processing, pests and diseases, and secondary

› Convener Dr. Ali Fuat Gokce and his team.

› Participants of the symposium.

metabolites and phytochemicals, were discussed. Some highlights were:

- The proposal for an international plant and *Allium* genomics collaboration, formulated by Dr. Michael Havey (USA), in order to develop a coordinated plan of genomic resources for *Allium*, especially for the onion genome.
- A new "omics" platform technology for applied cytogenetics and its implications for germplasm enhancement in *Allium* was proposed by Dr. Masayoshi Shigyo from Japan. Recent aspects of *Allium* cryopreservation were presented by Dr. Joachim Keller (Germany).
- The history and present status of onions that would not make people cry, was discussed by Dr. Colin Eady (New Zealand).
- Very useful information was presented by Dr. Andrew Taylor (UK) about understanding the genetic control of pathogenicity and resistance to *Fusarium oxysporum* in onion.
- Evidence of onion morphological floral traits and nectar composition related to seed production was presented by Dr. Claudio Galmarini (Argentina).
- Isolation and molecular characterization of new tandem repeats in *Allium fistulosum* genome was presented by Dr. Ilya Kirov (Russia).

Many other interesting experiences related to garlic, shallot, *Allium fistulosum*, leek, and other *Allium* crops were shared and supported the global research on *Alliaceae*. A highlight of the symposium was the field tour to Cappadocia Nevsehir, not only for the technical aspects, but also for the beauty of this historic Turkish location.

The Convener, Dr. Ali Fuat Gokce, and his team did a wonderful job organizing the activities of this symposium. The participants experienced the hospitality of Turkish people and had the opportunity to discover the culture of this wonderful country.

The ISHS recognizes the effort of Dr. Gokce and his team and wish to thank the Scientific Committee and all participants for their high quality presentations and posters. Moreover, the Convener would like to thank the sponsors for their financial support, which greatly contributed to the success of the event.

During the business meeting, the members of the ISHS Working Group on Edible *Alliaceae* elected from proposals from India, Indonesia and the USA, the one presented by Dr. Michael Havey to host the VIII International Symposium on Edible *Alliaceae* in Madison, USA, in July 2018. We want to invite all our colleagues interested in *Allium* to join us in Madison, Wisconsin.

Claudio Galmarini

›Contact

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› XVIII International Symposium on Horticultural Economics and Management

Commission Economics and Management #ishs_cmem

Issues related to marketing and competitiveness are high on the agenda of horticultural businesses, on the local, regional, as well as the global scale. Growers and their organisations are constantly affected by consumer demand, negotiations with powerful supermarkets and changes in imports from producers elsewhere. The XVIII International Symposium on Horticultural Economics and Management was held at the Swedish University of Agricultural Sciences (SLU) in Alnarp, Sweden on May 31-June 3, 2015, under the aegis of ISHS. The meeting had a broad agenda, covering a range of topics from the consumer through value chains and international trade to production management and knowledge transfer. The event was eminently introduced by Mårten Carlsson, the first Swedish professor in horticultural economics, and former Vice Chancellor of SLU, who gave an exposé of the early history of the ISHS Commission Economics and Management, starting with "the founding fathers", among whom were W. Busch from (then West) Germany, R. Folley from the UK and W.J. Sangers from The Netherlands. Sangers described the forming of the discipline in an article in *Chronica Horticulturae* 6(1) (1966), where important matters included economic optimum, policy and location and structure of the industry. The first symposium was held in Reading, UK in 1968, where emphasis was on these issues, as presented in *Acta Horticulturae* 13 (1969). Concepts like marketing, communication and consumer preferences were not yet

› Participants of the symposium. Photo by Jan Larsson.

› Symposium Convener, Dr. Lena Ekelund. Photo by Jan Larsson.

on the agenda, and neither were any environmental problems. Mårten Carlsson encouraged everybody involved to complete the picture and contribute to the writing of the history of Horticultural Economics as a discipline. The following link contains some of the highly interesting material, a "starting kit" for this continuous process: http://194.47.52.113/janlars/partnerskapAlnarp/ekonf/20150531_ISHS/StaringKitDevOfHortEc.pdf

During the symposium some 30 participants from 13 countries gave 24 oral presentations and showed six posters within the different topics. A third of the presented research concerned the consumer, which can be viewed as a trend. Horticultural producers are increasingly aware of the importance of consumer trust and confidence in their products. Those who are not, risk losing market share to those who listen to the consumers' concerns, particularly about climate-friendly fruit and vegetables, attractive flowers or fresh fruit as part of a healthy diet. Studies presented in this field showed the potential to add new value to products for the discerning consumer.

The horticultural value chain is changing according to consumer desires and habits. New concepts are becoming important, as demonstrated in various papers on ethics and responsibility in Australian food chains, horticultural tourism in China, food security in Kenya, and online flower shopping in Germany. Whereas focus has earlier been on physical distribution, it is now on value creation in the chain, i.e. value as defined – and paid for – by the final consumer. International competition is an important area in a sector that is largely characterised by free trade. Trade routes have changed as new members, like Hungary, enter into the European Union (EU). Other production has been affected by decisions within certain countries, for example, the effect on Polish apples when Russia introduced an embargo on imports. At the same time, countries outside the EU are trying to compete within the EU, for example, potatoes from Egypt and fruit and vegetables from the candidate EU country, Turkey.

Viewed in a longer perspective, from the first meeting to the present, there has been a clear progression of focus, from production aspects downstream in the value chain, towards the consumer, which has increased the emphasis on problems of marketing and sustainability. However, improved management has continued to be of importance, particularly risk management and conversion to organic. One presentation at the 1968 Reading symposium was: Making Advice Acceptable. Now, the question is rather how knowledge is transferred between researcher and grower, with examples given from big glasshouse firms in The Netherlands and small-scale growers in Turkey, highlighting the importance of cross-communication rather than telling individuals what to do.

The 18th symposium was one in a series of meetings between experts in business and market aspects on horticulture, including researchers, and people from organisations, firms, advisors and other actors involved in the horticultural sector. Knowledge transfer was exemplified during the technical tour to flower, fruit and vegetable growers and a fruit producer organisation, when the link between the academy and the grower became evident.

Thanks to all participants for contributing to a successful event with interesting presentations and stimulating discussions, to Partnership Alnarp for financial support and to the organising committee for adding to the spirit of the "Horticultural Economics Family".

Lena Ekelund

› Discussions with the managing director (Henrik Stridh) during the visit to the producer-owned fruit marketing organization, Äppleriket. Photo by Jan Larsson.

› Technical tour showing the diversity of plant production. Photo by Jan Larsson.

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› Greensys2015 – International Symposium on New Technologies and Management for Greenhouses

Commission Horticultural Engineering #ishs_cmen
Commission Protected Cultivation #ishs_cmpc

› Greensys2015 participants.

Greensys2015 – International Symposium on New Technologies and Management for Greenhouses, held in Évora, Portugal, on 19-23 July 2015, was organized by the Rural Engineering Department of the University of Évora, under the aegis of the International Society for Horticultural Science with the direct involvement of the ISHS Commissions Horticultural Engineering and Protected Cultivation.

Greensys2015 consisted of scientific and technical oral and poster sessions, and social and cultural programs. The thematic areas covered new technologies and management for greenhouses, namely, climate control and modelling; covering materials; crop modelling; equipment, robotics and automation; energy; greenhouse management and product quality; sustainable production; environmental impacts; greenhouse systems and design; fertigation, water and growing medium management; computational fluid dynamics (CFD); plant protection; semi-protected cultivation systems; and light use in greenhouses. The symposium was an excellent opportunity for exchanging knowledge and ideas, presenting innovations and discussing the state of the art and future perspectives for the greenhouse sector.

Greensys2015 had a total of 268 participants from 32 different countries, including 60 students. Delegates from Spain, Japan, The Netherlands, China, Greece and Italy contributed the most presentations (Figure 1).

A total of 345 abstracts were received and, in the end, 258 were presented, either orally or as a poster, in the 14 thematic areas. Light use in greenhouses; fertigation, water and growing medium management; climate control and modelling; greenhouse management and product quality; energy; CFD; and sustainable production, were the thematic areas with the highest number of presentations (Figure 2).

The welcome reception, held in the University garden, was an opportunity to welcome the participants before starting work, in a friendly and pleasant atmosphere.

Three excellent invited lectures were given by experts internationally recognized for their important contribution to the greenhouse production and technology sectors. Dr. Silke Hemming showed the ultimate advances in greenhouse systems, focused on systems design, sensors and decision support systems. Dr. Esteban Baeza talked about innovation in greenhouse technology in arid and semi-arid regions, with emphasis on the importance of improvement in climate control strategies. Prof. Stefania de Pascale talked about the importance of improvement in water and nutrient management and presented recent advances in soil and plant testing.

Invited keynote speakers that opened the oral sessions in CFD, greenhouse management and product quality, and energy, were Prof. Murat Kacira, Prof. Gene Giacomelli and Prof. Qichang Yang, respectively. During the three days of scientific sessions, in which all sessions had a high number of participants, very interesting presentations were reported and fruitful discussions occurred.

Some discussions may lead to future cooperation arising from new ideas for future research projects. Examples of this became evident from several sessions. In the 'Light use in greenhouses' area, more experiments are needed in order to understand the effect of light on plants and on the whole canopy. In the 'Greenhouse systems and design' session, it seemed clear that a multi-disciplinary approach is needed, to be able to propose alternative greenhouse designs. It appeared that inconsistencies still exist in some results concerning the effect of coloured nets. Wide application of CFD, climate control and modelling was discussed and some suggestions were given to include more parameters in order to get closer to real conditions. Growers need to have online information about crop behaviour. Some innovations were presented but more improvements are still needed. Many of the presentations looked into possibilities to increase sustainability, for example by using energy renewable resources.

Several parallel activities occurred during the Greensys2015 symposium. Bluecape sponsored a Workshop on the OpenFOAM CFD software, which attracted more than 20 participants. During the joint business meeting of the Commissions Horticultural Engineering and Protected Cultivation, Dr. Thomas Bartzanas was elected as the new Chair of ISHS Working Group Computational Fluid Dynamics and Dr. Irineo Lopez Cruz as

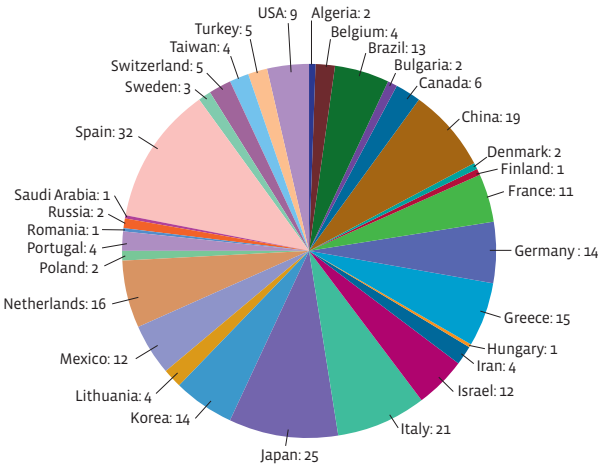

Figure 1. Number of presentations per country.

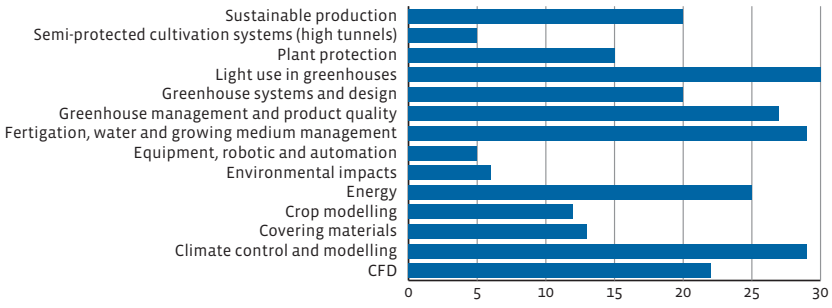

Figure 2. Number of presentations per thematic area.

› Prof. Murat Kacira, Chair ISHS Commission Horticultural Engineering (left), and Prof. Stefania de Pascale, Chair ISHS Commission Protected Cultivation (right), handing out the ISHS medal award to Prof. Luis Silva, Prof. Fátima Baptista and Prof. Jorge Meneses (Symposium Conveners).

the new Chair of ISHS Working Group Greenhouse Environment and Climate Control. Dr. Irineo Lopez Cruz from Mexico was elected as Convener for Greensys2021. CFD and Protected Cultivation in Mild Winter Climates Working Group meetings were also held.

At the closing ceremony, the University Rector, Prof. Ana Maria Freitas, emphasised the importance of Greensys2015 for the scientific community and for the world, because it deals with several scientific areas in a multidisciplinary approach and contributes to the sustainability of our planet.

› Technical visit at Vale da Rosa.

On the last day, participants were taken on a technical visit to Vale da Rosa, a farm with 250 ha of vineyards protected with plastic films and nets, and finished with a cultural tour to Monsaraz, an historic medieval village.

Greensys2015 was supported by Évora University, the School of Sciences and Technology, ICAAM – the Mediterranean Institute of Agrarian and Environmental Sciences, the High School of Agronomy, the Specialized Section of Rural Engineering/SCAP, the Portuguese Association of Horticulture, EurAgEng and Évora Township. This event was sponsored by private companies, namely Bayer Crop Science, Hubel Verde, Hubel Industria da Água, Svensson, Grundfos, Hexastep and Bluecape. We truly believe that the participants of Greensys2015 returned home very pleased with the scientific content of this event and also enjoyed the atmosphere at the University and their stay in the beautiful city of Évora.

Fátima Baptista, Luis Silva and Jorge Meneses

› Contact

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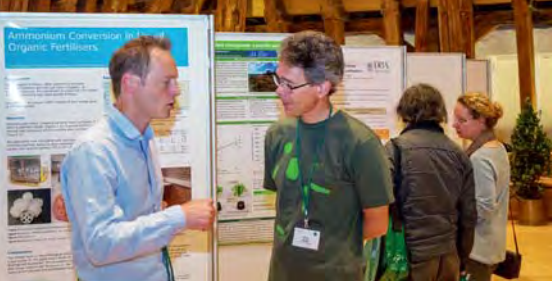
› International Symposium on Growing Media, Composting and Substrate Analysis (SusGro 2015)

Commission Plant Substrates and Soilless Culture #ishs_cmps

The latest symposium of the Growing Media, Composting for Horticultural Applications, and Substrate Analysis Working Groups within the ISHS Commission Plant Substrates and Soilless Culture, and supported by the International Peatland Society (IPS) – SusGro 2015 – was held from 5-10 September 2015. The symposium took place at the Vienna University of Technology, Austria, in a wonderful location close to the centre of the city. Indeed, the splendid and spacious lecture hall with its barrelhouse roof was admired by all delegates, and the ability to host all posters and information from sponsors was greatly appreciated. Just over 100 delegates from 33 countries attended the symposium.



› Poster discussion.

› Visit to compost plant of the City of Vienna.

› Participants of the symposium.

The theme of the symposium was sustainability – both of production and use of growing media and compost – and this was reflected in the keynote presentations. The Chair of the Commission Plant Substrates and Soilless Culture, Professor Michael Raviv from the Newe Ya'ar Research Centre in Israel, led off by considering the use of compost in sustainable growing systems. His presentation was followed by a series of oral and poster presentations on production and use of compost as well as other organic wastes in growing media, finishing with contributions on the highly developed systems for production of composts in Austria with their notable attention to quality control.

The second quite superb keynote presentation, that of Dr. Brian Jackson from North Carolina State University, USA, on "New and revised methodologies and technologies in substrate production and characterisation", attracted many plaudits, and provided an excellent benchmark for the oral and poster presentations on physical characteristics, novel substrates, methodology and nutrient status of media that followed. An especially welcome contribution came from Gerald Schmilewski of Klasmann-Deilmann, Germany, who outlined the production statistics of growing media for Europe, illustrating the importance of the industry: a thorough justification for research and development.

Professor Jean Caron, from Laval University in Quebec, Canada, provided an excellent review of the limitations of physical properties of materials other than peat, and how these may be overcome in growing media. His presentation was complemented by a series of contributions associated with the theory and practice of physical determinations in growing media, including moisture content, water use, and wettability. A session followed on practical issues associated with roof gardens and use of growing media in municipal urban situations, and the day was rounded off with a well-received lecture on whisky tasting presented by Nick van der Griendt, The Netherlands, who stood in at the last minute for Neil Godsman from Scotland. The tasting that accompanied the lecture was greatly appreciated.

Biological properties of growing media was the focus of the final day, which began with a presentation by Professor Beatrix Alsanius from the Swedish University of Agriculture on detection of microorganisms in growing media, which had an emphasis on modern methodology such as next-generation sequencing. Modern techniques formed part of several contributions, and practical considerations of biological control of diseases as well as the expanding problems of unwanted saprophytic growths in growing media, were considered. Papers on the use of biochar in media concluded the formal part of the symposium.

Poster pitches of 90 s proved popular, and as noted, the presence of posters in the lecture hall (and close to refreshment facilities!) allowed presenters and delegates to interact in a splendidly informal manner. A prize for the best poster, sponsored by the Austrian Soil Science Society, was awarded to Hans Verhagen of the RHP (Regeling HandelsPotgronden) Foundation, The Netherlands, to add to the ISHS medal belatedly, but very deservedly, awarded at the symposium dinner for his unstinting help at the previous Commission symposium in Leiden, The Netherlands, in 2013.

The technical tour of the symposium began with a visit to the remarkable compost plant of the City of Vienna, where more than 40,000 t of separately collected biowaste is processed to produce a high quality compost. This product is largely used by the city's agricultural production, can be received freely by the citizens for use in private gardens, and is used for the production of a growing medium called "Guter Grund", performed by COMPO/terrasan. A visit to the production plant was also part of the morning programme. At the compost practitioner's day, which coincided nicely with the symposium, some of the latest technology for compost production was shown to the participants. Finally, a tour visiting the new research facilities at the Federal Research and Training Centre for Horticulture near the Emperor's castle of Schönbrunn, including a marvellous dinner served in the "blue glasshouse", rounded off the excursion day.

Social interaction forms a major part of Commission events and it was a great honour to be welcomed by the Mayor of Vienna to a reception within the architectural splendour of the City Hall. An evening in the country north of Vienna at a "Heuriger", or celebration of harvest, was widely appreciated. There, the opportunity was taken to present an ISHS medal to Gerald Schmilewski of Klasmann-Deilmann, first and foremost for Gerald's notable contributions to symposia reflected in the many *Acta Horticulturae* publications with which he has been associated, secondly for his unstinting support as representative of the IPS for joint symposia with the Commission Plant Substrates and Soilless Culture, and thirdly for his company's continued sponsorship of these symposia over many years. The prolonged applause and toast that greeted the announcement was an indication of the esteem in which the group holds Gerald Schmilewski! At the symposium dinner, but also at the close of the symposium, our Convener, Dr. Andreas Baumgarten, was rightly congratulated at some length for his efforts in putting together a superb event in the best traditions of the Commission, and in recognition he received the ISHS medal from Professor Raviv.

At the close of the symposium, Drs. Brian Jackson, James Altland and Jim Owen gave a fine presentation of the Portland area of Oregon where the next (all-working group) symposium of the Commission will be held from 20-25 August 2017.

Bill Carlile and Andreas Baumgarten

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From the Secretariat

› New ISHS members

ISHS is pleased to welcome the following new members:

New Individual Members

Algeria: Benaissa Keltoum; **Argentina:** Emilio Busnelli, Assist. Prof. Leopoldo Fernández Sabate, Prof. Alejandro Pannunzio; **Australia:** Dr. Ruth Huwer, Ms. Nicola-Anne Mann, Mr. Wade Mann, Dr. Emily Saeck, Ms. Melinda Simpson, Mr. Oscar Villalta; **Austria:** Dr. Eva Erhart; **Bangladesh:** Dr. Md. Abdul Goffar, Dr. Md. Atiqur Rahman; **Belgium:** Rik Ceyssens, Bruno Claeys, Koen Dejonghe, Steven Franssens, Prof. Dr. Haissam Jijakli, Carlo Krol, Hans Luts, Rik Penninck, Maaike Perneel, Frédéric Rosseneu, Dominiek Stinckens, Mr. Robbe Van Beers; **Brazil:** Dr. Maria Coelho de Lima, Dr. Andreia Hansen Oster, Andre Sezerino, Ms. Aline Silva, Mr. Juan David Solano Mendoza, Prof. Dr. Cristiano Steffens, Prof. Dr. Leila Trevisan Braz; **Cambodia:** Mr. Tong Socheath; **Canada:** Dr. Zengguang Pan; **Chile:** Dr. Andrés France, Ms. Claudia Moggia, Mr. Sebastián Rivera; **China:** Yang Bi, Yanqin Jiang, Prof. Fengwang Ma, Prof. Lin Wu, Prof. Dr. Yong Xu, Biyan Zhou, Ms. Yan Zhu; **Chinese Taipei:** Ms. Chia-Chih Chang, Dr. Jan Chang, S.H. Huang, P.Y. Tung, Mr. Shih-Yi Yang; **Croatia:** Dr. Sinisa Srecec; **Cyprus:** Dr. Zoi Konsoula; **Dominican Republic:** Mr. Gustavo Gandini; **Fiji:** Valerie S. Tuia; **France:** Assist. 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Year 2016

- January 24-27, 2016, Ambalavayal, Wayanad, Kerala (India): **International Symposium on Succulents and Other Ornamentals.** Info: Prof. Dr. P.V. Balachandran, Director of Extension, Directorate of Extension - KAU, Mannuthy, Thrissur, Kerala, 680651, India. Phone: (91)487-2370150, E-mail: balachandran.pv@kau.in or Prof. Dr. Rajendran Pangath, Associate Director of Research, Regional Agricultural Research Station, Kerala Agricultural University, Ambalavayal, Wayanad, 91, 673593, India. Phone: (91)4936 260421, Fax: (91)4936 260421, E-mail: adramb@kau.in Web: http://issorars.org
- March 6-9, 2016, Santiago (Chile): **XIV International Symposium on Processing Tomato - XII World Processing Tomato Congress.** Info: Dr. Cosme A. Argerich, Instit. Nac. de Tecnol. Agro., C.C. Nro. 8, La Consulta, 5567 Mendoza, Argentina. Phone: (54)2622470304, Fax: (54)2622470753, E-mail: argerich.cosme@inta.gob.ar or Prof. Dr. Montaña Cámara, Dpto. Nutrición y Bromatología II, Facultad Farmacia. UCM, Plaza Ramón y Cajal sn, 28040 Madrid, Spain. Phone: (34) 913941808, Fax: (34) 913941799, E-mail: mcamara@farm.ucm.es or Dr. M.Teresa Pino, Rosario Norte 400 D53, Las Condes, Santiago, Chile. Phone: (56)-2-7575148, E-mail: mtpino@inia.cl E-mail symposium: wptc2016@tomate.org Web: http://www.worldtomatocongress.com
- March 7-9, 2016, Krabi Province (Thailand): **I International Symposium on Tropical and Subtropical Ornamentals.** Info: Dr. Kanchit Thammasiri, Department of Plant Science, Faculty of Science, Mahidol University, Rama VI Road, Phyathai, Bangkok 10400, Thailand. Phone: (66)89-132-7015, Fax: (66)2-354-7172, E-mail: kanchitthammasiri@gmail.com E-mail symposium: tso2016thailand@gmail.com Web: http://www.sc.mahidol.ac.th/scpl/tso2016
- March 13-17, 2016, Giza (Egypt): **IX International Symposium on In Vitro Culture and Horticultural Breeding.** Info: Adel A. Abul-Soad, Horticulture Research Institute, 9 Cairo University St., 12619 Giza, Egypt. E-mail: adelaboelsoaud@gmail.com E-mail symposium: 9ivchbegypt16@gmail.com Web: http://www.hortinstitute.com/index.php?option=com_content&task=view&id=172&Itemid=113
- April 10-14, 2016, Orlando, FL (United States of America): **XI International Vaccinium Symposium.** Info: James Olmstead, University of Florida, 2211 Fifield Hall, Gainesville, FL 32611, United States of America. E-mail: jwolmstead@ufl.edu Web: http://conference.ifas.ufl.edu/vaccinium/
- April 11-14, 2016, Izmir (Turkey): **III International Symposium on Organic Greenhouse Horticulture.** Info: Prof. Dr. Yüksel Tüzel, Ege University, Agriculture Faculty, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323111398, Fax: (90)2323881865, E-mail: yuksel.tuzel@ege.edu.tr or Assist. Prof. Golgen Bahar Oztekin, Ege University, Faculty of Agriculture, Department of Horticulture, 35100 Bornova Izmir, Turkey. Phone: (90)2323112577, Fax: (90)2323881865, E-mail: golgen.oztekin@ege.edu.tr Web: http://www.oghsymposium2016.org/
- April 27 - May 1, 2016, Antalya (Turkey): **III International Symposium on Biotechnology of Fruit Species.** Info: Prof. Dr. Ahmet Naci Onus, Department of Horticulture, Faculty of Agriculture, Akdeniz University, 07059 Antalya, Turkey. Phone: (90) 242-3102441, Fax: (90) 242- 2274564, E-mail: onus@akdeniz.edu.tr E-mail symposium: fruitbiotech@gmail.com Web: http://fruitbiotech2016.org
- May 9-12, 2016, Antalya (Turkey): **International Symposium on Carob: a Neglected Species with Genetic Resources for Multifunctional Uses.** Info: Prof. Dr. Hamide Gubbuk, Akdeniz University, Faculty of Agriculture, Department of Horticulture, 07058 Antalya, Turkey. Phone: (90)2423102422), Fax: (90)2422274564, E-mail: gubbuk@akdeniz.edu.tr Web: http://www.carob2016.org
- May 9-13, 2016, Antalya (Turkey): **III International Symposium on Plum Pox Virus.** Info: Prof. Dr. Kadriye Caglayan, Mustafa Kemal University, Agriculture Faculty, Plant Protection Department, 31034 Antakya-Hatay, Turkey. Phone: (90)326 2455836 Ext.1347, Fax: (90)326 2455832, E-mail: kcaglayano@yahoo.com or Dr. Birol Akbas, Tarimsal Arastirmalar ve, Teknoloji Gelistirme Kampüsü, Istanbul Yolu Üzeri No 38, P.K. 51, 06171 Yenimahalle Ankara, Turkey. Phone: (90) 312 3271793, Fax: (90) 312 32708024, E-mail: bakbas@tagem.gov.tr E-mail symposium: k_degirmenci@hotmail.com Web: http://isppv2016.org
- May 12-13, 2016, Palermo (Italy): **I European Conference of Post Graduate Horticulture Scientists (ECPHS).** Info: Prof. Dr. Paolo Inglese, Department Agriculture and Forest Sciences, Università degli Studi di Palermo, Viale delle Scienze, ED. 4, 90142 Palermo, Italy. Phone: (39)09123861234, Fax: (39)09123860820, E-mail: paolo.inglese@unipa.it E-mail symposium: ecphs2015@unipa.it Web: http://www.soihs.it/ecphs/default.aspx
- May 16-20, 2016, Shiraz (Iran): **International Symposium on Role of Plant Genetic Resources on Reclaiming Lands and Environment Deteriorated by Human and Natural Actions.** Info: Dr. Ali Gharaghani, Department of Horticultural Science, College of Agricuture, Shiraz University, 12th Kilometers of Shiraz to Isfahan Road, 71441-65186, Shiraz, Iran. Phone: (98)7136138145, E-mail: agharghani@shirazu.ac.ir or Prof. Morteza Khosh-Khui, Department of Horticultural Science, College of Agriculture, Shiraz University, Shiraz, Iran. Phone: (98)7116243978, Fax: (98)7116246165, E-mail: mkhoshkhui@yahoo.com E-mail symposium: convener@ispgr-iran2016.com Web: http://www.ispgr-iran2016.com
- May 22-26, 2016, East Lansing, MI (United States of America): **VIII International Symposium on Light in Horticulture.** Info: Prof. Erik Runkle, 1066 Bogue Street, Michigan State University, East Lansing, MI 48824, United States of America. Phone: (1)5173530350, Fax: (1)5173530890, E-mail: runkleer@msu.edu or Prof. Roberto G. Lopez, Purdue University, 625 Agriculture Mall Drive, West Lafayette, Indiana, USA 47907, United States of America. Phone: (1) 765 4963425, Fax: (1) 765 4940391, E-mail: rglopez@purdue.edu Web: http://www.lightsym16.com
- May 22-26, 2016, Port-au-Prince (Haiti): **International Symposium on Valorisation, Preservation and Processing of Tropical Fruits and Vegetables.** Info: Dr. Marie Thérèse Charles, 430 Boulevard Gouin, Saint-Jean-sur-Richelieu QC J3B 3E6, Canada. Phone: (1)450-346-4494, Fax: (1)450-346-7740, E-mail: marietherese.charles@agr.gc.ca or Prof. Harold Corantin, Damien, route Nationale #1, Port-au-Prince, BP: 1441, Haiti. Phone: (509)48927198, E-mail: hcorantin@yahoo.fr Web: http://fruitsvegetableshaiti2015.com
- May 23-26, 2016, Murcia (Spain): **II International Workshop on Floral Biology and S-Incompatibility in Fruit Species.** Info: Dr. Encarnación Ortega Pastor, Dpto. de Mejora Genética, CEBAS-CSIC, Campus Universitario de Espinardo, Apdo 164, 30100 Espinardo, Murcia, Spain. E-mail: eortega@cebas.csic.es Web: http://www.fbsi2016.org

- May 31 - June 3, 2016, Sabour, Bhagalpur, Bihar (India): **V International Symposium on Lychee, Longan and Other Sapindaceae Fruits.** Info: Prof. Dr. Vishaw Bandhu Patel, Professor and Chair, Department of Horticulture (F&FT), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India. Phone: (91)112451011, Fax: (91)112452613, E-mail: patelvb7@gmail.com or Dr. Rewati Raman Singh, Department of Horticulture FFT, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, 813210, India. Phone: (91)641-2451011, E-mail: drrsinghbau@gmail.com or Dr. Ruby Rani, Department of Horticulture and Fruit, Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, 813210, India. Phone: (91)0641-2451011, E-mail: rruby92@yahoo.co.in E-mail symposium: lychee2016@gmail.com
- June 13-16, 2016, Málaga (Spain): **V International Symposium on Tomato Diseases: Perspectives and Future Directions in Tomato Protection.** Info: Dr. Enrique Moriones, IHSM-UMA-CSIC, Algarrobo-Costa, Málaga, Spain. E-mail: moriones@eelm.csic.es or Dr. Rafael Fernández-Muñoz, IHSM La Mayora UMA-CSIC, Camino de La Mayora sn, E-29750 Málaga Algarrobo-Costa, Spain. Phone: (34)952-548990, E-mail: rfern@eelm.csic.es E-mail symposium: tomatodiseases2016@ihsm.uma-csic.es Web: http://www.tomatodiseases2016.es
- June 13-18, 2016, Verona (Italy): **X International Symposium on Grapevine Physiology and Biotechnology.** Info: Mario Pezzotti, Univeristy of Verona, Strada Le Grazie 15, 37134 Verona, Italy. E-mail: mario.pezzotti@univr.it Web: http://www.grapevine2016.org
- June 20-25, 2016, Athens (Greece): **VI International Conference on Landscape and Urban Horticulture.** Info: Prof. Dr. Maria Papafotiou, Dept. Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294555, Fax: (30)2105294553, E-mail: mpapaf@aua.gr or Dr. Panayiotis Nektarios, Dept Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294554, Fax: (30)2105294553, E-mail: pan@aua.gr or Dr. Angeliki Paraskevopoulou, Dept. Floriculture & Landscape Architecture, Agricultural University of Athens, 75, Iera Odos, 118 55 Athens, Greece. Phone: (30)2105294554, Fax: (30)2105294553, E-mail: aparas@aua.gr E-mail symposium: secretariat@luh2016.org Web: http://www.luh2016.org/
- June 21-24, 2016, Cartagena, Murcia (Spain): **VIII International Postharvest Symposium: Enhancing Supply Chain and Consumer Benefits - Ethical and Technological Issues.** Info: Francisco Artes, ETSIA Paseo Alfonso XIII, 48., 30203 Murcia Cartagena, Spain. Phone: (34) 68-325510, Fax: (34) 68-325433, E-mail: fr.artes@upct.es E-mail symposium: postharvest@upct.es Web: http://www.postharvest2016.org
- June 26-29, 2016, Singapore (Singapore): **XIV International Symposium on Virus Diseases of Ornamental Plants.** Info: Dr. Sek-Man Wong, Department of Biological Sciences, National University of Singapore, 14 Science Drive 4, Singapore 117543, Singapore. E-mail: dbswsm@nus.edu.sg Web: http://www.dbs.nus.edu.sg/Plant2016/
- June 28 - July 2, 2016, Kunming (China): **XII International Symposium on Flower Bulbs and Herbaceous Perennials.** Info: Prof. Ding Mu, No.12 Zhongguancunnandajie, Haidian District, Beijing City, 100081, China. Phone: (86)10-82105944, Fax: (86)10-62174123, E-mail: muding2011@126.com Web: http://www.flowerbulbs2016.org
- July 17-21, 2016, Freising and Hallbergmoos (Germany): **XI International Symposium on Plum and Prune Genetics, Breeding and Pomology.** Info: Prof. Dr. Dieter Treutter, Am Braeuberg 7, 85410 Haag a/d Amper, Germany. Phone: (49)8161713753, Fax: (49)8161715385, E-mail: dieter.treutter@wzw.tum.de or Dr. Michael Neumüller, Am Süßbach 1, 85399 Hallbergmoos, Germany. Phone: (49)8119933558, Fax: (49)8119933656, E-mail: nm@obstzentrum.de
- August 2-5, 2016, Minneapolis, MN (United States of America): **III International Symposium on Woody Ornamentals of the Temperate Zone.** Info: Dr. Stan C. Hokanson, Univ. of Minnesota, Dept. Of Horticulture, Breeding & Genetics, Woody Landscape Plants, 258 Alderman Hall, 1970 Folwell Ave., St. Paul, MN 55108, United States of America. Phone: (1)6126241203, Fax: (1)6126244941, E-mail: hokan017@umn.edu Web: http://www.woodyornamentals2016.org/
- August 7-12, 2016, Ibadan (Nigeria): **III All Africa Horticultural Congress.** Info: Prof. Dr. Isaac Ore Aiyelaagbe, Department of Horticulture, University of Agriculture, PMB 2240 Abeokuta, Ogun State, Nigeria. Phone: (234)8033815606, Fax: (234)39243045, E-mail: ola_olu57@yahoo.com E-mail symposium: aahc2016@yahoo.com Web: http://afrohort.org
- August 8-12, 2016, Atlanta, GA (United States of America): **II International Symposium on Germplasm of Ornamentals.** Info: Prof. Dr. Donglin Zhang, University of Georgia, Dept. Of Horticulture, 1111 Plant Science Building, Athens, GA 30602-7273, United States of America. Phone: (1)7065420776, Fax: (1)7065420624, E-mail: donglin@uga.edu or Prof. Dr. Zhang Qixiang, Nat'l Engineering Res.Center Floriculture, Beijing Forestry University, No.35, Qinghua East Road-Haidian Dist., Beijing 100083, China. Phone: (86)1062338005, Fax: (86)1062336321, E-mail: zqx@bjfu.edu.cn or Prof. Dr. Byoung Ryong Jeong, Department of Horticulture, 501 Jinjudaero, Gyeongsang National University, Jinju, Gyeongnam 660-701, Korea (Republic of). Phone: (82)55-772-1913, Fax: (82)55-757-7542, E-mail: brjeong@gmail.com Web: http://woodies.uga.edu/conference.html
- August 14-17, 2016, Québec City (Canada): **VIII International Strawberry Symposium.** Info: Prof. Dr. Yves Desjardins, Horticulture Research Center/INAF, Faculty of Agriculture and Food, 2440, Blvd. Hochelaga, # 2736, Laval University, Québec, QC G1V 0A6, Canada. Phone: (1)418-656-2131x2359, Fax: (1)418-656-3515, E-mail: yves.desjardins@fsaa.ulaval.ca or Prof. André Gosselin, Université Laval, Pavillon ENVIROTRON, Ste-Foy (Quebec), G1K 7P4, Canada. Phone: (1)4186562131ext2068, Fax: (1)4186567871, E-mail: andre.gosselin@fsaa.ulaval.ca E-mail symposium: iss2016@conferium.com Web: http://www.iss2016-quebec.org
- August 23-25, 2016, Kuala Lumpur (Malaysia): **III International Conference on Agricultural and Food Engineering.** Info: Dr. Samsuzana Abd Aziz, Dept. of Biological Agricultural Eng., Faculty of Engineering, 43400 Selangor UPM, Serdang, Malaysia. Phone: (60)3 89464455, Fax: (60)3 89466425, E-mail: samsuzana@upm.edu.my E-mail symposium: eng.cafei2016@upm.edu.my Web: http://www.cafei.upm.edu.my
- NEW August 28 - September 2, 2016, Bologna (Italy): **XI International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems.** Info: Prof. Dr. Luca Corelli-Grappadelli, Department of Agricultural Sciences, Università di Bologna, Via Fanin 46, 40127 Bologna, Italy. Phone: (39)0512096400, Fax: (39)0512096401, E-mail: luca.corelli@unibo.it E-mail symposium: convener@orchardsystems2016.org Web: http://www.orchardsystems2016.org
- September 19-22, 2016, Avignon (France): **HortiModel2016: Models for Plant Growth, Environment Control and Farming Management in Protected Cultivation.** Info: Dr. Nadia Bertin, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722324, E-mail: nadia.bertin@avignon.inra.fr or Dr. Valentina Baldazzi, UR 1115 PSH, INRA, Domaine St Paul, 228 route de l'aérodrome, Site Agroparc, 84914 Avignon, France. Phone: (33)0432722447, E-mail: valentina.baldazzi@avignon.inra.fr E-mail symposium: hortimodel2016@paca.inra.fr Web: https://colloque.inra.fr/hortimodel2016/

- September 20-25, 2016, Yangling City (China): **I International Apple Symposium.** Info: Prof. Dr. Zhen-Hai Han, Institute for Horticultural Plants, China Agricultural University, No. 2 Yuanmingyuanxilu, 100193 Beijing, China. Phone: (86)1062732467, Fax: (86)1062734391, E-mail: rschan@cau.edu.cn or Prof. Fengwang Ma, 3 Taicheng Road, College of Horticulture, Northwest AF University, Yangling, Shaanxi Province, 712100, China. Phone: +8613572076386, E-mail: fwm64@nwsuaf.edu.cn or Dr. Stuart Tustin, Plant & Food Research, Private Bag 1401, Havelock North, New Zealand. Phone: (64)68778196, Fax: (64)68774761, E-mail: stuart.tustin@plantandfood.co.nz
- September 26-28, 2016, Chengdu City (China): **II Asian Horticultural Congress - AHC2016.** Info: Prof. Dr. Yongchen Du, Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sci., 12 Zhongguancun Nandajie, Beijing 100081, China. Phone: (86)1068919515, Fax: (86)1062174123, E-mail: duyongchen@caas.cn Web: http://ciccst.org.cn/ahc2016
- NEW September 26-28, 2016, Kafr El-Sheikh (Egypt): **VI International Symposium on Tropical and Subtropical Fruits.** Info: Dr. Ali R. El-Shereif, Horticulture Department, Faculty of Agriculture, Kafrelsheikh University, 33516 Kafr El-Sheikh, Egypt. Phone: (20)473254315, Fax: (20)479102930, E-mail: aelshereif@agr.kfs.edu.eg Web: http://www.kfs.edu.eg/intersociety/display.aspx?topic=26108
- September 26-30, 2016, Mendoza (Argentina): **IX International Congress on Cactus Pear and Cochineal.** Info: Dr. Juan Carlos Guevara, Argentine Institute for Arid Land Research, (IADIZA), Adrian Ruiz Leal s/n, Parque General San Martín, 5500 Mendoza, Argentina. Phone: (54)02615244103, Fax: (54)02615244101, E-mail: jguevara@mendoza-conicet.gob.ar or Prof. Maria Ochoa, Delibano Chazarreta 544, Santiago del Estero 4200, Argentina. Phone: 54 385-4315885, E-mail: mariajudith8a@gmail.com or Ms. Josefina Grünwaldt, Argentine Institute for Arid Land Research, (IADIZA), Adrian Ruiz Leal s/n, Parque General San Martín, 5500 Mendoza, Argentina. Phone: (54)02615244103, Fax: (54)02615244101, E-mail: jgrunwaldt@mendoza-conicet.gob.ar E-mail symposium: cactus2016@mendoza-conicet.gob.ar Web: http://cactus2016.mendoza-conicet.gob.ar
- October 2-7, 2016, Antalya (Turkey): **VI International Chestnut Symposium.** Info: Prof. Dr. Umit Serdar, Ondokuz Mayis University, Faculty of Agriculture, Horticultural Department, 55139 Samsun, Turkey. Phone: (90)3623121919, Fax: (90)3624576034, E-mail: userdar@omu.edu.tr Web: http://chestnut2016.org/
- October 5-7, 2016, Potsdam (Germany): **International Symposium on Sensing Plant Water Status - Methods and Applications in Horticultural Science.** Info: Dr. Werner B. Herppich, Leibniz-Inst. Agricult. Eng. Potsdam-Bornim, Max-Eyth-Allee 100, 14469 Potsdam, Germany. E-mail: wherppich@atb-potsdam.de or Prof. Dr. Manuela Zude, Leibniz Institute for, Agricultural Engineering, Max-Eyth-Allee 100, 14469 Potsdam-Bornim, Germany. Phone: (49)331-5699-612, Fax: (49)3315699849, E-mail: zude@atb-potsdam.de E-mail symposium: spws2016@atb-potsdam.de Web: http://www.spws2016.atb-potsdam.de/
- October 10-14, 2016, Split (Croatia): **VIII International Olive Symposium.** Info: Dr. Slavko Perica, Director, Institute for Adriatic Crops, Put Duilova 11, 21000 Split, Croatia. Phone: (385) 21 434434, Fax: (385) 21 316584, E-mail: slavko@krs.hr E-mail symposium: ios2016-info@krs.hr Web: http://ios2016.krs.hr/
- NEW October 10-14, 2016, Montpellier (France): **X International Symposium on Banana: ISHS-ProMusa Symposium on Agroecological Approaches to Promote Innovative Banana Production Systems.** Info: Dr. Jean-Michel Risede, CIRAD, RU GECO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: +33(0)467617152, E-mail: risede@cirad.fr or Lescot Thierry, CIRAD, RU GECO, Persyst Department, Boulevard de la Lironde, TA B26/PS4, 34398 Montpellier, France. Phone: (33)467615666, Fax: (33)467615821, E-mail: thierry.lescot@cirad.fr or Dr. Inge Van den Bergh, Bioversity International, C/O KULeuven, W. De Croylaan 42 bus 2455, 3001 Leuven, Belgium. Phone: (32)16377067, E-mail: i.vandenbergh@cgiar.org E-mail symposium: symposium@promusa.org Web: http://ishs-promusa2016.cirad.fr/

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