Chronica Horticulturae

Volume 50 - Number 3 - 2010

A publication of the International Society for Horticultural Science

Horticultural Highlights

Master of Science in Horticulture: New Approaches in Europe • Guiding Young People to Horticulture • Native Australian Acacias: Unrealised Ornamental Potential • Celebrating 100 Years of Beltsville Agricultural Research • Organic Agriculture: Business is Booming in Nigeria • Horticulture of the Taj Mahal: Gardens of the Imagination • Annatto: A Natural Dye from the Tropics

Symposia and Workshops

Medicinal and Nutraceutical Plants • Fig • Orchid • Loquat • Irrigation of Horticultural Crops • Date Palm • Cucurbit

ISHS

CHRONICA HORTICULTURAE

Chronica Horticulturae© ISBN: 978 90 6605 503 2 (Volume 50 – Number 3; September 2010); ISSN: 0578-039X.
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Editorial Office and Contact Address:
ISHS Secretariat, PO Box 500, B-3001 Leuven 1, Belgium. Phone: (+32)16229427, fax: (+32)16229450, e-mail: **info@ishs.org**, web: **www.ishs.org** or **www.actahort.org**.

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Cover photograph: Floral imagery made up of stone inlays (pietra dura) in the Taj Mahal. See article p. 30.

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ISHS

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Farewell from the Outgoing Board, Welcome to the New

Robert J. Bogers, Jules Janick, Norman E. Looney, Jung-Myung Lee, António A. Monteiro and Ian J. Warrington

This issue of *Chronica Horticulturae* celebrates the transfer of the authority to a new Board that will direct the course of ISHS for the next four years. Of the outgoing Board, four of us have served eight years and Jung-Myung Lee and António A. Monteiro *(ex officio)* have served four. It is fair to say that despite the experience of very detailed agendas, demanding Board meetings and very long international flights, we have thoroughly enjoyed the experience and have learned new insights into horticulture, science, and our Society. Great changes to the Society have occurred during our terms and we are all proud of the successes we have observed. Nonetheless we are each mindful of the issues that remain to be addressed and of the challenges that lie ahead across all areas of the Society's activities and endeavors. All of us have openly expressed our views about our Society in this column and this is not the time or place to repeat them. It is appropriate however, to welcome the new Board (Yves Desjardins, Errol W. Hewett, Kim E. Hummer, António A. Monteiro, Georg J. Noga and Ian J. Warrington *(ex officio)*) and we wish them every success for the term ahead.

At this time we would like also to express our appreciation and, indeed our admiration, to Executive Director Jozef Van Assche and his loyal staff (Dirk Van Holderbeke, Peter Vanderborght, Joanna Falleyn, Maria Testor, Steven Franssens, Karen Sniekers and Kelly Van Dijck) for their devotion to our Society. In the vast scheme of things, horticultural science is but a small world, but it is apparent that we are all family. Our service to the Society will continue but in very different ways. We look forward with anticipation to the future, confident that ISHS will continue to move forward with confidence and with vigor.

Outgoing Board members in front of new ISHS Headquarters at Catholic University of Leuven, from left to right: Ian Warrington, António Monteiro (*ex officio*, Co-President of IHC2010), Norman Looney, Jung-Myung Lee, Rob Bogers, Jules Janick (Jozef Van Assche, Executive Director).

The Congress and the Society

António A. Monteiro, President of ISHS

The IHC 2010 is over and many participants have considered it a huge success for the ISHS. Besides the high attendance and the excellence of the programme there were innovative activities and new concepts that are worth following up. The theme of the Congress, ***Science and Horticulture for People***, was closely related to the ISHS mission and priorities as I will explain below.

Science is the central pillar of the ISHS and its raison d'être. The Society should continue to invest on its scientific structure to assure the delivery of top quality scientific knowledge. We preferred "science" to "horticultural science" in the IHC theme because science is universal and has no label. A substantial share of the scientific knowledge presented at the ISHS congresses and symposia is produced by scientists that do not consider themselves as horticultural scientists or are not members of horticultural departments. They may have diversified backgrounds such as economy, molecular biology, plant physiology, genomics and just ignore horticulture. Yet these scientists come to ISHS meetings because these meetings provide a target to their knowledge. This is our strength. The ISHS is a magnet that attracts the best science and makes it available for horticultural innovation. The attendance to our meetings is much broader than the so called horticultural scientific community because the ISHS meetings are a hub where disciplinary knowledge is integrated using holistic approaches. The focal points are the applied topics of our diversified and highly successful symposia.

To keep this dynamic process alive the Board in collaboration with the ISHS Executive Committee, the core of our scientific structure, has to endeavour efforts to catch the attention of the best scientists to our symposia and to assure the publication of good science and technology in *Acta Horticulturae*, the flagship of ISHS publications. However, the ISHS will only continue to be a magnet for science if our activities are well rooted in horticulture and are well attended by people from the horticulture industry and stakeholders. Our meetings without an active presence of the industry will be a weak magnet and may lose much of their appeal. The presence of potential knowledge users at these meetings will turn them into a must to attend by reputed scientists. Then the so-called horticultural science is happening.

It is estimated that about one quarter of the attendance to the ISHS meetings comes from the industry, but these participants are silent partners most of the times. They deserve higher visibility and a more active role in the life of the Society. The Horticulture Brokerage Event organised during the IHC 2010 is just an example of this strategy, which has exceeded our most optimistic expectations. The demand for contacts was huge and we experienced intense interaction between knowledge providers and knowledge users.

People is the last word in the IHC theme following **Science** and **Horticulture**. The ultimate aim of the ISHS is to serve people through horticulture. We are in a very good position to accomplish this mission since horticulture has a tremendous potential to improve the lives and the livelihoods of distinct types of people all over the world. I am just picking a few examples of the people that can benefit from horticulture products and services.

First of all we have the consumers that buy fruits, vegetables and flowers daily. However, they do not realise the tremendous scientific investment behind the products they purchase to make them fit into their convenience and needs. Consumers ignore that they are the target of the most important innovations in horticulture chains. An adequate advocacy strategy can increase the visibility of the role of horticultural science in our lives. The target should be the opinion makers that can influence the perception of horticultural science by the general public.

Horticulture industry involves millions of people and is regarded as a valuable tool for economic and social development. It is easy to find striking examples of the use of this tool all over the world. Most horticultural products have high value-added components and therefore intensive horticulture provides a counterweight to extensive agriculture in terms of local or regional development. Some forms of horticulture e.g. urban and peri-urban horticulture, vegetable and fruit production for self-consumption and for local markets, are regarded as very efficient means for the development of poor regions. However, the promotion of horticulture in many of these regions adds to the complexity of horticultural sciences. Biological sciences and growing techniques should be accompanied by crop management and socio-economic sciences for a good understanding of local horticultural systems. Therefore the diversity of knowledge represented by ISHS sections, commissions and working groups gives the ISHS the adequate tools to tackle horticulture for development.

The ability for touching people directly is the big advantage of the ISHS. People can read our publications, attend our meetings, become members of our Society and have access to the knowledge we make available. The ISHS can develop its own way and find the right partners to accomplish its mission. Granting access to horticultural knowledge to the people who need it and facilitating the contact between those who need help and those who can help alleviate the problems is a great contribution to development. PubHort (www.pubhort.org) is already a powerful tool to disseminate information, and has a huge potential but clearly other on-line services can be added. This will provide access to better and more diversified benefits for the ISHS members.

However, horticulture goes much beyond food especially in the developed world. Environmental horticulture, gardening, horticultural therapy, amenity-horticulture are attracting an increasing number of people, some of whom are discovering a new relationship with plants. The IHC 2010 colloquium "Plants, People and Places" looked into the future and presented innovative ideas with the objective of integrating plants in our urban culture. Plants and horticulture should be regarded as a regular component of our lives as are the performing arts and sports for example. There is a long way to go and so the sooner we start the better.

The New Board of the ISHS

On August 24, 2010, at the meeting of the General Assembly, the ISHS members present confirmed and inaugurated the new Board of the ISHS. As laid down in the Statutes and in the Rules of Procedure of the Society, the Board is composed of five elected persons and two *ex officio* members.

The new Board members with their respective responsibilities for the next four years are:

- Professor António A. Monteiro (Portugal); President of the ISHS and Chairperson of the Board
- Dr. Kim E. Hummer (United States of America); Vice-President and Vice-Chairperson of the Board, responsible for the Scientific Activities of the Society
- Prof. Dr. Georg J. Noga (Germany); Treasurer, responsible for the Financial Affairs of the Society
- Professor Yves Desjardins (Canada); Responsible for Publications
- Prof. Dr. Errol W. Hewett (New Zealand); Secretary, responsible for Innovation, Industry and Insight
- Professor Ian J. Warrington (New Zealand); Co-President of the XXIXth International Horticultural Congress
- Ir. Jozef Van Assche (Belgium), Executive Director of the ISHS

PROFESSOR ANTÓNIO A. MONTEIRO, PRESIDENT OF THE ISHS AND CHAIRPERSON OF THE BOARD

António A. Monteiro was born in Batalha, Portugal, in 1951, graduated in Agriculture in 1975, obtained the Ph.D in Horticultural Sciences in 1983, and is presently Full Professor of the Instituto Superior de Agronomia (College of Agriculture and Forestry), Technical University of Lisbon, Portugal.

His present professional activity includes teaching vegetable and ornamental crops at the Technical University of Lisbon, research on vegetable breeding and growing techniques, and an active involvement in R&D with the horticulture industry. His research interests have included in the past tomato fruit-setting in non-heated greenhouses, greenhouse ventilation to reduce fungi diseases, characterization and study of protected cultivation in mild-winter climates, and vegetable production in general.

António A. Monteiro

Presently he is involved in brassica breeding with emphasis on the study of the Portuguese cole and turnip landraces, and on resistance to fungi pathogens. He supervised 10 Ph.D. students and is co-author of more than 60 scientific articles.

A. Monteiro was visiting assistant professor at the University of Wisconsin-Madison (1987); consultant on protected cultivation for the FAO (1986-91); President of the Portuguese Horticultural Association (1988-92); Director of the National Department of Vegetable and Ornamental Crops (1988-92); National Coordinator for R&D in Horticulture (1995-96) at the National Institute for Agrarian Research; and Chairman of the Department of Crop and Animal Science (1992-94) at the College of Agriculture and Forestry (Tech. Univ. of Lisbon).

He served the ISHS in the position of Chairperson of the ISHS Working Group Protected Cultivation in Mild Winter Climates (1986-94) and Working Group Brassicas (1994-98), and of Board member (1994-02). A. Monteiro is member of the ISHS since 1980, Council member since 1990 and ISHS Honorary Member since 2002. He is also Honorary Member of the Spanish Society for Horticultural Sciences and of the Portuguese Horticultural Association.

He was Co-President of the 28th International Horticultural Congress, Lisboa, 2010.

DR. KIM E. HUMMER, VICE-PRESIDENT AND VICE-CHAIR-PERSON OF THE BOARD, RESPONSIBLE FOR THE SCIENTIFIC ACTIVITIES OF THE SOCIETY

Kim E. Hummer was born in 1952, received her B.S. in Biology in 1974, her M.S. in Plant and Soil Science from the University of Vermont in 1978, and her doctorate in Horticulture from Oregon State University in 1981. Her expertise includes the conservation of fruit, nut, and specialty crop genetic resources. Her present research passion involves the study of ploidy in strawberry species. She also actively studies genetics of blueberries, blackberries, raspberries, currants, gooseberries, and unusual berry crops such as blue honeysuckle. During her career she has been a participant of more than 15 plant collecting and exchange expeditions to locations including China, India, Italy, Japan, Portugal, Russia, and throughout the United States including Alaska and Hawaii. She was selected as Specialty Crop Curator for the US Department of Agriculture, Agricultural Research Service, National Clonal Germplasm Repository in Corvallis, Oregon in 1987, and became Research Leader of that gene bank in 1989. In December 2009, she was asked to manage the Palmer, Alaska, Arctic and Subarctic Plant Gene Bank, in addition to that in Corvallis.

Dr. Hummer is an active member in the American Society of Horticultural Science, and was selected as a Fellow in 2006. She was the first woman president of the American Pomological Society (2004-2006), and has been the liaison between that society and the ISHS to digitize valuable historical horticultural publications and provide them on-line for the benefit of all horticulturists. In 2006, she chaired the expert committee that developed the Global Conservation Strategy for Strawberry, sponsored by the Global Crop Diversity Trust. In 2009, she was recognized by the Sveriges Lantbruksuniversitet with an honorary doctorate in Agronomy. She is the author of more than 160 scientific journal papers, 13 chapters, and co-wrote or edited 8 books. She has been the Chair of the ISHS Commission on Plant Genetic Resources for the past 8 years. During that term, she convened or was scientific chair on 5 symposia, and was a member of the scientific committee or represented ISHS at 7 additional ones. She also participated on the ISHS publication committee for the past 4 years. Dr. Hummer is strongly in favor of strengthening the scientific aspects of the ISHS, promoting horticultural science as a career choice, advocating for the importance of horticultural crops to improve human health and nutrition, and encouraging horticulture and ISHS activities throughout the world.

Kim E. Hummer

PROF. DR. GEORG J. NOGA, TREASURER, RESPONSIBLE FOR THE FINANCIAL AFFAIRS OF THE SOCIETY

Georg J. Noga

Prof. Georg J. Noga, born in 1952, studied nutritional sciences and home economics at the University of Bonn. He received his diploma (Dipl. oec. troph.) in 1977 and his Doctor's degree in Human Nutritional Sciences (Dr. troph.) in 1980 from the University of Bonn after completing his thesis in the Institute of Fruit and Vegetable Sciences on peel roughness and deficiencies in color formation of Satsuma mandarins in Western Turkey. He then worked as a staff member and research scientist at the Institute in Bonn from 1980 to 1990. During this time, he spent his postdoc from 1982 to 1983 in Dr. John Bukovac's laboratory in the Department of Horticulture, East Lansing, Michigan State University. In 1991, Georg Noga was appointed as senior research scientist and in 1994 as head of the postharvest physiology group at the Institute of Fruit and Vegetable Sciences at Bonn University. From 1995 to 1998 he was full professor and director of the Fruit Research Institute at Stuttgart-Hohenheim University and also head of the Fruit Research Center in Bavendorf/Lake Constance. In 1998,

he transferred back to Bonn University and since then holds the position of Director of the Institute of Horticultural Science. In 2009, he was elected as Chairman of the Department of Crop Sciences and Resource Conservation (INRES). Professor Noga has his major research focus on plant stress physiology and fruit quality including nutritional value of horticultural products. He has authored more than 75 scientific papers and contributed numerous articles to professional journals. Georg Noga is also enjoying the biodiversity of plants being Vice-Director of the Botanical Gardens of the University of Bonn.

Together with his partners from Rhineland-Palatinate and Juelich Research Center he initiated and established KoGa, the Center of Competence for Horticulture, in Bonn/Klein-Altendorf in 2002 with the concept of bringing together basic science, innovations in technology, applied research and extension services in one unit. In 2009, he launched the KoGa-African Research Network Initiative (ARNI) as open structure with highly qualified research partners, preferentially Humboldtians, from different African countries.

Professor Noga served as Vice-President of the German Society for Horticultural Sciences (2000-2002) and as President of the Society from 2002 until 2007 encouraging members to become more internationally involved. Under his presidency, the German Journal "Gartenbauwissenschaft" has been developed into "European Journal for Horticultural Sciences" (EJHS), which is now being integrated in the ISHS publication platform. Also, he initiated the First International Symposium on Horticulture in Europe (SHE), which took place in 2008 in Vienna.

Georg Noga started his activities in ISHS in 2000 as delegate of the German Society of Horticultural Sciences and served as internal auditor for 2 terms until 2010. Professor Noga is strongly supportive of maintaining the achievements and financial resources that have been accomplished by the previous ISHS Board. He will dedicate his efforts in strengthening National Horticultural Societies in Western countries to prevent Horticulture Departments from being further eroded. Also, he will continue to intensify cooperation with developing countries through North-South dialogue.

PROFESSOR YVES DESJARDINS, RESPONSIBLE FOR PUBLICATIONS

Prof. Desjardins was born in Montreal, Canada in 1959. He graduated from the University of Guelph with BS in 1982 and a M.Sc. in 1984. He received a Ph.D. from Laval University in 1990 and has been professor at Laval University since 1991.

From 1999 to 2002, he has been Director of the Horticulture Research Centre at Laval University

Yves Desjardins

and also directed the Québec Phytoprotection Network from 1999 to 2003. From 2002 to 2007, he was Academic and International affairs director at the Institute for Nutraceutical and Functional Food. He is currently the lead scientist of one of the research axis (Characterization of bioactive compounds) of INAQ, the "Institut de Nutrition Aquitaine-Québec". He was president of the Canadian Society for Horticultural Sciences from 2002 to 2004.

Prof. Desjardins is still active in research and works on fruit and vegetables crop physiology and pursues fundamental work on in vitro plantlets ecophysiology. His laboratory uses functional genomic tools like transcriptomics, proteomics, and metabolomics, to study the adaptive phenomena taking place during the transition from heterotrophy to autotrophy in the course of acclimatization of tissue cultured plants. Prof. Desjardins has directed several PhD students and numerous R&D projects in horticulture. He is the author of many scientific and technical papers dealing with tissue culture and vegetable and fruit physiology and participated to the writing of many books on the physiology and acclimatization of tissue cultured plants. Since 1999, he has studied health effects of fruit and vegetables. His recent research focuses on the characterization and extraction of polyphenols and particularly proanthocyanidins found in blueberries and cranberries and their effects on cardiovascular diseases, metabolic syndrome, diabetes and other chronic diseases. He collaborates on numerous projects related to health effects of FAV and is involved in a number of clinical trials on the effect of small fruit bioactive compounds (polyphenols) on type-2 diabetes.

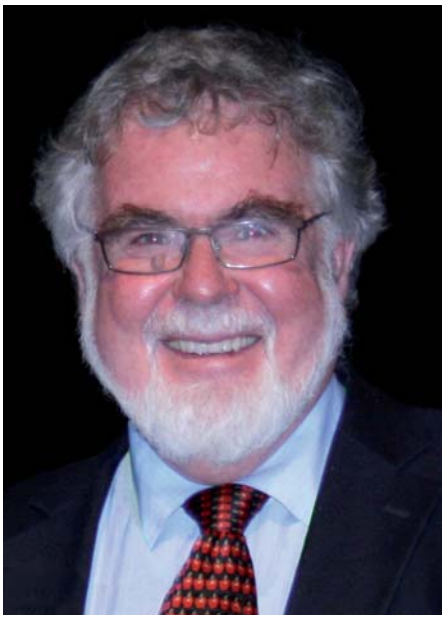
Prof. Desjardins is a member of ISHS since 1986, when he participated to his first IHC meeting in Davis, California. Since then, he has attended every IHC meeting. His active involvement with ISHS dates back to 1994 where he was Canadian representative on the Council. From 1996 to 2002, he has been actively involved in the organization of the IHC2002 in Toronto, being the Chair of the Scientific Task Force Committee. In this function, he was instrumental in proposing a new structure for the scientific program of the International Horticultural Congress where Chairs of Sections and Commissions are now closely associated with the organization of thematic symposia. This change has generated much interest in the Congress, has provided focus and coherence to the scientific program and created a feeling of belonging normally found in smaller symposia organised by the ISHS around the world. The same model has since been adopted by the other editions of IHC with great success.

Prof. Desjardins has been Convener or Co-Convener of many symposia organized by ISHS. For instance, he convened the Second International Symposium on Acclimatization of Tissue Cultured Plants in Merida, Yucatan in 2004. He was also actively involved in the planning of the Third International Symposium on Acclimatization of Tissue Cultured Plants in Faro, Portugal in 2007, where he was also the plenary invited keynote speaker. Being involved in research on health effects of fruit and vegetables, he organized in 2005 the first International Symposium on Health Effects of Fruit and Vegetables (FAVHEALTH, Quebec City, Canada) under the auspices of ISHS. The goal of this symposium series was to create a unique forum for researchers from different disciplines, like horticulture, nutrition and health sciences, to meet formally and bridge the communication gap between agriculture and medical sciences. The conference also aimed at asserting the leadership of horticultural sciences in an emerging field dominated by medical sciences. The ISHS Quebec City's meeting was a great success and led to the creation of the ISHS Commission "Fruits and Vegetables and Health" in 2006 of which he became Chair.

Prof. Desjardins believes in improving the overall quality of the Society's publications and enhancing the use of information technologies and computers for publishing and scientific exchanges. Yves and his wife Louise have four sons, Charles, Philippe, Éloi and Clément.

PROF. DR. ERROL W. HEWETT, SECRETARY, RESPONSIBLE FOR INNOVATION, INDUSTRY AND INSIGHT

Professor Errol Hewett has been confirmed as a member of the new Board of ISHS at the recent IHC2010 in Lisbon. He has been replaced as the



Errol W. Hewett

Chair of the Commission Education, Research Training and Consultancy, a position he has held since 2006, by Dr. David Aldous of Australia.

Dr. Hewett, born in 1942, is Professor Emeritus of Horticultural Science within the Institute of Food, Nutrition and Human Health at Massey University, Auckland, New Zealand. Trained as a plant physiologist at the University of Canterbury and the University College of Wales, and specializing in postharvest physiology and technology, he worked for the former DSIR before moving to Massey University in 1986. He is a Past President and Honorary Fellow of the New Zealand Society of Horticultural Science. He was on the Editorial Board of *Scientia Horticulturae* for 12 years and *Postharvest Biology and Technology* for 10 years. He is currently on the Editorial Board of the *New Zealand Journal of Crop and Horticultural Science, International Journal of Postharvest Technology and Innovation,* and *Horticulture, Environment and Biotechnology.*

Dr. Hewett has taught classes in postharvest physiology to senior students and also introductory horticultural botany to first year students. He has supervised 20 PhD candidates and several Masters and postgraduate diploma theses. He was, until 2009, Deputy Chair of the Doctoral Research Committee at Massey University that manages the PhD programme for more than 1000 PhD students, as well as Chair of the Graduate Student Advisory Committee and the International Student Advisory Committee at Massey University.

Professor Hewett travels widely to attend conferences and has been an invited keynote speaker at many in different countries. He was on the Scientific Committee of three ISHS Kiwifruit symposia including convening the meeting in New Zealand in 1991. He co-convened the 2009 ISHS Symposium "Postharvest Pacifica – Managing Quality in Chains" and was co-convener of ISHS Postharvest Symposia at IHCs in Toronto and Seoul. He has edited or co-edited several *Acta Horticulturae.* He is a member of the Board of Trustees of the International Tropical and Subtropical Fruit Network (TFNet) based in Malaysia.

Dr. Hewett is actively involved with the fruit industry in New Zealand developing a manual of best practice for the stone fruit industry, and is an invited member of several review panels for the kiwifruit industry as it seeks to continuously improve fruit quality. He has undertaken international consultancy projects in Pakistan and Albania. As a member of the Martech Consulting Group Ltd., he has co-authored the annual production of 'FreshFacts' since 1999, an annual publication that outlines production and export information on the New Zealand horticultural industry.

Professor Hewett is passionate in his belief that horticulture is a key driver for growth and development in both developing and developed countries. He is committed to ensuring that ISHS further enhances its position as the premier international organisation representing horticultural science, and wishes to see much improved cooperation and interaction between academia, research institutions and the private sector world wide.

PROFESSOR IAN J. WARRINGTON, CO-PRESIDENT OF IHC2014

Prof. Warrington was born in Timaru, New Zealand in 1946 and has been an active horticultural research scientist for the past 40 years. His research specialty is environmental physiology and he is well known internationally for his research on apples, kiwifruit, grapes and ornamental plants.

Ian J. Warrington

From 1995 to 2002 he was Chief Executive of The Horticulture and Food Research Institute of New Zealand (HortResearch), an organisation that has made major contributions to the highly successful horticultural industries of that country. In this position he acted as the interface between government, research & extension and growers, in a wide range of matters relating to horticultural innovation and development. Until recently, he was Professor of Horticultural Science and Deputy Vice-Chancellor at Massey University.

Professor Warrington has been widely recognized for his achievements including being made an Honorary Fellow of the New Zealand Society for Horticultural Science, a Fellow of the American Society for Horticultural Science and recently a Fellow of the ISHS. He is also a Fellow of the Royal Society of New Zealand. Professor Warrington has served on the Board of the ASHS as the International Vice-President and has actively encouraged international members to become more involved in the activities of that Society.

He is the author of over 130 scientific journal papers and of many other technical reports, conference papers and popular articles. He has co-edited the texts "Kiwifruit: Science and Management" and "Apples: Botany, Production and Uses".

An active member of ISHS for over 35 years, Ian has regularly attended and contributed to Council meetings as a country representative since the Congress in Florence in 1990. He has been involved in organizing or co-organising ISHS symposia and Congress sessions since the Congress in Sydney in 1978. He has been Vice-Chairman of the Fruit Section and arranged the hosting of the Board/Council/Executive Committee meeting in New Zealand in 1996 and of the Board and Executive Committee in Thailand in 2009. He was the ISHS Vice-President from 2002 to 2010.

Professor Warrington is strongly supportive of retaining and strengthening the key features that make ISHS a success including ISHS sponsored symposia and the *Acta Horticulturae* series, the new look *Chronica* and the Congress. He is very committed to exploring ways in which ISHS can promote the status of Horticultural Science as a career choice that will encourage young people to become involved as professionals in the industry. This includes exploring options for ISHS to further advocate the importance of horticulture to people's diets, the quality of their lives and the viability of rural communities. In particular, he is committed to ensuring that IHC2014 is an outstanding success.

Jozef Van Assche

IR. JOZEF VAN ASSCHE, EXECUTIVE DIRECTOR OF THE ISHS

Jozef Van Assche was born in Leuven, Belgium, in 1960 and received his Master in Horticulture in 1983 at the Faculty of Agriculture of the University of Leuven. His thesis dealt with 'Economical Aspects of In Vitro Culture'. He continued as a research student at the University of Foreign Studies in Osaka (Japan) and at the University of Tokyo, Faculty of Agriculture, from 1983 till 1985. He then worked for ICI-England 'West Europe and Far East Marketing Department' from 1985 till 1986. Van Assche became the executive manager of a Beverages and Foods Group from 1987 till 1993. In 1993 he returned to the world of science and joined the staff of the ISHS. He was appointed Executive Director in 1995. He is determined to bring horticultural science to the benefit of all, including researchers in the developing world, and together with the ISHS team to serve the horticultural profession as a whole.

Jozef is a keen gardener and enjoys coming home to his wife Mieke and his three children Kerlijn, Laureen and Andreas.

Norman Looney presenting the new Board members at the ISHS General Assembly at IHC2010.

Newly Elected Chairs and Vice-Chairs of Sections and Commissions

Kim E. Hummer, ISHS Vice President

We have 10 Sections emphasizing horticultural commodities and 14 cross-commodity Commissions whose activities are the key to the success of the ISHS. Our recent Executive Committee elections, with voting from more than half of ISHS members, selected popular, dynamic, and energetic Chairs and Vice-Chairs who will guide our scientific program for the next 4 years. Our Sections and Commissions have more than 120 active Working Groups who host periodic symposia that are relevant to our membership and scientists at large. The proceedings of these symposia are published in the *Acta Horticulturae* series, which is a highly-web-visible, frequently downloaded, cornerstone of the Society. Each *Acta* presents a detailed synopsis of the science in the world on that topic at that moment. Each manuscript submission is reviewed by at least two members of the editorial board, revised by the author, and accepted by the editor(s), prior to publication in the *Acta*.

Chairs and Vice-Chairs of each of the Sections and Commissions were recently elected and their appointments were officially confirmed by the ISHS Council at the IHC2010 in Lisbon, Portugal. Additional Sections, Commissions or Working Groups can be formed when interest is demonstrated. In the immediate future the scientific programme of the Society is poised to maintain or increase the number of symposia per annum compared with those in previous years. In 2006, 32 ISHS symposia produced 15,334 *Acta* pages; in 2009, 41 symposia produced 20,107 pages. Our *Acta* with their highly-cited scientific manuscripts reflect a platform of sound science that is reaching more people in more countries than ever before. These publications are accessible through the website: www.actahort.org.

Our distinguished Chairs and Vice-Chairs for 2010 through 2014 are as follows:

SECTIONS

Banana and Plantain	Chair Dr. Stephan Weise (France) Vice-Chair Dr. Jim Lorenzen (Uganda)
Citrus	Chair Dr. Yair Erner (Israel) Vice-Chair Prof. L. Gene Albrigo (USA)
Medicinal and Aromatic Plants	Chair Prof. Dr. Akos Máthé (Hungary) Vice-Chair Dr. Ana Maria Barata (Portugal)
Nuts and Mediterranean Climate Fruits	Chair Dr. Damiano Avanzato (Italy) Vice-Chair Dr. Gale H. McGranahan (USA)
Ornamental Plants	Chair Prof. Dr. Margrethe Serek (Germany) Vice-Chair Dr. J.M. Van Tuyl (The Netherlands)
Pome and Stone Fruits	Chair Prof. Guglielmo Costa (Italy) Vice-Chair Prof. Daniele Bassi (Italy)
Root and Tuber Crops	Chair Prof. Dr. Noureddine Benkeblia (Jamaica) Vice-Chair Prof. Umezuruike Linus Opara (South Africa)
Tropical and Subtropical Fruits	Chair Prof. Dr. Sisir Kumar Mitra (India) Vice-Chair Dr. Víctor Galán Saúco (Spain)
Vegetables	Chair Prof. Dr. Silvana Nicola (Italy) Vice-Chair Dr. Daniel Leskovar (USA)
Vine and Berry Fruits	Chair Prof. Dr. Bernadine C. Strik (USA) Vice-Chair Dr. Nick Dokoozlian (USA)

COMMISSIONS

Economics and Management	Chair Prof. Dr. Peter P. Oppenheim (Australia) Vice Chair Dr. Peter J. Batt (Australia)
Education, Research Training and Consultancy	Chair Assoc. Prof. Dr. David Aldous (Australia)
Fruits and Vegetables and Health	Chair Prof. Dr. Olaf Van Kooten (The Netherlands)
Horticultural Engineering	Chair Dr. Sadanori Sase (Japan) Vice Chair Dr. Murat Kacira (USA)
Irrigation and Plant Water Relations	Chair Dr. Richard L. Snyder (USA) Vice Chair Prof. Dr. Arturo Alvino (Italy)
Landscape and Urban Horticulture	Chair Prof. Dr. rer. hort. habil. Gert D. Groening (Germany) Vice Chair Prof. Dr. Giorgio Prosdocimi Gianquinto (Italy)
Molecular Biology and In Vitro Culture	Chair Dr. Maurizio Lambardi (Italy) Vice Chair Dr. Bart Panis (Belgium)
Nomenclature and Cultivar Registration	Chair Dr. Janet Cubey (UK) Vice Chair Dr. J. Van Scheepen (The Netherlands)
Plant Genetic Resources	Chair Dr. Hannah Jaenicke (Germany) Vice Chair Dr. Barbara Reed (USA)
Plant Protection	Chair Dr. Chris Hale (New Zealand) Vice Chair Dr. David Hunter (Canada)
Plant Substrates and Soilless Culture	Chair Dr. W.R. Carlile (Ireland) Vice Chair Dr. Michael Raviv (Israel)
Protected Cultivation	Chair Dr. Nicolas Castilla (Spain) Vice Chair Dr. Josef Tanny (Israel)
Quality and Post Harvest Horticulture	Chair Dr. Sirichai Kanlayanarat (Thailand) Vice Chair Dr. Peter A. Toivonen (Canada)
Sustainability through Integrated and Organic Horticulture	Chair Dr. Robert K. Prange (Canada) Vice Chair Prof. Dr. Stefaan De Neve (Belgium)

Master of Science in Horticulture: New Approaches in Europe

Silviero Sansavini

Higher education among European universities in the agricultural sciences, including horticulture, is a notable patchwork of curricula. The latest expansion of the European Union (EU) to 27 member states has brought into sharper relief the need to harmonize curricula so as to bring the disparate systems of academic titles into some semblance of uniformity. This is especially urgent given that there are university systems, such as the Italian, which award degrees with a legal status whereas others like the UK, award degrees that have a purely academic value. These differences can result in equivalency discrepancies and career problems for those in private professional practices. While there is no central European authority in a position to grant degree reciprocity, the increasing number of specific bilateral agreements pushing mutual recognition of post-graduate degrees among European countries is close to the top of the higher educational agenda of the EU. Another compelling fact underscoring the urgency of the issue is the increasing ease with which students move between countries and universities. This mobility is driven largely by the EU Erasmus student-exchange program and the attendant European Credit Transfer System (ECTS) that have been in place for a number of years. The EU thus provides students with modest financial aid and a system with which they can receive credit spent at their home institutions for courses taken at cross-border universities.

Student exercise with loading agarose gel (horizontal electrophoresis analysis). Courtesy of FED-IASMA Doctorate School of San Michele all'Adige, Trento.

The EU Commission has tried since the inception of Erasmus (called Socrates in the early 1990s) to prod member states into harmonising their curricula and degrees and continues to do so through what is now known as the Bologna Process, an international agreement with the aim to create the European Higher Education Area (EHEA) (1999), based on cooperation between ministries, higher education institutions, students and staff from 46 countries, with the participation of international organisations. Their website provides information about it. The model it chose to emulate in pursuit of this aim was the UK system of a three-year undergraduate, or Bachelor's degree and usually, at least two additional years for what in the British system is a research Master's degree. This was in contrast to the widespread system of five-year undergraduate degree courses on the Continent. In effect, if we take a degree in agricultural sciences as an example, we find that graduates under the old system in most universities earned an Agronomy Engineer or Agricultural Sciences degree. While Germany, the Netherlands, Spain, and Italy have fully adopted the EU model, some countries have done so with home-grown variations, but have developed also the Bachelor + Master system. France practices both systems and maintains the 5 years title of Ingénieur Agronome, while Greece has also kept a good part of the old system in place. An important ulterior motive for adopting the relatively new EU model was to help stem the student drop-out rate in the first three years, and in so doing, give students with the new Bachelor's degree a higher entry-profile in the job market.

MASTER'S DEGREE IN HORTICULTURE

Despite the Bologna Process and subsequent follow-up accords, there are still notable discrepancies in the comparability and compatibility of standards for this Master of Science (MSc) degree. In effect, while there are very few MSc programs in horticulture *per se*, there are many that include disciplines that are related to it more or less directly. A look at the differences and, by inference, the similarities is instructive.

Optical microscope evaluation of regenerating tissues. Courtesy of FED-IASMA Doctorate School of San Michele all'Adige, Trento.

Several countries have taken what may be called a generalist approach to a Master's program by incorporating horticulture among a list of different but related subjects. Wageningen University (WUR) in the Netherlands is a good case in point, having placed Horticulture within the courses offered in its Master in Plant Sciences. Other countries have opted for what we might call a particularistic approach, the name under which horticulture goes by and the subjects related to it having as many denominations as the imagination of the faculty and administrative staff can come up with. Take Italy for example. The two-year Magister program in its universities – corresponding to the MSc program – has almost a dozen names depending on university (Bologna alone has four) including for example Crop Production Systems, or those specifying horticulture within a major field such as Protected Crops. There are, of course, countries whose universities have a straightforward MSc in Horticulture, but they are a definite minority.

Furthermore, the term Master has generated confusion in the minds of the public since some countries use other names to indicate what is supposed to be the same or comparable degree. A Master's degree is used, perhaps inappropriately, to refer to a semester or one-year cycle of courses specifically designed to enhance a candidate's chances of securing an entry-level job. Examples of this kind of degree include courses in subjects such as horticultural produce, marketing of food commodities, integrated crop production, or biological pest control. This kind of degree is recognised in Italy, but is not a pre-requisite for a PhD. Given that such a course is very often commissioned by banks and foundations linked to them, it should more appropriately be dubbed a Diploma. There are several kinds of Masters that are offered outside the walls of academe, but this will not be dealt with here.

Let us examine a more nuanced look at the advanced-degree system in Europe's higher educational institutions by considering a novel approach that has been taking shape over the last few years, one that appears to be more consonant with the objectives and principles of the EU. The initiative is called the International Master's Program and is being implemented via voluntary partnership agreements among cross-border universities designed to create a common curriculum of courses that are offered in packages at the participating institutions and usually taught in English, though the language of the given host university is often an additional option. Students must attend courses in at least two partner universities, over a period of two consecutive years, with other regulations depending on the degree course and partner institutions.

A bit of history is in order at this point. The first embodiment of an internationally oriented MSc in Horticulture, albeit not part of the current initiatives, originated a decade ago at Hannover University in Germany. While that Master's program did not initially involve partner universities, the program was managed in an international way, including the makeup of its examining commission. The Hannover Master thus provided a model for the international initiative involving partner universities that is now making headway in the EU.

Students of University of Bologna (Biotech course) operating in lab. Exercise to extract transformed plasmids from *Escherichia coli.* Courtesy of DCA, University of Bologna.

The new International Masters are usually two-year programs of 60 ECTS credits per year with reciprocal recognition by the partner institutions' awarded degree. While each participating university must manage the costs of the degree, the EU may support the program through a particular selection process that provides yearly grants to students from developing countries, the aim being to create an average group of about 20 foreign students per MSc degree course. As the international master's programs increase, they should also play a part in hastening social integration within the European Union. One barrier here is the plethora of languages spoken within the EU, and the known fact that people are loath to give up their own. While the International Masters attempt to dismantle this barrier by teaching all courses in English, the standard national programs are almost all taught in the language of the given country, two exceptions being the Netherlands and partially Spain and Italy, which offer Master's Degree courses in both English and their native languages.

Graduate student is grinding fruit flesh for GC analysis. Courtesy of DCA, University of Bologna.

INTERNATIONAL MASTER'S CURRICULA

Wageningen University (WUR), The Netherlands

This is probably the most popular and broad-based MSc program in Europe today, attracting many students. There were 33 Master's Degree courses in 2009/2010. With such a broad range of disciplines providing the structural backbone to the curricula, the idea underlying the programs is to imbue these two-year Masters with the most advanced professional skills available. There is one Master in Plant Sciences. It includes disciplines that emphasise multi-functional agronomy, supply-chain interaction with the environment, the food industry, and food safety from the viewpoint of consumers. The courses mentioned in the overview above together make up 48 ECTS credits, which is the amount of courses in any MSc-program at Wageningen University. In addition, students practice the skills and knowledge they learned in the courses in their second year, when they do their MSc-thesis (6 months) and an academic internship (4 months). The general number of students attending these courses is between 30-50, while for a specialization like Greenhouse Horticulture it ranges from 15-20. For example, Crop Science has three recognized thesis groups: Crop and Weed Ecology Systems, Plant Production, and Biological Farming Systems. These in turn include greenhouse horticulture, natural resources management, plant breeding and genetic resources, plant pathology and entomology, and since 2008, quality and supply of fruits and berries (developed with the Faculty of Sciences at the University of Copenhagen) (with Leibnitz University in Hannover), and vegetable production and supply systems. Other WUR MSc-programs are: Agricultural and Bioresource Engineering, Soil Science, Hydrology and Water Quality, Engineering, Plant Biotechnology, Environmental Sciences, Organic Agriculture, Food Safety, Food Technology, Food Quality Management, Nutrition and Health, Forest and Nature Conservation, Landscape Architecture and Planning. Then Management of Agro-ecological Knowledge and Social Change (MAKS) takes into account two types of innovations: new technology and artefact, and new socio-organizational arrangement involving a variety of social actors.

Leibniz Universität, Hannover

The MSc in International Horticulture was inaugurated in 1997. Since its inception, it has successfully aimed at attracting students from all over the world who already have a BSc degree in Agriculture, Horticulture, or Economics and are offered a certain number of scholarships, initially provided by the European Union but now provided by the German Academic Exchange Service (DAAD). The course program is well structured. All of the 40 courses are taught in English, but there are also German programs for basic knowledge. The main characteristic is that these two-year programs are split into lectures and research projects, resulting in full immersion for students who earn half of their credits from lectures and the other half from projects. The final examination is held by an international committee. The major fields are Floriculture, Fruit Science in collaboration with WUR, Genetics, Plant Breeding, Bioinformatics, Horticultural Economics, Horticultural and Agri-Engineering, Plant Pathology, Entomology, Plant Biotechnology, Plant Nutrition, Tree Nursery Science, Vegetable Production. Each MSc student is assigned a tutor depending on his or her major field. Tuition fees currently run to € 400

Old technical devices for wine production in Trento province. Courtesy of FED-IASMA Doctorate School of San Michele all'Adige, Trento.

per semester plus an enrolment fee of € 240 per semester for services such as transportation. Students must also spend a month working as interns for a private farm or company.

International MSc in Horticulture (IMaHS)

The three original partner institutions of IMaHS are Bologna University (UNIBO), Technische Universität München (TUM) in Munich (Weihenstephan), and BOKU, University of Natural Resources and Applied Life Sciences, in Vienna. Two other Universities, Corvinus in Budapest and Humboldt in Berlin, joined after 2008. The program is the result of a joint effort by the five universities through their research network. The strong integration among these Universities provides a wide range of complementary expertises contributing to create a holistic education for future graduates. The objective of the Master's course is to develop professionals able to work in global horticultural markets. The distinguishing feature of the program resides in the fact that all courses are in English and students must attend at least one semester of the two-year curriculum at a participating university other than his or her home institution.

The system is very flexible and offers an individual profiling with respect to the personal career of the students. They have the possibility to specialize or to study in a broad sense. Only the core program of the first semester is obligatory and is equivalent at each partner university. The partners offer their scientific specialities as courses in a pool where the students can make a rather free choice. UNIBO covers three main fields: Sustainable Orchard Management and Post-harvest, Monitoring Quality of Products and Production Systems, and Horticultural Economics. The courses offered at TUM cover two main fields: Environmental Safety and Intrinsic Product Quality. They include special research topics on Energy Use and Protected Cultivation Systems and Optimisation of Plant Metabolism for Both Plant Resistance and Human Health. The courses offered at BOKU cover the fields Sustainable Vegetable and Ornamental Plant Management, including Integrated and Organic Plant Protection and Soil Fertility and Resource Conservation. Humboldt-University of Berlin is focusing on Food Quality Mangement and Urban Horticulture and Corvinus University of Budapest offers Sustainable Horticulture.

Finally, all the students must dedicate the whole fourth semester (30 ECTS) to a research orientated thesis carried out in one of the five partner universities in cooperation with a second partner.

The IMaHS has been funded through the European Union Erasmus Mundus grants since 2008; the amount of the annual allocation is about € 21,000, and additional fellowships for invited international scholars are available. For organisational reasons, it was necessary to define a more restricted curriculum for the students who receive a scholarship. This Erasmus Mundus course program, which is co-ordinated by Prof. G. Costa, UNIBO, includes only the three founder members but defines a clearly regulated study path within the general program International Horticultural Science.

AGRIS MUNDUS MSc in Sustainable Development in Agriculture

The university partners are Montpellier SupAgro, the coordinating institution, WUR, University of Copenhagen, University College Cork, University of Catania, and Madrid Polytech. This two-year course is linked to the European Natura University network, which since 1988 has focused its activity on rural development and agricultural management for disadvantaged populations. There are seven fields of specialization: Crop Production Systems, Horticultural Crops, Tropical Rural Forestry, Land and Water Management, Human Nutrition, Food Systems and Security, Livestock Production. The mobility track of the program requires one year of study at a participating university of choice and the second at another. Subjects are taught in English, Spanish, Italian, and French. Candidates who successfully complete all requirements are awarded two MSc Degrees, one from each university, along with a certificate issued by Natura attesting to the student's qualifications in sustainable development in agriculture.

Student involved in greenhouse experimental trials of potted grapes. Courtesy of FED-IASMA Doctorate School of San Michele all'Adige, Trento.

International Master in Vintage, Vine, Wine and Terroir Management

The partners are Bologna University, Valencia Polytech University, Corvinus University in Budapest, Bucharest University of Agronomic Sciences and Veterinary Medicine, University of Tras-Os-Montes and Alto Douro in Vila Real, Technological Educational Institute of Athens, Sacred Heart University in Piacenza, Angers Higher Agricultural School, coordinating institution (all members of the Erasmus Mundus Consortium), South Africa's Stellenbosch University, Chile's Pontifical University, and Switzerland's Changins Engineering University. This Master's program aims to develop internationally trained experts in the wine sector, with a double competency. From the study of wine terroirs to the analysis of consumer behaviour, the comprehensive curriculum combines scientific, technological, economic, organisational and marketing knowledge with field experience. The program is designed to train innovative executives and top managers to play an active part in the enhancing of wines from the technical, strategic and commercial points of view at an international scale. Graduates will be employable at a manager level in European and international companies dealing with the wine sector, or can go on for a PhD. The course admits 30 students a year who must have a Bachelor's degree and linguistic competence in French and English since half the subjects are taught in each, although they must also learn one other foreign language during their four semesters. There are 9 core modules offered in at least 3 partner institutions, which change every year depending on the rotation set up by the Course Committee. Candidates who pass all modules are awarded the Master's degree but it has different types of validity and takes different forms depending on partner country and the mobility path (student movement among EU's higher education institutions).

International Master in Fruit Science (IMFS)

This program is offered by the Faculty of Science and Technology at the Free University of Bozen-

Field experience to evaluate phenotypical phase and agronomic traits of vineyard. Courtesy of FED-IASMA Doctorate School of San Michele all'Adige, Trento.

Bolzano (FUB) (South Tyrol, Italy) in cooperation with the University of Ljubljana in Slovenia and Czech Republic's Mendel University at Lednice-Brno. This two-year program is planned to start in the 2010-2011 academic year and is designed to provide management-level skills and competence for future executives in the fruit industry, worldwide. After one fall semester at FUB, the students will join those coming from the two partner institutions for a common study year, split among the three universities. The syllabus includes such major fields as advances in fruit crop management and biotechnology, fruit quality, consumer's behaviour and human nutrition, ecology and physiology of production systems, and marketing; the core part of the program subjects is going to be taught in English. One semester is devoted to the Master thesis, written and discussed in English. The program will deliver a joint MSc degree.

NOVA - BOVA Network

This Network is a cooperation program between two groups of Universities, those of the Baltic (BOVA - a Network of Forestry, Veterinary and Agricultural Universities: EMU, Estonian University of Life Science, coordinator; LLU, Latvia University of Agriculture; LZUU, Lithuanian University of Agriculture; LUA, Lithuania Veterinary Academy) and Nordic countries with the Network NOVA, which includes six universities, HU, University of Helsinki; NLH, Agricultural University of Norway; SLU, Swedish University of Agricultural Science; the Agricultural College Hvanneyri (Iceland) and Veterinary Scholl, University of Denmark and Norway.

The two Networks started to cooperate since 1996 with joint programs of intensive MSc courses, one in "Horticulture" and another linked to EU-Socrates Erasmus program "Management of biodiversity and multifunctional landscape". These joint degree programs (JDP) award academic degrees with legal effects for all partner institutions.

NOVA – BOVA Network has produced several benefits despite the credit system valid across Europe has still some heavy problems for procedures, administration rules, financial support, grading schemes.

TEMPUS

Another EU initiative that embraces Master's degrees, vocational training, and continuing adult education is TEMPUS. It is an outreach program designed to modernize higher education and professional training in the surrounding partner countries of Eastern Europe, Central Asia, the Western Balkans, and the Mediterranean Basin through university cooperation projects. The current program is Tempus IV (2007-2013) and under it the EU Commission has approved 69 projects out of 608 submitted in the 2009 second call for proposals. While several of these initiatives involve higher education, the one that started at the beginning of 2010 is called Establishing a New Master's Degree in Sustainable Crop Protection and is aimed at participating Egyptian universities. The project is coordinated by Turin University through its Agrinnova centre for agri-environment innovation and includes as partner institutions Italy's National Research Council, Plant Protection Institute in Bari, Spain's Lleida University, the International Center for Advanced Mediterranean Agronomic Studies (CIHEAM) at Chania in Greece and seven Egyptian Universities: Mansoura, Zagazig, Ain Shams, Suez, Assuit, South Valley and Kafr El Sheikh. The degree course is designed to endow candidates with the knowledge and skills involved in integrated and biological pest management systems for plant protection in line with those same requisites in European institutions of higher learning.

MASTER'S DEGREE PROGRAMS BY EUROPEAN COUNTRIES

Belgium

The two universities that organize a Master program linked to horticulture are Katholieke Universiteit Leuven (KUL) and Ghent University. While neither participates in the above international programs, the MSc degree in horticulture-related subjects at both is recognised internationally. In effect, both have a number of internationally recognised MSc degrees at various faculties, with some being taught only in Dutch-Flemish and some only in English, and both use the ECTS credits to further transparency and international mobility. The horticulture-related MSc at each university is a two-year degree and has a syllabus centring on crop production and animal husbandry in the Faculty of Bioscience Engineering. For example, at KUL the classes are taught in Dutch and include applied plant biotechnology, foodstuff management and marketing, plant physiology, plant diseases and pests, agro-ecology and sustainable management of production systems, applied plant breeding, development physiology of higher plants, plant nutrition, and crop production systems.

Bulgaria

At Plovdiv Agricultural University there are MSc programs, including horticulture, which allow the student to continue the training till the PhD program.

Czech Republic

At University of Life Sciences, Prague, there is a horticultural specialization. These students, after the Bachelor's degree, acquire a broad theoretical knowledge and practical skills in various sectors of horticulture, but are also educated in the subjects with economical and technological focus. They also obtain experience in horticultural firms.

Denmark

AARHUS University (Arslev) offers an MSc program at the Faculty of Agricultural Sciences designed to expand knowledge for efficient and sustainable agriculture for food production. The curriculum offers an MSc in Agrobiology, which includes horticulture, agro-environmental management, biosystems engineering, molecular nutrition, and food technology. Interested students can coordinate their thesis work with the Department of Horticulture. Copenhagen University has an MSc at the Faculty of Life Sciences in horticulture through a joint program with Wageningen for the supply and quality of soft fruits.

France

The most important initiative is the SupAgro Master 3A (Agronomie, Agro-Alimentaire) program at Montpellier. All courses are taught in French (with English option) to attract many students from Francophone Africa. Two masters are related to Horticulture: "Sepmet" and "Hortimet". Both require a 2-year course with 4 semesters offering a total of 120 ECTS. During the 1st year students spend a semester in a campus (for analyzing the Agriculture process), then they have a semester of optional lecture. In the 2nd year they have 30 ECTS of specific lectures and the experience of the Master work. There is also a one year course of specialization – "Apimet" – within the 5 years program of the University diploma Ingénieur Agronome. The "Sepmet" (Semences et Plants Méditerranéens et Tropicaux) program has a goal to form a "professional" devoted to the field of breeding and improvement of the main Mediterranean and tropical crops (including fruits and vegetables). The "Hortimet" program follows the perspective of Global Hort. The graduates must know the whole process chain of production (from cultivar improvement to field management, storage and transformation, distribution of the produce), rules of the market and its control. "Hortimet" is organized jointly by SupAgro (Montpellier) and Agrocampus Ouest Centre of Angers. "Apimet" requires 30 ECTS for teaching (10 disciplines) and 30 for a final stage. The aim is to give the student a multidisciplinary and integrative approach by SupAgro with intense cooperation of the biggest agricultural companies operating at Montpellier in Agropolis and of CIRAD, INRAD, and IRD.

Germany

Apart from those mentioned among the international programs above, MSc programs in German are offered in Agriculture at Osnabruck University and in Fruit Science and Viticulture at University of Wiesbaden at Rüsselheim and Geisenheim.

Greece

Two of the five agricultural universities offer master programs. The one at Athens has an MSc in Modern Systems of Plant Production, Plant Protection and Landscape Architecture, with Horticultural Crops and Floriculture being one of the four major fields of this degree. The other at Thessaloniki has an MSc program with eight major fields of study, including Horticultural Science. The higher education system in Greece requires prospective candidates of post-graduate degrees to complete a five-year undergraduate degree, making the length of time it takes to complete an MSc or PhD in Greece longer than in other European countries.

Hungary

In addition to the Corvinus participation at the IMaHS program coordinated by Bologna, Debrecen University has an MSc program in Agricultural sciences, with subjects taught in both Hungarian and English, including environmental management, agricultural engineering (also in English), food quality and safety (also in English), livestock science (also in English), crop production, horticulture, and plant protection and nature conservation. A third institution, Kecskemet College, has a specialization program in horticulture.

Italy

Apart from the international degrees mentioned above and taught in English, the 23 faculties of agriculture at the nation's universities offer roughly 106 two-year Magistral degree programs, all of which are taught in Italian, that follow the three-year Bachelor's degrees and are considered equivalent to the MSc. While the average number of students is about 70 per course, more than 40% have ten or fewer students, a trend that could jeopardise the future of many current programs. Almost all the programs offer degrees in crop production systems, including horticulture, and some even specialise in fruit science, floriculture and viticulture-enology.

Student instruction during a professional trip of the Horticulture MSc course at Technical University of Munich (TUM), Freising, Weihenstephan, Germany.
Courtesy of Prof. D. Treutter.

Lithuania

Lithuanian University of Agriculture has an Agronomy faculty that offers four MSc study programs in agronomy, agro biotechnology, agro ecosystems and horticulture covering fruit and vegetable crops (the ECTS are 40 per year). Language is only Lithuanian. The LZUU is part of the BOVA network for international MSc program.

Poland

Poznan University of Life Sciences offers a one and a half year MSc program in Horticulture (93 ECTS) with specialization in pomology, floriculture, seed science, parks and green areas, landscape architecture, and plant protection. All courses are taught in Polish. The University offers also a one and a half year Master's Degree in Plant Breeding, Seed Science and Technology with all subjects taught in English. Warszaw University has also several MSc programs that involve horticulture.

Portugal

There are two Master courses in horticulture: a Horticultural Master in Fruits and Vegetables at the University of Algarve, Faro; and an Integrated Fruit Production Master in the Polytechnic Institute of Castelo Branco. Most universities, including the Technical University of Lisbon, offer Master courses in agriculture (Engenharia Agronómica) that include a specialization in horticulture as part of a 5 year program but are undergoing a transition to the new Bologna process of 3+2 years.

Romania

The universities of Bucharest, Craiova and Jasi offer MSc programs that include horticulture; all courses are taught in Romanian.

Slovenia

The University of Ljubljana, the country's largest, plans to offer as many as 15 MSc courses when all of them will be established. Aside from being a partner of the international degree with Bozen and Mendel Universities mentioned above, it plans to offer, starting in 2010-2011 an MSc in horticulture covering fruit science, viticulture, vegetable crops, and ornamental and medicinal plants.

Spain

The most relevant MSc degrees to horticulture here are those offered at Cordoba, Zaragoza, and Valencia Universities and at the IAMZ (Agronomic Mediterranean Institute of Zaragoza). Cordoba has two Masters running in the 2009-2010 academic year: one is a two-year and the other a one-year program. The latter focuses on crop production, protection and breeding and the former on olive grove management and oil technologies and it is jointly with the IAMZ, the International Olive Oil Council (IOOC) and four national institutions. The IAMZ is one of the four CIHEAM Centers. The Zaragoza one runs a two-year MSc program. The first year is basically a suite of training courses that include, for example, plant breeding, olive grove management and oil technologies (see Cordoba), integrated planting for rural development and environmental management, foodstuffs and marketing, livestock and fisheries. The second year focuses on a field trial or laboratory experiment depending on the major field a student chose in the preceding year; the final thesis must be completed within four years. While this degree is officially equivalent to standard university MSc in Spain, many of Zaragoza's degree courses are jointly run with partner Spanish universities. The Inter-University Master has a number of partners including Valencia Polytech (UPV), the home institution, Madrid Polytech (UPM), and Catalonia Polytech (UPC). This MSc focuses on plant breeding, the syllabus is taught in Spanish, only 30 students are admitted per year and the course lasts one year or two: candidates with an undergraduate degree in agronomy or biotechnology can complete their requirements in one year whereas candidates of other Bachelors are required to complete the two-year program. The degree course is designed to train executive and top management professionals for a career in the seed industry and fruit nursery sector, including marketing. The syllabus includes about twenty subjects ranging from reproductive biology and molecular-genetic studies to "in vitro" and transgenic techniques aimed at conferring resistance, high yields and high fruit quality on crops. Madrid Polytech University has a two-year degree course since 1990 in Garden and Landscape Master.

Sweden

The Swedish University of Agricultural Sciences (SLU) offers a number of both one- and two-year MSc degrees. The MSc programs offered at the Faculty of Landscape Planning, Horticulture and Agricultural Sciences at Alnarp, near Malmö in Southern Sweden, are two five-year programs comprising a three-year Bachelor and a two-year MSc. Subjects in the Bachelor's program are taught in Swedish and the syllabus in the Master's program is in English. The two MSc degrees are in Horticultural Science, Biology and Landscape Architecture. The emphasis of the Master is on Applied Plant Biology, including

Field visit of cherry covered culture at Technical University of Munich (TUM), Freising, Weihenstephan, Germany (MSc course). Courtesy of Prof. D. Treutter.

plant protection biology, plant breeding and biotechnology, and plant production and quality. The courses offered are advanced plant breeding and genetic resources, applied plant biotechnology, environmental issues in crop production, insect chemical ecology, principles of crop physiology, applied crop physiology, and the degree project for the MSc thesis in horticulture.

Switzerland

The Swiss agricultural science education system has as top level the Department of Agricultural and Food Sciences of the Swiss Federal Institute of Technology (ETH) in Zürich offering in its Master's curricula some horticultural courses without a specific specialization. At a second level several universities of applied sciences offer agricultural and environmental education at Bachelor and Master level. The University of Applied Sciences Zürich offers a Bachelor of Science in Environmental Engineering. It is a full-time degree program lasting three years and an area of specialization in organic agriculture and horticulture is offered. In addition, at Lausanne University (DIBMU) a MSc program on Plant Molecular Biology is available.

UK

Several institutions of higher education offer MSc programs. The University of Reading's Centre for Horticulture and Landscape, School of Biological Sciences, offers a program in horticulture as a preparation for a career in any aspects of the subject, including specialization in crop production, crop protection, amenity horticulture and therapeutic horticulture; the degree can be completed as a full-time student in 12 months or part-time in 24-36 months. Environmentally desirable production methods are emphasized. Reading is the only research university left in Britain still teaching horticulture to both undergraduates and postgraduates. Writtle College, the largest of the old incorporated colleges, is a partner of Essex University today and offers through it MSc/MA courses in international horticulture and MSc degrees in horticulture (crop production), in postharvest technology and in landscape management. Degrees can be completed either on a full- or part-time basis. The University of Warwick took over HRI Wellesbourne, started holding courses there in 2007 and will integrate the Department of Biological Sciences into the new School of Life Sciences as of October 2010. Of the MSc degrees currently being offered those in Enterprise in Horticulture and Plant Bioscience for Crop Production are directly related to horticulture. While it offers a series of qualifications that it examines and validates but that are taught by other institutions, the Royal Horticultural Society (RHS) offers a Master of Horticulture that can be completed in three or more years and is primarily designed for those already working in a professional capacity within the industry.

CONCLUSIONS

One fact that stands out in this brief survey of Europe's MS programs is how so few of them are specifically in horticulture itself. This appears to reflect several facets of modern post-industrial society, including the low number of jobs in agriculture *per se* and the increasing focus of academies and the professions on topics such as plant biology and its link to crop production systems, ecology, environmental stewardship, foodstuffs and food safety, and on-farm energy production from non-food crops and inputs. Revisiting crop management practices to reduce a farm's carbon footprint is one practical example.

We are likely seeing a new conceptual framework taking shape, one encompassing a multifunctional agricultural industry in which the skills and knowledge base of horticulture are as necessary as ever, if not more so, in maintaining the competitive and quality profile of food commodities in the marketplace. The landscape unfolding before us also places a great deal of value on the conservation of genetic resources and biodiversity, issues that are directly or indirectly related to emerging demands for local foods that are, and have always been, typically grown in many areas. There are also certain common landmarks in the academic territory we have charted. Many of the MSc programs surveyed include genetics and biotechnology applied to plant breeding, physiology including nutrition, soil and plant management, quality as a basis for cropping, basic ecology in relation to production systems and practices, nutraceutics, foodstuff safety, and the growing popularity of landscape planning and urban horticulture.

It would appear that the best way forward will bring together universities, research institutions, and private enterprise with an international focus in order to shape a more uniform model for a Master's degree in horticulture. Such an effort will likely require thinking outside the box. For example, we might imagine something along the lines of a Euro-Hort Curriculum for post-graduate education that incorporates the best of what the Erasmus exchange program has spawned and incorporating a common core of MSc and PhD programs.

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ACKNOWLEDGEMENTS

The author warmly thanks Prof. J. Janick, Purdue University, West Lafayette, USA, for editing the text; Prof. G.R. Dixon, University of Strathclyde, Glasgow and past-Chairman of the ISHS "Commission on Education", and the following European colleagues: J. Balas, BOKU University, Wien, Austria; O. Callesen, University of Aarhus, Denmark; R.W. Cameron, University of Reading, UK; H. Dorna, Univ. of Life Sciences, Poznan, Warsaw, Poland; F. Dosba, University of Montpellier, France; C. Gessler, EHT, Politechnick Zurich, Switzerland; F. Gil-Albert, Universidad Politecnica, Madrid, Spain; W. Keulemans, Katholic University, Leuven, Belgium; G. Kireva, Agricultural University, Plovdiv, Bulgaria; A. Kuipers and R.J. Bogers, WUR University of Wageningen, Netherlands; A. Manganaris, Technological Educational Institution of Thessaloniki, Greece; D. Marian, University of Debrecen, Hungary; A. Monteiro, Technical University, Lisboa, Portugal; M. Nothnagl, SLU, Fac. Landscape Planning, Horticulture and Agr. Sciences, Alnarp, Sweden; F. Nuez Viñals, Universidad Politécnica de Valencia, Spain; L. Rallo, University of Cordoba, Spain; A. Sasnauskas, Lithuanian University of Agriculture, Lithuania; F. Spinelli, University of Bologna, Italy; F. Stampar, University of Ljubljana, Slovenia; Josef Sus, University of Life Sciences, Prague, Czech Republich; M. Tagliavini, Libera Università di Bolzano, Italy; D. Treutter, TUM, Technischen Universität, Munchen, Germany; F. Toma, Fac. of Horticulture, Bucharest, Romania; G. Végvári György, Corvinus University of Budapest, Hungary.

ABOUT THE AUTHOR

Dr. Silviero Sansavini is Professor Emeritus, Dipartimento Colture Arboree, at University of Bologna, Italy. He served as President of the ISHS from 1994 to 1998. Email: silviero.sansavini@unibo.it

Silviero Sansavini

Guiding Young People to Horticulture

Gerard McEvilly and David Aldous

The issue of attracting the next generation of horticulturists to the profession has been regularly addressed by ISHS on many levels. This includes the pages of *Chronica Horticulturae* (R.J. Bogers, 2007; R.P. Bogers, 2007) and at the ISHS Symposia held by the Commission on Education, Research Training and Consultancy (Rom, 2004; Aldous, 2009), as well as through an online forum: Future of Horticultural Science within Academia (http://www.ishs.org/future/). While these discussions are important, a practical approach is needed to address this issue. We have attempted one approach: the development of an online guide to courses and careers in horticulture (Fig. 1). This directory is the first of its kind produced in Australia as a source of institutions and careers relevant to horticulture as well as mapping out an appropriate training pathway via a University, trades institute, or private provider (Cooper, 2009). We believe the overall rationale and approach is relevant to all countries.

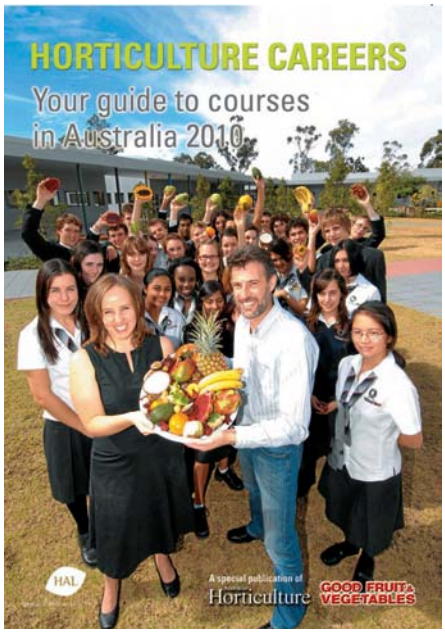


Figure 1. The cover photo of *"Horticultural careers – your guide to courses in Australia 2010"*, features students from the Queensland Academy of Science, Mathematics and Technology (Toowong), with Queensland Primary Industries and Fisheries (QPIF) senior flavour scientist Heather Smyth and former QPIF food scientist Stuart Johnson (http://horticulture.realviewtechnologies.com/?cdn=0&xml=Courses_and_Careers_in_Horticulture).

THE CHALLENGE: CONFUSION REIGNS WHILE OPPORTUNITY KNOCKS

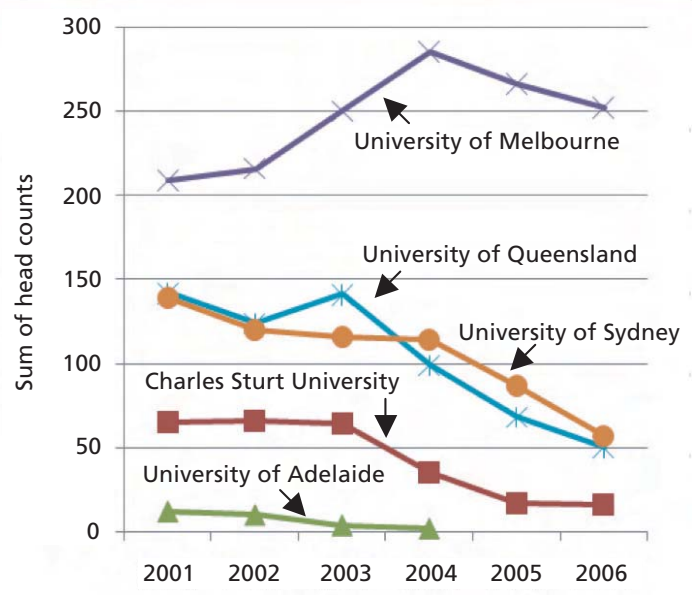
Concerns about declining enrolments in university courses, raised through several ISHS channels, is certainly applicable to Australia. Although these declines have been with us for the last 25 years there have been significant declines of between 10-50% in student numbers (Guisard and Kent, 2009) and graduates since 2004 (Fig. 2). In addition, courses that specify horticulture in their titles or descriptions have declined (Rayner et al., 2009; McSweeney et al., 2009).

Although these authors offer many reasons for these changes, one key factor appears to be overlooked – namely, how well do we communicate with potential undergraduate students (and their advisors) about the courses on offer and the careers that may eventuate? We were shocked to discover how difficult it is for high school graduates with an interest in plants and the aptitude for university study, to work out their options, despite the power of the internet. Horticulture and plant science topics are often tucked away in agricultural science, agricultural ecology, botany, environmental science, food technology, landscape architecture, agricultural engineering, as well as biotechnology and other courses. In particular, many courses entitled "horticulture" are being replaced by ones with an "environmental" focus. The educational paradigm has shifted, yet the need for trained people remains.

EMPLOYMENT AND CAREER OPPORTUNITIES

In recent years the gross value of Australian horticultural production has been estimated to be $AUD8.6 billion, with lifestyle horticulture products and services valued at 1% of the gross domestic product (Haydu et al., 2008) or the equivalent of $AUD5.3 billion. Employment in this industry ranges from 175,000 to 275,000 employees across some 40 individual commodities, such as fruit, vegetables, cut flowers, nuts, turf, nursery and gardens (Agri-Food Skills Australia, 2010). Such a valuable marketing chain requires well trained horticultural gradu-

Figure 2. Total undergraduate student number enrolled in five Australian universities in the Field of Education (FOE) "Horticulture." Data adjusted to reflect the number of students transferred from the University of Sydney to Charles Sturt University in 2005 (after Guisard and Kent, 2009). Note that the University of Adelaide in recent times has phased out their four year model.



ates as well as technically sound operators to sustain their products and services across both the domestic and export economy.

ALTERNATIVES TO UNIVERSITY PROGRAMS

Horticulture is taught across two main educational channels in Australia, comprising either academic studies through university and practical or trades-based studies through an alternative system such as the state-based colleges of Technical and Further Education (TAFE). Students train, often on a day-release or block-release basis, over several years to attain various levels of certification or, ultimately a diploma. Horticulture options are much clearer than with universities, with a basic choice of production horticulture or amenity horticulture.

Beyond the two options of university or TAFE, there exist many opportunities for horticulture-related training with private or other providers. These cover a vast range of topics and formats, ranging from one-day tuition on particular skill areas to extended training courses in management. Some schemes are in place to support the need for lifetime learning and continuous education programs with many trades-based and university programs having a mandatory period of industry placement.

DEALING WITH DIVERSITY

It could be argued that the diversity of the horticultural industry precludes any attempt to take a "whole of industry" approach to tackling the issue of attracting the next generation. However, this very diversity guarantees a lifetime of opportunities and interest for anyone choosing horticulture as a career.

The challenge for the compilers of the guide was to try to encompass this diversity and opportunity in a few pages of editorial that accompanied the course directory. In addition, an important element was to mention many of the varied initiatives across the industry (and extending into agriculture) that already exist to support young people through scholarships, mentoring, travel grants and professional development programs.

METHODOLOGY

Over 2008-09 a survey questionnaire was conducted in association with 20 Universities that offered agricultural/horticultural/environmental science programs in Australia. Initially, the aim was to publish a simple table of the available courses, accompanied by some examples of the areas of study and snapshots about some graduates. However, when a major rural publisher in Australia was approached to publish this feature, a broader approach was suggested. This involved not only collecting data from these universities on the courses available, but looking at a range of case studies of young people enjoying a wide range of occupations, from science through to production, marketing and servicing the community. The guide also included a number of short interviews with senior industry leaders, capturing their enthusiasm for the industry and their desire to encourage young people.

THE RESPONSE – AN ONLINE GUIDE FOR SCHOOL GRADUATES

The publication, *"Horticultural Careers – Your Guide to Courses in Australia 2010"* was published online in December, 2009 (Fig. 1) (Cooper, 2009). The guide was developed with Rural Press Limited, the publishers of the Australian trade magazines *"Australian Horticulture"* and *"Good Fruit and Vegetables"*, and edited by Brad Cooper and consulting editor Gerard McEvilly. It consists of two sections: the course directory and the editorial section providing commentary. Importantly, the guide extends beyond the university sector to cover non-academic courses provided by government and other private training institutes.

This highlights a key issue that is often overlooked by forums debating the dearth of horticulture graduates. Horticulture is an incredibly diverse area and there are an equally diverse number of ways to enter the profession and to continue building skills and knowledge in the scientific, technical, practical and managerial disciplines. While the focus of ISHS is on horticultural science, the industry served by ISHS members requires participants with increasingly sophisticated skills in non-science based disciplines.

The guide provides the name of the institution, entry level and the range of higher education, technical and further education and continuing education programs offered in Australia. The publishers decided that the primary audience for the publication should be high school graduates and their parents and career advisors. Online publication overcomes many of the difficulties of reaching this target audience and also allows for ease of updating. This format also simplifies research by users, providing hot links to all the institutions and to other key reference sources. The link was circulated widely to key stakeholders such as career advisors networks and science teachers associations.

However, a key secondary audience is the industry itself, which needs to be better informed about this issue. Thus, a printed copy of the editorial section was distributed with copies of the two Rural Press Limited publications through funding from Horticulture Australia Limited. Horticulture Australia Limited is also the national research, development, and marketing organisation, which would also publicise the guide through its grower organisation members. It is expected that future editions could be fully commercially funded through advertising from business and educational institutions.

Figure 3. South Australian industry placement students learn about biological control.

PEOPLE: HORTICULTURE'S TOP CROP

The guide describes a range of careers that require good background in horticultural education and training. Careers can range from agribusiness through to gardener/groundkeeper to winemaker/wine producer and vineyard manager. Personnel involved within the food industry are often engaged in the production, processing, distribution and sale of fruit and vegetable crops consumed as food or drink. The lifestyle horticulture group involves those people and organisations who were engaged in the production, sale, and management and marketing of plants used for environmental, recreational and leisure purposes. Another grouping is service and involves those people engaged in supplying non-plant products and services, horticultural education, research and outreach, and the community at large, such as biological control (Fig. 3) and plant breeders rights (Fig. 4).

INDUSTRY AND GOVERNMENT INITIATIVES

It was important to recognise and highlight some of the many large and small-scale programs in place, or under development, to attract and retain young people in horticulture. These range from establishing gardening programs in primary schools through to industry sponsorship of undergraduate and postgraduate studies and continuing education. For example, the Australasian branch of the Produce Marketing Association has recently established a "Foundation for Industry Talent", focussed on assisting commercial businesses to improve staff recruitment and retention. The Australian Nursery and Garden Industry

Figure 4. Students study plant breeders' rights trial clover during their industry placement at the Tasmanian Institute of Agricultural Research, Launceston, Tasmania.

Association launched a careers and training website during 2009. These and other sectoral or regional initiatives are mentioned in the guide. Other recent and related initiatives include the Primary Industry Centre for Science Education (PICSE) (http://www.picse.net), a program that illustrates the connection between the science taught in high schools and the science used locally in primary industries.

There are many other initiatives within Australia designed to attract the next generation of researchers, producers, marketers and others to the horticulture industry. However, this highlights a further challenge to ensure that these initiatives reinforce, rather than confuse, the message. Recently, the Primary Industries Education Foundation (PIEF) was established in Australia to optimise the effectiveness and success of primary industries educational programs (http://www.primaryindustrieseducation.com.au/). One of PIEF's goals is to provide national leadership and coordination of initiatives to encourage primary industries education in schools through a partnership between industry, government and educators.

NEXT STEPS

A second edition of the guide was published in September 2010. A link to this guide is available from the authors. This timing will be better suited to the key decision points for Australian students making subject choices for their closing years at school, or for those considering post-school education. There are many options for improving and/or broadening the guide. Future editions will be informed by an evaluation of the impact of the guide, assessed through feedback from science teachers and careers advisors, through their respective associations.

It is hoped that, with the guide now in circulation, industry stakeholders will take ownership of the initiative and ensure that it continues and improves into the future. It is also hoped that this summary of the genesis and development of the guide will encourage other ISHS members to develop similar local products, and to share similar experiences.

A guide such as this is only one element of a strategy to attract the best talent into horticulture. Perhaps its key role is to be a "one stop shop" that can distil the diversity of horticulture into a few pages and place people on the path to the information they need. In doing so, it can help ensure that our incredibly diverse and complex industry sends a clear message to its future members: if you are interested in plants and their products, we will help you turn that interest into a rewarding career that benefits mankind.

ACKNOWLEDGEMENT

The authors acknowledge the photographs on schools initiatives provided by Assoc. Prof. David Russell, National Director, Primary Industry Centre for Science Education (PICSE), University of Tasmania.

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ABOUT THE AUTHORS

Gerard McEvilly

Gerard McEvilly (corresponding author; Email: gmcevilly@gmail.com), is a freelance consultant, specialising in supply chain and climate change issues and has teaching responsibilities at the University of Sydney. He was formerly a senior manager with Horticulture Australia Limited and is now the Principal of Horticulture Supply Chain Services, 29 Bingara Road, Beecroft, NSW, 2119, Australia.

David Aldous

Dr. David Aldous was Associate Professor in Environmental Horticulture, Melbourne School of Land and Environment, The University of Melbourne-Burnley campus, Richmond, 3121, Victoria, Australia. Currently Adjunct Associate Professor, School of Land, Crop and Food Sciences, The University of Queensland, Lawes, 4345, Queensland, Australia.

Both authors are members of the Organising Committee for the 2014 International Horticulture Congress, to be jointly hosted by Australia and New Zealand in Brisbane.

Native Australian Acacias: Unrealised Ornamental Potential

Kamani Ratnayake and Daryl Joyce

Acacia, commonly known as wattle, is the largest genus of flowering plants in Australia. Over 950 species have been identified on the continent, constituting more than half of the 1352 species found worldwide (Maslin, 2001; Maslin and Orchard, 2004). Wattles have integrated with the Australian "identity", giving rise to symbolic use at national and local community levels. *A. buxifolia*, or its close relative, was incorporated into the Australian Coat of Arms in 1912. It was adopted as a symbol of unification because of widespread occurrence of the *Acacia* genus across the continent (Fig. 1A, B; World Wide Wattle, 2009). *A. pycnantha* (Golden Wattle) had long been popularly regarded as Australia's national flower. It was officially proclaimed her national floral emblem in 1988 (Fig. 1C; Australian Symbols, 2000). Declaration of the national flower was linked to proclaiming September 1st as Wattle Day. The predominant green and gold colours of wattle foliage and flowers, respectively, are the country's official national colours (Australian Symbols, 2000). Furthermore, many of the Australian medals of honour that recognise achievement or meritorious service feature wattles, e.g. The Order of Australia. Some shires around the country, such as Dalwallinu, Hyden and Cootamundra, have adopted local species of wattle as their floral emblem. In these instances the species are *A. anthochaera* (Kimberly's wattle), *A. lanei* and *A. baileyana* (Cootamundra wattle), respectively (World Wide Wattle, 2009).

Acacia belongs to family *Mimosaceae*, which is treated by some botanists as *Mimosoideae*, a subfamily of the *Fabaceae* (Table 1). *Mimosaceae* consists of 60 genera and over 3000 species (Cowan, 2001). Three of the five tribes comprising the *Mimosaceae* occur in Australia; *Mimoseae*, *Acacieae* and *Ingeae*. The only representative of *Acacieae* in Australia is *Acacia*, but with more than 1000 taxa (Maslin, 2001). Acacias have extensive variation in morphological, ecological, geographic, biochemical and genetic attributes, and are distributed in a diverse range of terrestrial habitats. Genus *Acacia* is further classified into subgenera *Acacia*, *Aculeiferum* and *Phyllodineae*. Subgenera *Acacia* and *Aculeiferum* are largely restricted to the northern region of Australia, and are comprised of about 10 species. Within Australia, *Acacia* flora are dominated by species in subgenus *Phyllodineae*, of which over 700 are endemic to the continent (Horlock et al., 2000; Maslin, 2001). Although there has been a proposal to subdivide *Acacia*, the decision was to conserve the name *Acacia* for species of Australian group (subgenus *Phyllodineae*), with retypification of the species (Maslin et al., 2003; Maslin and Orchard, 2009). Nonetheless, further splitting of *Acacia* and name changes are possible in future (Maslin et al., 2003; Maslin and Orchard, 2004).

Table 1. Botanical classification of *Acacia*. Adapted from Maslin, 2001.

Kingdom:	*Plantae*
Division:	*Magnoliophyta*
Class:	*Magnoliopsida*
Order:	*Fabales*
Family:	*Mimosaceae*
Tribe:	*Acacieae*
Genus:	*Acacia*
Subgenera:	*Acacia* *Aculeiferum* *Phyllodineae*
Species:	1352 species

In *Acacia*, individual flowers are arranged in an inflorescence comprising from three florets (e.g. *A. lunata*) to 130 or more (e.g. *A. anceps*). Inflorescences are either globular heads (e.g. *A. cultriformis*) or cylindrical spikes (e.g. *A. blakei*). Flower colour can vary through cream, pale yellow to gold, with occasional purple (e.g. *A. purpureopetala*) and red (e.g. *A. leprosa*) species. The true leaves of *Acacia* are compound (bipinnate) leaves; e.g. *A. baileyana*. However, mature leaves of most acacias are reduced to phyllodes (flattened petioles; e.g. *A. holosericea*), a xeromorphic adaptation to survive in dry environments. In a few species, cladodes (modified stems) function as leaves; e.g. *A. glaucoptera* (Australian Wattles – Genus *Acacia*, 2008).

The biological diversity of Australian *Acacia* flora represents a resource of economic, environmental and social utilisation. Aboriginal communities use certain *Acacia* species as sources of food (e.g. *A. victoriae, A. murrayana*), medicine (e.g. *A. oncinocarpa, A. holosericea*) and tools and weapons (e.g. *A. anuera, A. mimula*). Australian acacias are widely utilised overseas in the form of wood products, such as fuelwood (e.g. *A. ampliceps, A. maconochieana*) and timber products (e.g. *A. mangium, A. melanoxylon*), as a source of tan-

Figure 1. A: The Australian Commonwealth Coat of Arms wherein branches of wattle tied with a ribbon frame the shield as an ornamental accessory. Reproduced with permission of the Department of the Prime Minister and Cabinet. B: *A. buxifolia* subsp. *buxifolia*. Courtesy: Anthony O'Halloran. **C: *A. pycnantha*, Australia's national floral emblem.** Courtesy: Bruce Maslin, World Wide Wattle, 2009. **D: *Acacia* as a filler flower (arrowed) in a floral arrangement.** Courtesy: www.zerli.co.il.

Figure 2. Cut flower *Acacia* species popular in Europe. A: *A. dealbata*. B: *A. retinodes*. C: *A. baileyana*. D: *A. podalyriifolia*. Courtesy: A and D: Australian National Botanic Gardens; B and C: Tony Slater.

nin from their bark (e.g. *A. mearnsii, A. decurrens*) and for edible seeds (e.g. *A. elachantha, A. colei*) and fodder (e.g. *A. saligna*; Searle, 2009). There are also environmental benefits from *Acacia*, such as fixing of atmospheric nitrogen and their being used for soil improvement (e.g. *A. ampliceps, A. salicina*) and land rehabilitation (e.g. *A. saligna*; McDonald et al., 2001; Maslin and McDonald, 2006).

HORTICULTURAL USES OF *ACACIA*

Various *Acacia* species are highly prized in Australia and overseas for their ornamental value as amenity plants (e.g. *A. redolens, A. auriculiformis*). Rapid growth rates, diversity of form and habit and spectacular floral displays, often in winter, contribute to their amenity use. Low-growing species, such as *A. acinacea* and *A. drummondii*, and prostrate forms of usually upright species, such as *A. baileyana*, are widely grown in gardens (Horlock et al., 2000). For cut flower and foliage use, the species most commonly grown in Australia are *A. baileyana* (Cootamundra wattle), *A. baileyana* 'Purpurea' and *A. dealbata*, although many others have potential (Sedgley and Horlock, 1998). Also, oils from flowers and foliage of *A. dealbata* and *A. farnesiana* are used in Europe in the manufacture of high grade perfume (Maslin and McDonald, 2006). Nonetheless, the fact that relatively few species have been utilised to date suggests potential applications for many species remain unexplored.

ACACIA IN THE INTERNATIONAL FLORICULTURE MARKET

Some Australian *Acacia* species are grown as commercial cut flower and perfume crops in France, Italy, Israel and the USA (Fig. 2). European *Acacia* cut flower production is based on selections of the species *A. dealbata* ('Mirandole' and 'Le Gaulois'), *A. retinodes* ('Floribunda'), *A. baileyana, A. podalyriifolia* and their natural hybrids (Sedgley and Parletta, 1993; Horlock et al., 2000). *A. baileyana* 'Purpurea' is grown in Italy for its attractive cut foliage. Despite the European industry's dependence on a limited number of species grown under adverse conditions and often grafted on *A. retinodes* rootstock, *Acacia* has proved popular. Cut *Acacia* flowers are marketed collectively during the European autumn and winter under the name 'Mimosa' (Sedgley and Parletta, 1993). While *Acacia* products are distributed to markets throughout Europe, little in terms of quantity is sent to the USA and Japan. The Japanese market has shown interest in *Acacia*, but is reluctant to source European products that arrive in inferior condition due to the 24 hour transit time (Horlock et al., 2000).

AUSTRALIA'S STRENGTH IN HORTICULTURE

Worldwide exports and imports of floricultural products exceed US$ 9 billion (Bester et al., 2009). In the fashion-driven world floriculture industry, unusual and exotic products readily gain attention (Gollnow et al., 2003). Export potential lies in Australia's unique native flora, which is exotic to the international floriculture market. Up to 95% of Australian flower exports consist of Australian natives plus proteaceous flowers of South African origin. Worldwide production of Australian native species is estimated to be worth about A$ 400 million per year, with Australia's share only around A$ 50 million (Gollnow et al., 2003). In this context, Australia can potentially both proclaim national identity and enhance her cut flower exports through offering a range of *Acacia* species. The number and volume of *Acacia* species grown and marketed on the domestic market are insignificant at present. However, longstanding success as a cut flower in Europe suggests commercial potential for cut flowers and foliage of this genus in Australia. This is particularly so when traditional limitations of the European industry, such as lack of species diversity and sub-optimal growing conditions, are considered. There has been recent expanding interest within Australia in production of *Acacia* cut flower and foliage species (Horlock et al., 2000). *Acacia* species are most likely to be used as fillers in floral arrangements (Fig. 1D). Optimal growing conditions suggest easy cultivation because no large investments are necessary for environmental modifications. The rich genetic resource presents an opportunity to exploit desirable traits to maintain market interest, like novel flower/foliage characteristics. For export, Australian-grown cut flower *Acacia* species would arrive on the Japanese, European and

Figure 3. Some Australian *Acacia* species identified as promising cut flower and foliage crops in addition to those species in Fig. 2. A: *A. buxifolia*. B: *A. cultriformis*. C: *A. pravissima*. D: *A. merinthophora*. E: *A. floribunda*. F: *A. lanigera*. Courtesy: A, B, D: Tony Slater; C, E: Australian National Botanic Gardens; F: Anthony O'Halloran.

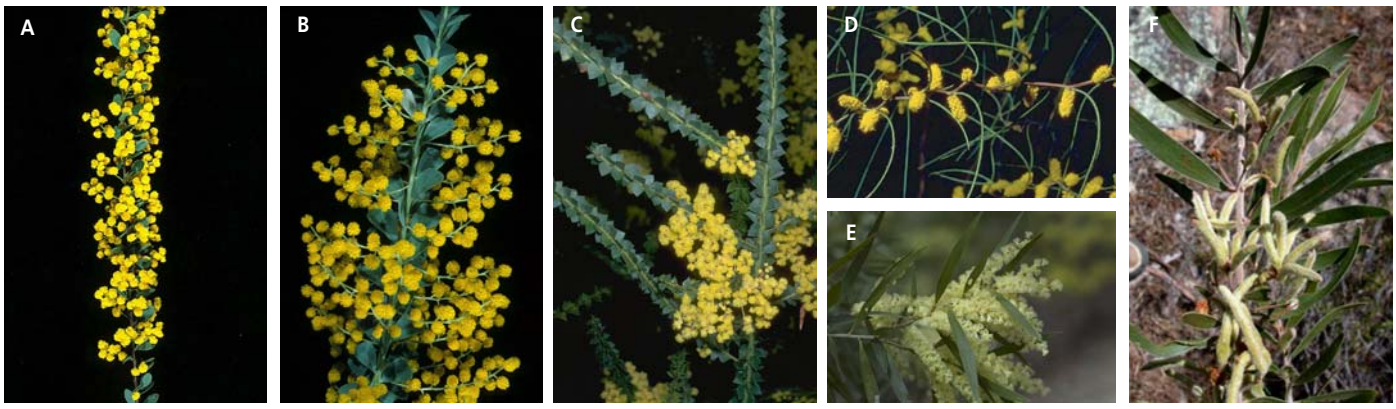


Figure 4. Additional Australian *Acacia* species with possible cut flower and foliage potential. A: *A. myrtifolia*. B: *A. perangusta*. C: *A. rossei*. D: *A. glaucoptera*. E: *A. acinacea*. F: *A. macradenia*. G: *A. decora*. H: *A. spectabilis*. I: *A. vestita*. J: *A. purpureopetala*. K: *A. mountfordiae*. Courtesy: A, B, C, D, E, F, H, I, K: Australian National Botanic Gardens; G: Queensland Herbarium; J: Bruce Maslin.

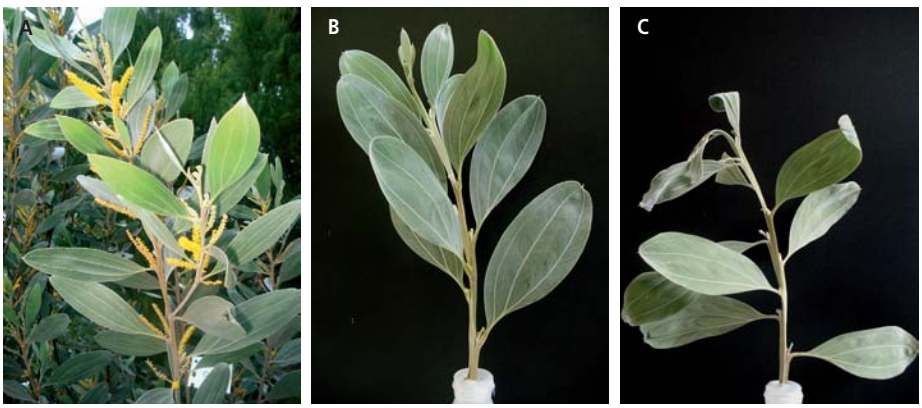
US markets during their spring, summer and autumn seasons. In market research conducted in 1997, Japan was identified as the biggest potential market for Australian grown acacias (Horlock et al., 2000). A short air travel time of around 12 hours represents a potential competitive advantage over European producers for the Japanese market.

Acacias selected for assessment of their cut flower and/or foliage potential include species with ball-shaped flowers without strong scent, long thin strappy leaves, reasonably long vase lives and visual appeal even when the flowers wilt. Such attributes are sought by Japanese importers and florists (Horlock et al., 2000). In this context, *A. baileyana, A. baileyana* 'Purpurea', *A. buxifolia* (box leaf wattle), *A. cultriformis* (knife leaf wattle), *A. pravissima* (Ovens wattle), *A. merinthophora* (zig zag wattle), *A. retinodes* (silver wattle, swamp wattle), *A. lanigera* (woolly wattle), *A. podalyriifolia* (Queensland silver wattle) and *A. floribunda* have been short-listed as promising (Horlock et al., 2000; Figs. 2 and 3). Other species considered worthy of inclusion are *A. decora, A. cometes, A. glaucoptera, A. acinacea, A. notabilis, A. vestita, A. myrtifolia, A. purpureopetala, A. mountfordae, A. macradenia, A. perangusta, A. rossei* and *A. spectabilis* (Sedgley and Parletta, 1993; Williamson, 1996; Fig. 4).

POSTHARVEST CONSTRAINTS

Acacia species that have a postharvest life of ≥ 7 days for local markets and ≥ 10 days for export markets are potentially suitable as cut flowers and foliage (Horlock et al., 2000). However, inherently short vase life is characteristic of many attractive *Acacia* species, including the well-known *A. baileyana*. Flowers and foliage on many species desiccate quickly, rendering cut stems unattractive within 2 to 6 days (Williamson and Milburn, 1995; Jones et al., 1998). Rapid decline in postharvest water uptake is a major cause of short *Acacia* vase life (Rappel, 1985; Williamson and Milburn, 1995; Damunupola, 2009). Underlying mechanisms may involve vascular blockage by cavitation and physiological wound healing processes. Microbial stem-end blockage is also a probable contributory factor. Wound responses and healing perhaps entail gum deposition, tylose formation and/or wound induced suberisation and lignification of cell walls in and around the xylem. *Acacia* species are widely known to produce gummy exudates with carbohydrates as their major constituent (Anderson and Dea, 1969). However, it is yet to be determined whether physiological processes or microbial proliferation at the stem end and in the vase solution is the primary determinant of poor postharvest water relations in cut *Acacia* stems. Since early studies by Rappel (1985) and Williamson (1996), research focused on understanding physico-chemical phenomena occurring in cut *Acacia* stems in terms of implications for postharvest longevity has maintained slow momentum. Postharvest treatments with pulse and vase solution additives have been assessed for selected *Acacia* species and realised varying degrees of success. For instance, cut *A. amoena* stems stood in 10 mM citric acid showed a 1.6-fold increase in vase life over stems in distilled water (Williamson and Milburn, 1995). Pre-transport pulsing with 0.01% Agral + 200 mg.L^{-1} aluminium sulphate for 16 h at 10°C was effective in extending the postharvest life of cut *A. retinodes* stems (Jones et al., 1998). These authors suggested that postharvest treatments for cut *Acacia* stems should be applied in the first 2 to 3 days after harvest for maximum efficacy. Williamson et al. (2002) screened a range of chemical compounds [viz. ascorbic acid, citric acid, abscisic acid (ABA), cycloheximide (CHI) and salicylhydroxamic acid (SHAM)] as vase solu-

Figure 5. *Acacia holosericea* (velvet leaf wattle). A: branches in flower. B: healthy cut foliage stem. C: wilted cut foliage stem.



tion additives for *A. baileyana*. Citric acid at 5 mM gave the maximum vase life, equating to a 1.7-fold increase over control stems in deionised water. Damunupola et al. (2009) evaluated S-carvone, a monoterpene from caraway and dill seeds known to inhibit suberin formation, as a vase solution additive. However, this wound response inhibitor did not extend the longevity of *A. holosericea* cut foliage at either 0.318 or 0.636 mM. Despite the promise of effective postharvest treatments (e.g. citric acid), the exact mechanisms of inherently short vase life in *Acacia* remain elusive. *A. holosericea* (Fig. 5) has recently been adopted by the Centre for Native Floriculture (Joyce and Turner, 2007) as a 'model' species with which to investigate postharvest biology and technology in detail (Damunupola, 2009; Damunupola et al., 2009). Stem hydraulic conductance is being characterised, including anatomical features of xylem conduits, by light and scanning and transmission electron microscopy (Damunupola, 2009). Further microscopical and histochemical studies are underway to localise and identify the nature of vascular occlusion in this species. Concurrently, efficacies of alternative postharvest treatments are being assessed. For instance, provision of certain inorganic cations as either a postharvest pulse treatment or vase solution additive improved the vase life of cut *A. holosericea* foliage by around 2.7-fold over deionised water controls. Vase life extension was accompanied by higher water uptake rates for the cut stems. Work is underway to optimise treatments and discern mechanisms of action of effective Cu^{2+} and Ag^{+} cations.

CONCLUSION

Australian native *Acacia* cut flowers and foliage remain a relatively underexploited resource for both export and domestic market opportunities. Very limited information on agronomic and postharvest practices has been published for *Acacia* to date. Being the major drawback, short postharvest life, in particular, needs to be overcome. Postharvest research focused on water balance and its regulation promises to elucidate mechanisms underlying short *Acacia* vase life. Based on R & D initiatives, marketing opportunities are likely to increase in the future as growers apply findings to genotype selection and pre- and postharvest management practices.

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About the Authors

Kamani Ratnayake

Daryl Joyce

Kamani Ratnayake is currently a PhD candidate at The University of Queensland (UQ), Australia. She is a lecturer attached to the Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka. Kamani attained an Australian Government sponsored Endeavour Postgraduate Award and joined UQ's Centre for Native Floriculture research group in 2008. Her current research is focused on understanding mechanisms towards improving the postharvest water relations of Australian native *Acacia* species. Email: k.ratnayake@uq.edu.au.

Daryl Joyce (corresponding author) is Professor and Director of the Centre for Native Floriculture at the School of Land, Crop and Food Sciences, The University of Queensland, Gatton QLD 4343, Australia. He works on maintaining and extending the postharvest longevity of horticultural crops. Much of Daryl's work is with ornamentals, particularly native Australian species. He is interested in developing technical solutions to applied problems based on understanding biological mechanisms. Phone: +61 (0)7 5460 1725, Fax: +61 (0)7 5460 1112, Email: d.joyce@uq.edu.au.

Celebrating 100 Years of Beltsville Agricultural Research

Stephanie Yao, Robert J. Griesbach and Richard H. Zimmerman

For the past century, the historic research facility now known as the Henry A. Wallace Agricultural Research Center (BARC) at Beltsville, Maryland, has played an important role in advancing agricultural science and improving people's lives worldwide. This center, which had its beginnings on acreage of the former Walnut Grange plantation in Beltsville, is operated by the Agricultural Research Service (ARS), the principal intramural scientific research agency of the U.S. Department of Agriculture (USDA). The arrival of BARC's centennial anniversary marks a significant moment in its history, serving as an opportunity to commemorate past research accomplishments that have contributed to BARC's reputation and success as a world leader in agricultural research.

HISTORY

The value of United States exports exceeded imports for the first time in late 1850s. Approximately 75% of these exports were agricultural products. Agricultural production was closely tied to the economic health of the nation. During our Civil War (1861-1865), major agricultural shortages threatened our economic health. Two major factors were the cause of the shortages. First, the war caused a significant reduction in farm labor, for over half of the farmers and farm laborers became soldiers. Second, the nation depended upon the export of crops that were exclusively grown in the South, such as sugar and cotton. Production of these crops virtually stopped during the war.

Because of these facts, Abraham Lincoln called for the establishment in 1862 of a Department of Agriculture to help restore agricultural production. Initial studies by the USDA focused on the immediate need to develop alternative crops (i.e., sorghum as a substitute for sugar cane; flax as a substitute for cotton; etc.) and provide information to farmers for increasing productivity (i.e., improved methods of cultivation; better varieties; etc.).

In 1867, William Saunders, the USDA's first botanist and landscape architect, established the broad goals for horticultural research. These goals were to: 1) procure seeds, cuttings, bulbs and plants from foreign and domestic sources and test their merits in various local conditions; 2) hybridize or culture plants of superior traits; 3) test products in varied cultures and the effects of pruning and other manipulations on trees and fruits; 4) investigate disease and insect pests; 5) thoroughly test all seed samples and other plant propagation materials; 6) cultivate hedge plants and show their usefulness; 7) collect and cultivate the best fruit trees and plants; 8) plant a collection of choice shrubs, gardens, and landscape scenery; and 9) erect greenhouses for display of exotic plants and teach the best and most economical constructing, heating and managing of such buildings.

Henry A. Wallace Beltsville Agricultural Research Center, ca. 1950.

After the Civil War, the activities of the USDA were expanded. Thirty-five acres of land lying between 12th and 14th streets and Constitution and Independence Avenues in the District of Columbia were assigned to the Department. At the south end of this land, the Agricultural building was constructed. A large conservatory for maintaining tropical economic plants was erected next to the building in 1871. Because of an increased need for research fields, Arlington Farm Experiment Station was established at the turn of the century across the Potomac River in Virginia. Research greenhouses were constructed in 1902 at the District of Columbia site and in 1910 at the Virginia site.

Meanwhile, the USDA also purchased land at the Walnut Grange plantation in Beltsville, Maryland. Dairy and animal husbandry research were relocated to this site in 1910, marking the beginning of BARC. Three years later, the Dairy Barn became the first building to be constructed in BARC and is the site of the first research activity. For the next 20 years, the USDA continued to gradually acquire surrounding land, constructing permanent buildings and small animal and poultry houses.

Prior to 1935, most research programs at the USDA were extension oriented. One of the results of the 1935 Bankhead-Jones Congressional Act was to provide approximately $10 million toward "research into the laws and principles underlying basic problems of Agriculture in its broadest aspects" (Ling, 1935). Based upon this funding, Secretary of Agriculture Henry A. Wallace moved research projects from experiment stations in surrounding areas to Beltsville, effectively creating the National Agricultural Research Center. The National Agricultural Research Center is now known as the Henry A. Wallace Beltsville Agricultural Research Center (BARC).

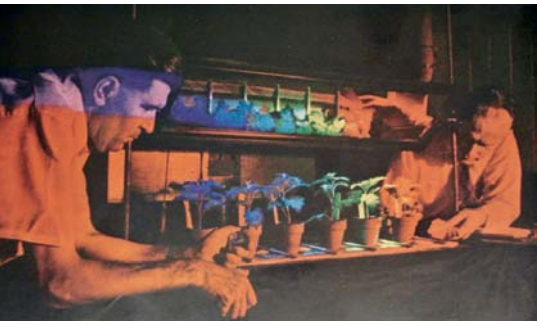
Although plant research in Beltsville did not begin until the mid 1930s, USDA plant science research dates back to the 19th century. Starting first on the National Mall, then moving to the Arlington Farm Experiment Station and finally settling in the western part of the BARC campus, USDA scientists have made significant contributions to advance horticultural research. In fact, nearly all USDA research conducted today throughout the United States originated at BARC. Here, in this article, we highlight just a few accomplishments of BARC scientists.

PHOTOPERIODISM AND PHYTOCHROME

Photoperiodic research was one of the first projects at BARC to benefit by the Bankhead-Jones Act. Previous research at Arlington Farm in 1918 by physiologist Wightman W. Garner and botanist Harry A. Allard discovered that changes in the daylength controlled flowering in tobacco and soybeans. They coined the term "photoperiodism" and classified the flowering response of many horticultural crops as requiring either short days or long days for flowering (Garner and Allard, 1920).

Wightman W. Garner (left) and Harry A. Allard (right) view trees grown under different photoperiods in the 1920s.

Harry A. Borthwick (left) and Sterling B. Hendricks (right) examine chrysanthemums growing under different wavelengths of light , ca.1950.



This research provided the basis for Furman L. Mulford to cooperate with Allard on developing the first garden chrysanthemums that were both winter-hardy and early flowering. All of the early flowering selections made by Mulford were further evaluated for winter hardiness at locations in Cheyenne, Wyoming; Woodward, Oklahoma; and Ithaca, New York. Before Mulford's research, nearly all commercial chrysanthemums were short-day plants that flowered in winter and were not winter-hardy (Mulford, 1939).

In 1936, botanist Harry A. Borthwick and physiologist Marion W. Parker were hired to continue the work of Garner and Allard. They constructed special dark chambers with modified benches that rolled on railroad tracks. These benches could easily and quickly move large numbers of plants into and out of the dark. Using these chambers, they discovered that a short flash of low-intensity light during the night prevented flowering of short-day plants (Parker and Borthwick, 1940).

This discovery provided horticulturist Neil W. Stuart of the Ornamentals Laboratory with the basic information needed to develop a practical method for regulating the flowering of *Chrysanthemum* (Stuart, 1943). Based upon these results, Kenneth Post at Cornell University and Vernon Gifford at Ohio State University also developed year-around production protocols for the crop.

After World War II, chemist Sterling B. Hendricks joined the team. Hendricks' expertise in spectrophotometry was used to design a special spectrograph to test the effects of different wavelengths of light on the photoperiodic response. This instrument allowed the team to determine that flowering was controlled by red light. In 1951, Eben H. Toole and Vivian K. Toole of the Seed Laboratory provided expertise on the photoperiodic response of seeds during germination. Together they determined that far-red light could reverse the effects of red light (Borthwick et al., 1954).

In 1957, physiologist Robert J. Downs, horticulturist Albert A. Piringer, biophysicist Warren L. Butler, biochemist Harold W. Siegelman and agricultural engineer Karl H. Norris joined the team. The team reasoned that the photoperiodic response needed to be mediated by a pigment that had to exist in two interconvertible forms, one absorbing red light (P_r) and the other absorbing far red light (P_{fr}). In 1959, the team finally detected the photoperiodic pigment, calling it *"phytochrome"* (Butler et al., 1959).

This brief history of the discovery of photoperiodism and phytochrome shows the type of groundbreaking research performed at BARC. Most projects involve an interdisciplinary approach with a team of scientists working together for a long period of time to solve a major problem. Hans Mohr of the University of Freiburg, a postdoctoral fellow with the team, stated that "The mode of cooperation among

Frederick V. Coville examines blueberry seedlings in breeding plots, ca. 1930.

the Beltsville group opened my eyes to the benefits of teamwork."

BLUEBERRY

In 1906, Frederick V. Coville began a breeding program to domesticate highbush blueberries. He began selecting blueberries from the wild in 1908, with his first selection being 'Brooks' from New Hampshire. A year later, Coville added a lowbush blueberry from New Hampshire named 'Russell' to his collection.

According to field diaries, Coville first attempted to self-pollinate 'Brooks' in 1909 and 1910, but the flowers set poorly and no seedlings resulted. Two years later, cross pollinations of 'Brooks' and 'Russell' were successful in producing offspring, establishing interspecific hybridization as the foundation of the blueberry breeding program (Eck and Childers, 1966).

After reading about Coville's breeding efforts, Elizabeth White invited Coville to Whitesbog, New Jersey, to continue his research on land that she provided. This fortuitous partnership produced thousands of seedlings from native New Jersey wild blueberry selections, greatly expanding the material in the blueberry collection. Cultivars selected by Coville and collected by White include 'Rubel,' a variety still grown for freezing.

Besides breeding, Coville established the cultural requirements (i.e., acid soil, winter chilling, etc.) and propagation methods for the crop. His initial breeding program focused on improving fruit flavor, fruit size and foliage retention. Coville's first cultivar was named 'Pioneer' because it was the first blueberry cultivar developed as a result of artificial hybridization. He also released 'Cabot' and 'Katherine' in 1920. Together, these three cultivars served as the

basis for establishing the modern United States blueberry industry.

After Coville's death in 1937, George M. Darrow assumed leadership of USDA blueberry breeding. Darrow expanded the breeding program by developing cooperative efforts for breeding and evaluation with many state experiment stations (i.e., Massachusetts, Maine, West Virginia, North Carolina, New Jersey, Michigan, New Hampshire, Florida, and Minnesota). These cooperative agreements have helped in the development of cultivars adapted to differing environmental conditions. The most notable cultivar Darrow helped develop is 'Bluecrop,' which was released in 1952 and is still the leading blueberry cultivar in the world.

Donald H. Scott took over the program after Darrow's retirement in 1957. Scott continued the cooperative research with the state experiment stations. As leader of the Small Fruits Investigations group, Scott focused on seed germination and further improving the breeding program. In 1965, he also hired Arlen D. Draper, who would later take over breeding efforts.

Draper is perhaps best known for his use of wild germplasm. Working with Scott and Gene J. Galletta, Draper employed various strategies to incorporate desirable traits found in wild blueberries into the cultivated blueberry, such as low chilling requirement (for Southern growers) and improved fruit quality. A number of cultivars being grown today were developed and/or selected by Draper. Notable cultivars include 'Duke,' one of the first large-fruited early season cultivars widely planted throughout the United States; 'Legacy,' a popular, high-yielding cultivar; and 'Elliott,' a late-ripening cultivar that produces large fruit.

Through the years, several BARC scientists have played a role in the program. Mark Ehlenfeldt and Jeannine Rowland currently oversee breeding efforts at BARC for the Northeast region. The Agricultural Research Service (ARS) also conducts blueberry research at laboratories in Poplarville, Mississippi, for Southeast production and Corvallis, Oregon, for the Pacific Northwest region. All locations use molecular technology to identify useful traits like disease resistance found in wild germplasm to develop new cultivars that meet growers' and consumers' needs.

Today, all of the highbush blueberry cultivars grown in the United States and some cultivars grown elsewhere in the world have BARC cultivars in their pedigree. Several BARC cultivars are, or have been, grown as the industry standard.

TOMATO

Whether for processing or fresh market, tomato growers face numerous problems caused by disease, pests and varying weather conditions. When Frederick J. Pritchard began breeding tomatoes at Arlington Farm in 1915, his focus was to develop disease-resistant cultivars. The first cultivars he released in 1918 – 'Norton,' 'Columbia' and 'Marvel' – were not resistant but tolerant to fusarium wilt, a disease that enters the plant through the roots and clogs up the water-conducting vessels of the roots and stems.

Seven years later, in 1925, the breeding program introduced 'Marglobe' to Florida. This important cultivar possesses practically complete field resistance to "nail head rust" and is credited with saving the tomato industry in south Florida. It soon became the most widely used tomato in the United States and is still used as an heirloom home garden tomato.

William Porte and the 'Pan American' tomato, ca. 1950.

In 1923, William Porte and Sears P. Doolittle took over leadership of the breeding program. They made extensive crosses between the cultivated tomato and related wild species in an effort to improve disease resistance. In 1941, growers were able to reap the benefits of Porte and Doolittle's hard work when the scientists released 'Pan American,' the first cultivar resistant to fusarium wilt. Throughout the 1950s, the scientists released three more fusarium wilt-resistant cultivars: a yellow-fruited garden cultivar named 'Sunray;' a pink-fruited fresh market cultivar named 'Pinkshipper;' and a pear-shaped processing cultivar named 'Roma' that is still popular today. In fact, most of the fusarium-resistant cultivars currently grown can attribute their resistance to early research conducted at BARC.

Resistance to verticillium wilt was combined with fusarium resistance in the 1960s with the release of 'Porte' and 'Enterpriser.' These new cultivars were released by Raymon Webb, who was also instrumental in developing machine-harvestable tomatoes. These types of tomatoes must be high yielding, firm, crack resistant and store well. In 1968, 'Harvester' and 'Parker' became the first tomatoes that could be harvested by a machine and contained resistance to fusarium and verticillium wilts. 'Mars,' also released in 1968, possessed the attributes of 'Harvester' and 'Parker' plus resistance to gray leaf spot.

In 1971, Allan Stoner and Thomas Barksdale took over the program. Although previous releases made important headway in helping protect the tomato industry, much research remained to be done to combine resistance to multiple diseases into one single breeding line or variety. In the 1970s, the scientists released five important cultivars with various combinations of resistance to fusarium and verticillium wilts, gray leaf spot, early blight, tobacco mosaic virus, the carmine spider mite and the potato aphid. These cultivars – 'Merit,' 'Potomac,' 'Red Rock,' 'Chef' and 'Arc' – are credited with saving the tomato processing industry in the eastern United States (Stoner, 1977).

Several BARC cultivars are, or have been, grown as the industry standard. However, much research remains to be conducted. Perhaps most important is the ability to produce high-yielding, high-quality fruit under a wide range of environmental conditions. John Stommel is focusing on developing tomato germplasm with enhanced fresh- and processing-market quality. He aims to identify genes that contribute to fruit quality, particularly those that control fruit firmness attributes and carotenoid content.

NEW GUINEA IMPATIENS

Impatiens are popular plants. They bloom continuously during the warm weather, contrasting colorful flowers against dense foliage that remains compact throughout the summer. Unlike other flower species, impatiens thrive in the shade. They keep themselves well groomed by sloughing off dead flowers, leaves and branches, and they tolerate air pollution well.

H. Marc Cathey (left) and Toru Arisumi (right) with New Guinea impatiens germplasm, ca 1970.

During the 1970s, the most common market varieties were hybrids of the African species (*Impatiens sultani*) or the Indian species (*I. balsamina*). As popularity of the plant grew among American gardeners, breeders and the horticultural industry saw an opportunity and a desire to increase the variety of impatiens on the market.

Therefore, in 1970, USDA plant collectors Harold F. Winters and Joseph J. Higgins traveled to New Guinea on an expedition to collect more species of *Impatiens.* The two men sent back 25 species from the highlands of Australian New Guinea and one species from the Indonesian island of Java. Two species from Celebes, Indonesia arrived later.

After nearly 2 years in quarantine, BARC's Plant Introduction Station in Glenn Dale, Maryland, sent cuttings from these plants to research institutions, commercial growers, amateur breeders and Longwood Gardens in Kennett Square, Pennsylvania, which co-sponsored the expedition. A team was established with Toru Arisumi at BARC, Robert Armstrong at Longwood Gardens and Joseph Weigle at Iowa State University to develop commercially acceptable cultivars from the wild germplasm.

Arisumi was responsible for the basic research. While the New Guinea-Indonesian collection provided a wealth of new and unusual plant material for breeders, the mature plants had a tendency to become tall and spindly and lost lower foliage as they aged. Furthermore, these plants were poor seed producers, making them difficult to propagate.

Arisumi overcame some of these drawbacks by hybridizing. In the mid-1970s, he introduced several new cultivars with names like 'Aloha,' 'Pee Gee,' 'Cascade,' and 'Sweet Sue.' Although they were continuous bloomers and more compact than their forebears, most had to be propagated by cuttings.

The crossing studies produced a picture of impatiens' probable evolutionary history. The studies also exposed problems that had to be solved before the New Guinea species could be crossed with their distant relatives from Africa and India. Arisumi determined the genetic relationships among the New Guinea species and other *Impatiens* species and developed embryo rescue procedures for creating interspecific hybrids and their subsequent colchicine treatment to increase their fertility (Arisumi, 1985).

In this way, 'Sweet Sue' was born. Released to florists and nurseries in 1976, this ever-blooming beauty contrasted large, bright-orange flowers against variegated leaves of green with yellow centers. A cross between a New Guinea hybrid and a Celebes species, 'Sweet Sue' set seed well and was the first introduction from the New Guinea-Indonesian collection to breed true from seed.

Recently, a novel cultivar of New Guinea impatiens with striped flowers, known as "flower break," was developed by BARC scientists Ramon Jordan and Mary Ann Guaragna. They also discovered that this new cultivar was infected with a new virus, which they named Impatiens flower break virus (IFBV). When healthy impatiens of several different cultivars, including 'Sweet Sue,' were manually inoculated with the virus, the plants became infected and a novel "flower break" symptom appeared. These scientists have developed a screening assay for detection that is currently being commercialized.

OTHER SIGNIFICANT ACCOMPLISHMENTS

BARC has many more accomplishments in the horticultural field. Some of the more significant ones include:

Strawberry Improvement

In 1910, Walter van Fleet began breeding strawberries at Glenn Dale. His research formed the basis for an expanded strawberry improvement program started in 1920 by George M. Darrow. The objects of the project were to improve fruit characters for specific uses and to produce plants adapted to different climates. Through the years, several BARC scientists have played a role in the program (i.e., Donald Scott, John Maas, Gene Galletta, Stan Hokanson, and Kimberly Lewers). The uniqueness of the program was that it was national in scope and involved cooperative breeding and trialing efforts with several different USDA and state experiment stations (i.e., USDA-Wyoming, USDA-Oregon, USDA-Mississippi, North Carolina, Illinois, Oregon, and Washington). Disease resistance, especially for red stele root rot, became the initial breeding emphasis. The team released the first "multiple-race," red stele root rot-resistant cultivars. All the red stele-resistant cultivars grown today have BARC cultivars in their pedigree. Several BARC cultivars ('Surecrop' released in 1956, 'Earliglow' released in 1975, and 'Allstar' released in 1981) are, or have had, significant impact on the industry in the Eastern U.S. (Galletta et al., 1997).

George M. Darrow examining strawberry roots for red stele resistance, ca. 1950.

Potato Improvement

In 1910, C.F. Clark began breeding disease resistant potatoes. Because of the economic impact of viral diseases, the initial breeding focused on the development of virus resistant germplasm. The first virus tolerant cultivars ('Chippewa,' 'Houma,' and 'Katahdin') were released in the late 1930s. This germplasm was distributed to state cooperators. In the 1930s, F.J. Stevenson assumed leadership of the program and, since then, several BARC scientists have played a major role in the program (i.e., Raymon Webb, Steven Sinden, Robert Goth and Kathleen Haynes). The potato improvement program was national in scope and involved cooperative breeding and trialing efforts with several different state experiment stations (i.e., Minnesota, North Dakota, Michigan, New York, North Carolina, New Jersey, Virginia, Florida, Ohio, Pennsylvania, Maine, Colorado, and Louisiana). Over half of the potatoes grown in the US today are cultivars released from this cooperative research program. Two BARC cultivars ('Kennebec' released in 1948 and 'Atlantic' released in 1976) are, or have been, grown as the industry standard for potato chip quality.

F.J. Stevenson holds fruits of potato germplasm, ca. 1950.

Genetic Concepts

In 1921, Sewall Wright working in the Bureau of Animal Industry at BARC published a series of papers which introduced for the first time path coefficient analysis. In these papers, he also introduced the concept of random genetic drift. These genetic concepts became the foundation for modern plant and animal breeding (Russell, 1989).

Storage Life of Flowers

In 1940, David V. Lumsden, R.C. Wright, T.M. Whiteman and J.W. Byrnes reported that ethylene decreased the storage life of cut-flowers.

They further found that the reduction in life did not depend upon temperature and that the common practice of storing cut-flowers with fruit at low temperatures could lead to reduction in flower longevity.

Pointsettias

During the 1950s and 1960s, geneticist Robert N. Stewart developed diploid poinsettia lines from commercial polyploids. These diploids were then used to develop germplasm with significantly improved keeping quality. At this time, horticulturist H. Marc Cathey began studies on the use of photoperiodic lighting and growth regulators in improving the commercial production of the crop (Kaplan, 1992).

Biochemistry of Flower Color

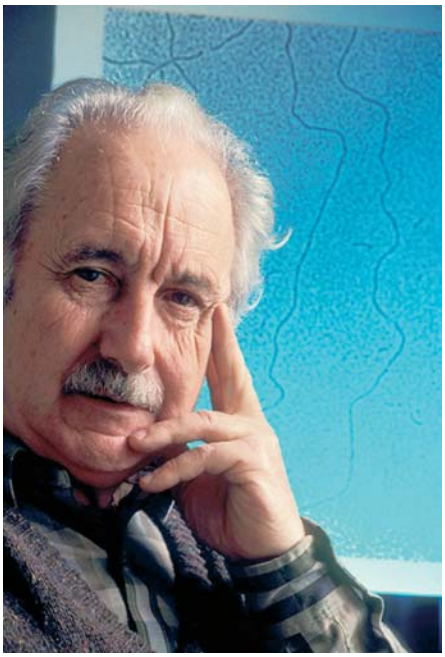
From the mid-1950s to the late 1970s, a broad interdisciplinary team composed of physiologist Sam Asen, biochemist Harold W. Siegelman, horticulturist Neil W. Stuart, geneticist Robert N. Stewart and agricultural engineer Karl H. Norris designed instruments to measure in situ flavonoid content of flowers and compare these measurements with in vitro data. The results showed that flower color was the result of a complex, pH dependent, physical interaction between anthocyanin and co-pigment molecules. This research provided a foundation upon which all current flower color studies are based (Asen, 1976).

Discovery of Brassinosteroids

In 1970, J.W. Mitchell, N.B. Mandava, J.F. Worley, J.R. Plimmer and M.V. Smith reported in *Nature* that the pollen from the rape plant contained a new plant growth stimulating substance. Subsequently, the research team, which involved collaboration between ARS scientists in several locations, demonstrated that this new substance could enhance crop yield, crop efficiency and seed vigor. These data provided the impetus to assemble a very large team of pathologists, physiologists, biochemists, chemists, and chemical engineers to isolate and identify the growth substance. The team started with 300 pounds of bee-collected rape pollen and identified the growth substance as a steroidal lactone. This chemical was unique and resulted in the discovery of a new class of phytohormones called the brassinosteriods (Grove et al., 1979).

Discovery of Viroids

During the late 1950s and early 1960s, W. Raymer and M. O'Brien of the Potato Diseases Laboratory studied an unusual disease called potato spindle tuber. They concluded that the disease causing agent was a very unusual virus. In the mid-1960s, Theodore Diener of the Plant Virology Laboratory joined the team as an expert on viruses. Diener determined that the disease agent was much smaller than any known virus; was not large enough to self-replicate; and did not contain a coat protein. In 1971, Diener reported on the discovery that the potato spindle tuber disease was caused by a new class of virus-like pathogens called "viroids." Diener then cooperated with R. Lawson of the Floral and Nursery Crops Laboratory to discover that chrysanthemum stunt disease was also caused by a viroid. While potato spindle tuber was not an economically important disease, chrysanthemum stunt was an economically devastating one. The discovery of the cause of chrysanthemum stunt led to the development of a fast and reliable test for the disease. Because of this test, chrysanthemum stunt is now only rarely encountered (Diener, 1971).



Theodore Diener in front of an electron micrograph of potato spindle tuber viroid, ca 1980.

CURRENT AND FUTURE RESEARCH

Today, ARS, of which BARC is a key part, conducts research to develop and transfer solutions to agricultural problems of high national priority and provides information access and dissemination to: (a) ensure high-quality, safe food, and other agricultural products; (b) assess the nutritional needs of Americans; (c) sustain a competitive agricultural economy; (d) enhance U.S. natural resources and the environment; and (e) provide economic opportunities for rural citizens, communities, and society as a whole. The research priorities include: (a) climate change; (b) food safety; (c) children's nutrition and health; (d) international food security; and (e) bioenergy research.

ARS employs approximately 2,100 permanent full-time scientists and approximately 3,300 technical and support staffs who conduct research at more than 100 locations. Research projects are grouped into 22 National Programs under the four broad pillars of Animal Production and Protection; Nutrition, Food Safety and Quality; Natural Resources and Sustainable Agricultural Systems; and Crop Production and Protection (http://www.ars.usda.gov/research/programs.htm). Research at BARC involves 21 of the 22 National Programs.

The Office of National Programs in Beltsville, MD coordinates the scope and objectives of Agency research projects, while eight Area Directors implement research projects at the locations in their geographic areas. All research projects undergo a mandatory 5-year peer review and assessment cycle to ensure accountability in meeting the changing needs of customers and stakeholders; the Office of Scientific Quality Review convenes panels of industry and university scientists to review research progress, evaluate the 5-year research proposals, and evaluate the scientific qualifications and abilities of agency researchers. The process is structured to ensure quality, impact, and research relevance.

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More information about the Beltsville Agricultural Research Center can be found at www.ba.ars.usda.gov.

About the Authors

Stephanie Yao

Robert J. Griesbach

Richard H. Zimmerman

Stephanie Yao is Public Affairs Specialist, Information Staff, USDA Agricultural Research Service, 5601 Sunnyside Ave., Beltsville, MD 20705, USA. Email: Stephanie.yao@ars.usda.gov
Robert J. Griesbach is Deputy Assistant Administrator for Technology Transfer, USDA Agricultural Research Service, 5601 Sunnyside Ave., Beltsville, MD 20705, USA. Email: Robert.Griesbach@ars.usda.gov
Richard H. Zimmerman retired from USDA Agricultural Research Service at the end of 1999 after 35 years as a research scientist at the Beltsville Agricultural Research Center. Email: rhz1415@verizon.net

Organic Agriculture: Business is Booming in Nigeria

Isaac Aiyelaagbe, Phil Harris, Jonathan Atungwu and Victor Olowe

The Department for Innovations, Universities and Skills (DIUS), UK is funding a collaborative project between the University of Agriculture, Abeokuta, Nigeria and Coventry University, UK through its Educational Partnerships in Africa (EPA).

The project aims to build capacity of young Nigerian graduates in organic agriculture and equip them with entrepren0eurial skills, which enable them to start their organic businesses, thus becoming job creators rather than job seekers.

Although Nigeria has abundant potential to exploit the lucrative international trade in organic produce, it has been unable to access it due to low awareness on the merits of organic produce, shortage of local skilled personnel in organic farming and the absence of an organised market for organic produce.

The project named the 'Work, Earn and Learn Programme' (WELP) targeted young Nigerian graduates building on their knowledge in agriculture, their energy and resourcefulness as well as their desire to take a hold of their future.

A third of the applicants for the WELP were selected ensuring balance for gender and

WELP graduates selling some of their organic produce.

Organic plantain produced by one of the WELP graduates.

national spread. The trainees undertook a 4-week intensive residential training course in the theory of organic agriculture followed by a 3-week attachment on private farms to acquire work experience in true life situations. Their farm attachment helped to hone their skills in farm management and customer relations. Thereafter, five outstanding WELP graduates were sponsored on 2-week overseas trips to experience the market end of organic agriculture with regards to production and produce handling.

Next came the big challenge: putting knowledge to work by starting their own businesses backed by free advisory services by the WELP and partner farmers (who hosted the WELP graduates during their farm attachements). Eight WELP graduates have taken up the challenge. One is growing organic plantains and fluted pumpkin, one produces local leafy vegetables, three are growing exotic vegetables for groceries, one has set up her snailery and two are growing organic maize for pop corn and livestock feed. WELP graduates have become employers of labour, take management decisions, and have increased local awareness on the merits of organic farming. They take pride in spending their own hard earned money. Although it has been a lot of hard work, business in organic farming is booming!

Encouraged by the success of their colleagues, two more WELP graduates will be setting up their own businesses: One in organic yoghurt production, and another in organic honey marketing.

The benefits have not been one-sided: The WELP lecturers have learnt a lot helping to put knowledge to work in organic agriculture; they are upgrading their lecture notes in readiness for the next batch of trainees. The partner farmers who hosted the WELP trainees are excited about what they learnt from the students during their stay and have extended an open invitation to the next batch of WELP trainees. So the WELP programme is making a positive difference in food security and improved livelihoods in Nigeria. WELP has demonstrated that given the right environment, young graduates can be gainfully self employed.

A WELP graduate marketing her organic vegetables.

The WELP project was sponsored by the Department of Business, Innovations and Skills, UK.

About the Authors

Isaac Aiyelaagbe

Phil Harris

Jonathan Atungwu

Victor Olowe

Isaac Aiyelaagbe is Professor of Horticulture at the University of Agriculture, Abeokuta, Nigeria. He specialises in fruit science and organic agriculture and coordinates the West African Network on Organic Agriculture, Research and Training (WANOART). Email: Ola_olu57@yahoo.com

Phil Harris is Professor of Plant Science in the Department of Geography, Environment and Disaster Management of Coventry University, UK and Head of International Development for the Faculty of Business, Environment and Society. He specialises on tropical crop development, sustainable agriculture and agroforestry. Email: byx038@coventry.ac.uk

Jonathan Atungwu is Senior Lecturer and Nematologist in the Department of Crop Protection, University of Agriculture, Abeokuta, Nigeria and National Coordinating Scientist, Organic Agriculture Project in Tertiary Institutions in Nigeria (OAPTIN). He specialises in organic control of pests and diseases. Email: jojerat1@yahoo.com

Victor Olowe is Professor and Head of Crop Research Programme, Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), University of Agriculture, Abeokuta, Nigeria. He specialises in agronomy of tropical grain legumes and development of organic standards in crop production. Email: owebaba@yahoo.com

Horticulture of the Taj Mahal: Gardens of the Imagination

Jules Janick, Rina Kamenetsky and Sumangala H. Puttaswamy

The 17th century mausoleum in Agra, India, known as the Taj Mahal, has been long considered one of the most, if not the most, beautiful building, in the world. The structure is part of a large complex of buildings and gardens encompassing 1.7 hectares. Although usually considered in terms of its architecture, the building and grounds are rich in horticulture. The gardens in the Persian style, although considerably altered from the original, are justly famous. The external and internal walls are profusely ornamented with bas reliefs and stone inlays of flowers and plants that combine Persian, Indian, and Western influences. Ornamental geophytes are a prominent part of floral imagery. The architecture, garden, and decoration of the Taj Mahal are considered the pinnacle of Indo-Mughal art.

Should guilty seek asylum here,
Like one pardoned, he becomes free from sin.
Should a sinner make his way to this mansion,
All his past sins are to be washed away.
The sight of this mansion creates sorrowing sighs;
And the sun and the moon shed tears from their eyes.
In this world this edifice has been made;
To display thereby the creator's glory.

Shah Jahan

HISTORY

The Taj Mahal (Crown of the Palace) located in Agra, India, is a domed mausoleum of white marble (Fig. 1). Construction was begun about 1632 and completed about 1652 by the Moghul emperor Shah Jahan (1592-1666), literally King of the World (Begley and Desai, 1989) who reigned from 1628 to 1658. Shah Jahan (Fig. 2A) was the great, great, grandson of Zahir-ud-din Muhammad known as Babur (the Tiger), invader of India from Central Asia, and descendant from both Timur (Tamerlaine) and Genghis Khan of Mongolia, hence the dynastic name Mughal. Jahan's mother was a Hindu princess of Jodhpur. Shah Jahan's empire at the time of his death comprised 90% of present day India. He became fabulously wealthy and is best known for the many buildings and monuments he created in Agra, Delhi, and Lahore. Soon after the Taj Mahal was completed Jahan became ill and was placed under house arrest by his son in the Agra fort. Subsequent division of the riches of his Kingdom led to the downfall of the Mughal dynasty.

Figure 1. The Taj Mahal. Photo by Jules Janick.

Figure 2. Shah Jahan (A) and his wife Mumtaz Mahal (B) (Pal et al., 1989).

A B

The Taj Mahal was constructed as a mausoleum for his second wife, Arjumand Banu Begum, who was to be known as Mumtaz Mahal (Exalted One of the Palace) (Fig. 2B). Born 1593 and married 1612, she died in childbirth in 1631 after bearing her 14th child. The court historian commented on her death in the extravagant, florid, style of Persian poetry as follows:

She brought from the groin of the exalted king
Fourteen royal issues into the world
Of these, seven now adorn Paradise
The remaining seven are the candles of government.
When she embellished the world with these children,
She waned like the moon after fourteen.
Where she brought out the last single pearl,
She then emptied her body like an oyster

(Begley and Desai, 1989)

The extravagant building representing an earthly paradise honoring a lost love has captured the romantic imagination of poets and the public while the name Taj Mahal has entered popular culture epitomizing opulence, beauty, and devotion. Its architectural reputation continues to soar. Although pictures of the building are general knowledge, viewing it for the first time is an experience beyond all expectations.

The Taj Majal represents the culmination of the Indo-Mughal style. However, while earlier Mughal buildings are usually red sandstone the Taj Mahal is white marble inlaid with colored

and semi-precious stones. The chief architect was the Persian Ustad Ahmad Lahouri. Its decoration makes extensive use of calligraphy and floral imagery and is greatly influenced by Persian paintings reflecting a special interest in gardens and plants.

HORTICULTURE

The Garden

The main complex is based on a 300 m^2 plot with 16 sunken flower beds (parterres) divided by walkways and flowing water that is typical in Persian gardens (Fig. 3). The main axis is divided by a long pool that wonderfully reflects the structure. The pool is lined on each side with about 80 columnar cypresses. Walkways are found on each side of the cypress strips. The charbagh garden (a garden based on four elements) was inspired by the Persian gardens introduced by Babur, symbolizing the four flowing rivers of mystical Islamic texts. In Persia, paradise is described as an ideal garden of abundance with four rivers flowing from a central spring or mountain. The river Yamuna behind the structure shows evidence of a Moonlight Garden (Mahtab Bagh) on the other side. Early accounts of the garden describe a profusion of vegetation including roses, daffodils, and fruit trees, but the plantings were altered during a reconstruction by Lord Curzon, British viceroy of India (1899-1905) and lawns became the main feature.

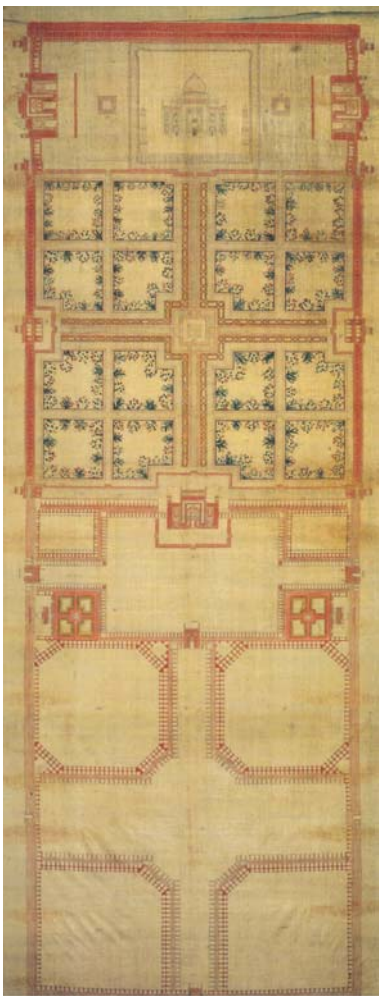
Decorations

The exterior and interior of the marble structure is ornamented with calligraphy, abstract forms, and plant motifs. Passages from the *Qur'an* are used as decorative elements. The calligraphy was created by the Persian calligrapher Abdul Haq from Shiraz, Persia in 1609 and the text is inlaid in jasper or black marble. Abstract geometric forms are used throughout, particularly herringbone inlays. Floors and walkways use contrasting tiles in tessellation patterns.

Floral imagery is presented in two forms: stone inlays (*pietra dura*) and bas relief sculpture (*dados*) carved in the marble. Both are a mixture of stylized and naturalistic depictions. These decorative forms are found on both the inside and outside walls and spandrels of the structure, the marble screen surrounding cenotaphs of Mumtaz Mahal and Shah Jahan, and the cenotaph itself. The analysis below bears heavily on the architectural historian Ebba Koch (2006). The plant identification is our best interpretation; we encourage comments.

Stone Inlays. The exterior decorations are made up of colored stone inset in the white marble of the structure, but the interior decorations include inlays of precious and semi-precious gemstones. The origin of the *pietra dura* appears to be derived from Florentine inlays of the Renaissance (Koch, 2001). There

Figure 3. Garden design of the Taj Mahal (Koch, 2006).



are two types of floral inlays. One is based on complex repeating designs of highly stylized flowers, stems and leaves, often used as borders (Fig. 4). The other represents entire plants. Although they are stylized, some are naturalistic enough to permit botanical identification, but many are not and may be considered fantasy plants (e.g. Fig. 4F left, 5D,F). Muslim tradition forbids elaborate decoration on graves, so the crypts are plain but the bases and casket are elaborately decorated with *pietra dura*. The cenotaphs are enclosed by elaborately decorated marble screens. Although many floral inlays are difficult to identify with botanical precision, various species are suggested including bellflower, chrysanthemum, columbine, crown imperial, daffodil, gloriosa, honeysuckle, various lilies, lotus, pomegranate, poppy, primrose, tulip, and windflower.

Bas Reliefs. The dados typically show plants in flower growing in a mound of soil (Fig. 6) or as flowering stems in urns (Fig. 7A). The plants appear somewhat naturalistic with extraordinary detail in some flowers but closer examination indicates that the plants are stylized with mirror symmetry and executed with consider-

Figure 4. Floral inlays: (A) *Liliaceae*, tulip (*Tulipa* sp.) or lily (*Lilium* sp.); (B) *Ranunculaceae*, windflower (*Anemone* sp.) or buttercup (*Ranunculus* sp.), Note small fruit of pomegranate (*Punica granatum*); (C) columbine (*Aquilegia* sp.); (D) honeysuckle (*Lonicera* sp.); (E) bellflower (*Campanula* sp.) or windflower (*Anemone rivularia*); (F) left unknown, right lotus (*Nelumbo nucifera*); (G) central flower chrysanthemum (*Chrysanthemum*) plus Siroi lily (*Lilium mackliniae*).

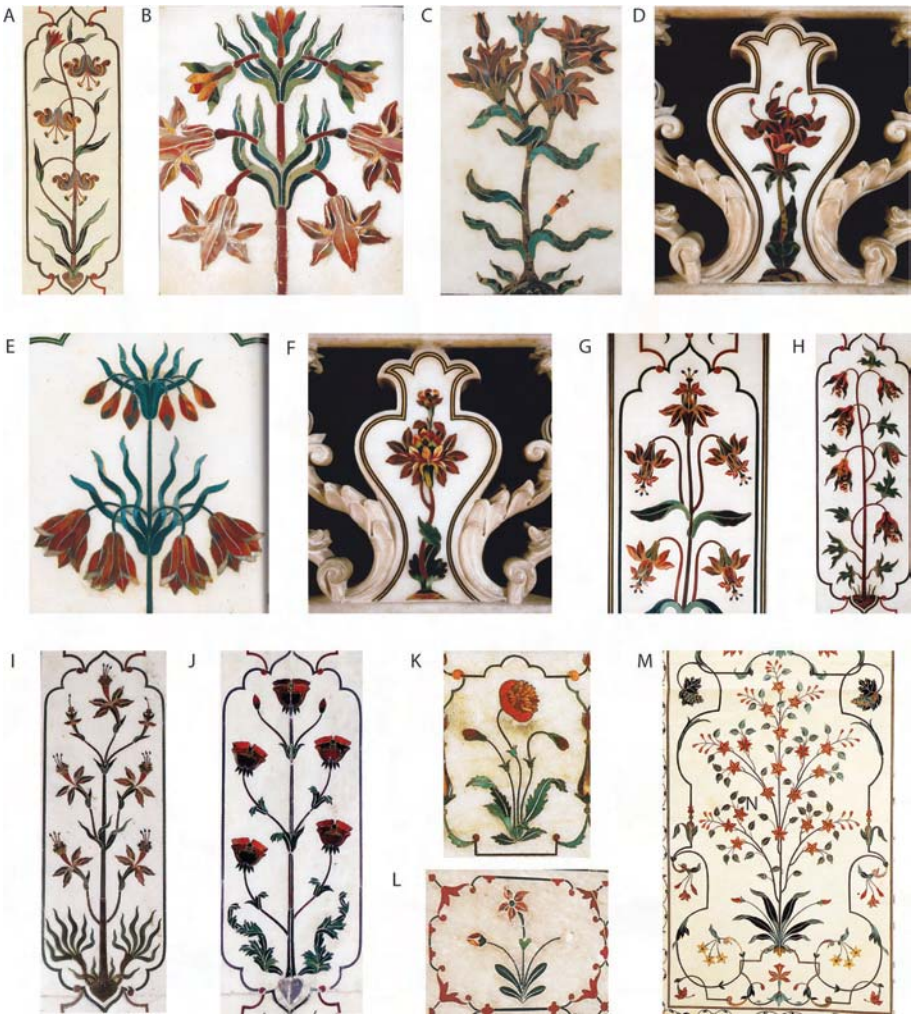
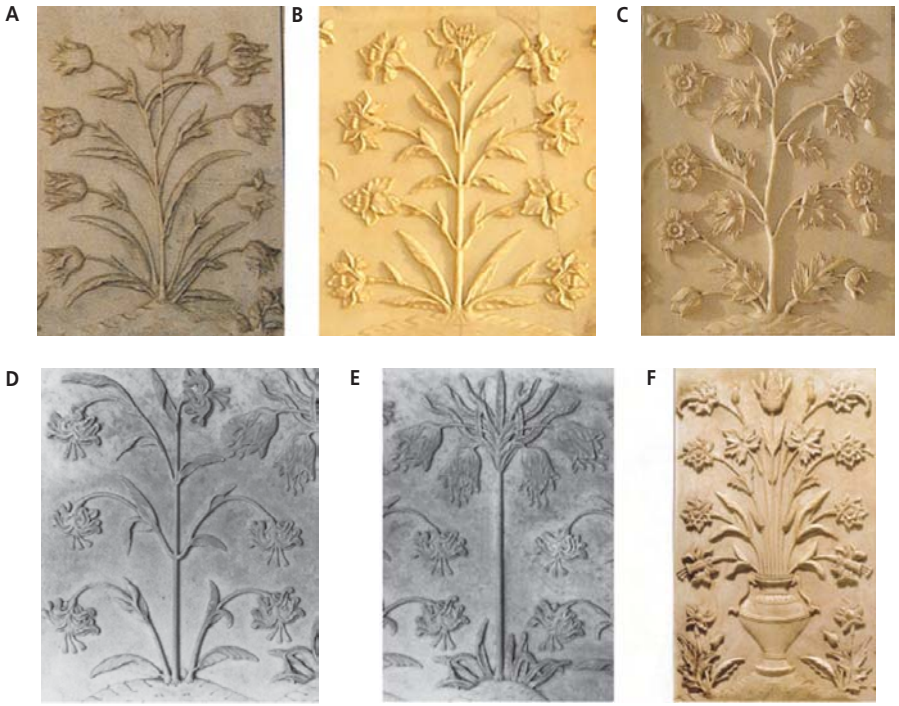


Figure 5. Flowering plant inlays: (A) turkscap lily (*Lilium martagon*); (B) milk and wine lily (*Crinum latifolium*); (C) toad lily (*Tricyrtis* spp.); (D) fantasy, based on toad lily (*Tricyrtis* sp.) or lily (*Lilium* sp.); (E) crown imperial (*Fritillaria imperialis*); (F) fantasy, based on chrysanthemum (*Chrysanthemum indicum*); (G) pomegranate (*Punica granatum*); (H) clematis (*Clematis* sp.); (I) unidentified; (J, K) poppy (*Papaver orientale*); (L) primrose (*Primula* sp.); (M) fantasy, based on erect bellflower (*Campanula* sp.).

able freedom resulting in depictions that are botanically imprecise. For example, the leaves and the flowers are often of different species (Fig. 8); and some plants have flowers of different kinds such as Fig. 6C, which has flowers of both windflower and tulip. Many of the dados are repeated in different locations and some strips show a series of alternating plants.

There is strong evidence that the dados were influenced by Western images as a result of Mughal contacts with Europeans (Skelton, 1972; Koch, 2001). There was a Portuguese delegation to the Mughal court as early as 1573, which resulted in the dispatch of an art delegation to Goa in 1575. Jesuit missionaries bought engravings by Flemish artists as early as 1580, which were exhibited, collected and copied. One engraving dated 1635 (Fig. 7B) by

Figure 6. Floral base reliefs or dados. (A) dzokou lily (*Lilium chitrangadae*), (B) spider lily (*Pancratium* sp.); (C) windflower (*Anemone* sp.) with tulips (*Tulipa* sp.) at base; (D) glory lily (*Gloriosa* sp.); (E) crown imperial (*Fritillaria imperialis*); (F) tulip (*Tulipa* sp.) in the center and in descending order: unknown, leaf of grape (*Vitis* sp.), windflower (*Anemone* sp.), daffodil (*Narcissus* sp.), and sea lily (*Pancratium* sp.) with plant of windflower at the base of the urn.



the Flemish artist Claes Jansz bears an inscription based on Isaiah 40:6, 8: *All flesh is grass, oh human being, it does not bring fame/And your beauty is like a flower*. The engraving is remarkably similar to the dado that appears in eight corners of the tomb chamber (Fig. 7A). However, the vanity theme of the engraving is transformed to a depiction of Paradise, symbolized in the *Qur'an* as a garden rich with flowering plants.

In the engraving, the predominant species in the center is a crown imperial with a tulip on the left side and an iris on the right. The dado includes two plants of daffodil growing on a mound of soil on each side of the urn containing flowering stems in mirror symmetry dominated by a lush iris (*Oncocyclus* group) in the center, quite similar to the one in the engraving, followed on either side in descending order by various flowers described in the figure caption of Fig. 7A.

BOTANY OF THE FLORAL IMAGERY

The floral decorations reflect the extent of floricultural knowledge in the Mughal period. Most

Figure 7. (A) Dados of cut stems in an urn: iris in the center, and in descending order on either side are columbine, daffodil, columbine, windflower, tulip, windflower, poppy capsule, delphinium. There are two daffodil plants on either side of the urn. (B) Engraved flowers in an urn of the Flemish artist Clades Jansz, 1635. Top three flowers from left to right are tulip, crown imperial, and iris. Others include columbine, bellflower, centaurea, various lilies, peony, rose, and poppy capsule.

A

B

of the plants that make up the floral imagery of the mausoleum are indigenous to India and the Mideast and represent plants frequently illustrated in Persian paintings and rugs. The main group of plants are ornamental geophytes including crown imperial, iris, various lilies, daffodil, and tulip, plants indigenous to and highly regarded in the Irano-Turanian floristic region. We were tempted to include fuchsia (Fig. 4C, Fig. 7A, third stem from the iris) based on previous suggestions (Kennedy, 2007). However, fuchsia is indigenous to the New World, and was unlikely to have been grown in Persia or India in the 17th century. It is possible that the images of fuchsia could have been derived from Western sources, but the earliest image of fuchsia we have located is by Charles Plumier in 1703, which rules it out. There are many plants we failed to identify and some may be fantasy plants based on artist's imagination or composites influenced by Western florilegia. A quantitative and qualitative analysis of the floral imagery of the Taj Mahal will require a complete detailed photographic survey of the internal and external structure.

Figure 8. Iris dados: (A and B) flowers and leaves are naturalistic; (C) iris flower with leaves of dicotyledonous plant.

A

B

C

Acknowledgement

We thank Judith Taylor, Jaap van Tuyl, and Yuval Sapir for helpful assistance with the manuscript.

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About the Authors

Jules Janick

Rina Kamenetsky

Sumangala H. Puttaswamy

Jules Janick is the James Troop Distinguished Professor at Purdue University, West Lafayette, Indiana, USA. He is currently Science Editor of *Chronica Horticulturae*.
Email: janick@purdue.edu

Rina Kamenetsky is a Researcher with a specialty on ornamental geophytes, Agricultural Research Organization, The Volcani Center and Professor of the Hebrew University of Jerusalem, Israel.
Email: vhrkamen@volcani.agri.gov.il

Sumangala H. Puttaswamy is a Researcher in floriculture at the Indian Institute of Horticultural Research, Hessaraghatta, 560089, Bangalore, India. Email: sumasiddharth@gmail.com

Annatto: A Natural Dye from the Tropics

Freddy Leal and Claret Michelangeli de Clavijo

Annatto is a Neotropical species and it was one of the first cultivated plants in the Amazon basin and later dispersed by the Amerindians to the rest of South America, Central America and the Caribbean. Since pre-Columbian times, American natives have known about the use and value of the annatto. Annatto is known, by the names of onoto, bija, achiote, urucu, among others. "Anoto" and "onoto" are Caribbean voices; "bija" or "bixa" are insular Caribbean (Taino) voices spoken in La Hispaniola; "achiote" is coming from the Nahuatl language and "urucú" is a Guaraní word used in Brazil.

Initially, it was used primarily for religious, supernatural ceremonies, but also as body paint during times of war and as a protection for mosquitoes. Thanks to its wide human dispersion, indigenous people had a reliable source to paint their bodies. The use of annatto as a food colorant and for staining baskets, potteries and hammocks had a later development. With time, medicinal use for the leaves, buds and seeds were developed for a multitude of conditions. Currently, dye extracted from annatto finds its place in the food, confection, cosmetics and clothing industries. Because of its multiple uses and the substitution of the synthetic colorants for natural ones in the food industry, annatto planting and production has increased internationally in recent times.

HISTORICAL AND BOTANICAL

The historical evidence indicates a wide distribution and cultivation throughout all the warm and humid American tropics well before the arrival of Columbus, and subsequently distributed to all humic tropic and subtropics worldwide thanks to the Spanish and Portuguese conquerors and explorers of the 15th and 16th centuries. Annatto was unknown to Europeans until the voyages of Christopher Columbus (Colón, 1498). During October 12, 1492, he made the first historical reference about the annatto and its seed used as a dye, after reaching San Salvador Island (Watling Island in the Bahamas).

Annatto belongs to the family *Bixaceae*. This is a monotypicous family of one to four species according to the botanical authority, whose natural distribution is restricted to tropical America and the Antilles, with one species *Bixa orellana* L. naturalized in all world tropics. Baer (1976) considered that the genus Bixa is of about five species: 1. *Bixa orellana*; 2. *Bixa urucurana*; 3. *Bixa platycarpa*; 4. *Bixa arborea*; 5. *Bixa excelsa.*

The genus probably originated in the slopes of western Andes between the Huallaga-Ucayali River, and the Madre de Dios-Madeira River, because most of the valid species are present there. In later times, Amerindians distributed annatto to the north towards Central America up to Mexico; to the northeast toward the Orinoco and the Amazon basins, all the way to the Caribbean (Antilles); and to the southeast, towards Bolivia, Paraguay and southeastern Brazil.

Annatto culture as a perennial in the humic tropics confers potential for use as a source of income for small producers. In fact, it grows well in marginal lands, as a fence crop, and requires few inputs, although it is fairly labor intensive; since annatto has a center of origin in South America, a selection of promising types and cultivars is quite feasible.

In tropical countries, local demands are satisfied by the small productions coming from scattered orchards or from plants growing in association with fruit crops. There are no reliable statistics of world production and commerce. A conservative figure of the world production is of about 7,000 to 10,000 t, most of it coming from Brazil (Arkcoll, 1990). There are only three major exporter countries: Peru, Kenya and Brazil, but the latter is a major importer too. Countries with small productions included: Dominican Republic, Colombia, Ecuador, Jamaica, Costa Rica and Guatemala in the western hemisphere; Côte d'Ivoire and Angola in Africa; and India, Sri Lanka, Thailand and the Philippines in Asia (Green, 1995). The principal importer countries are India, Japan, Turkey, Russia, Argentina, Canada, U.S.A., Switzerland and the European Union. In these markets, the largest demands for annatto are in the seed extract form for use in the food industry. The use of seed extracts depends on

Annatto botanical features: A. Flower buds, B. Flowers, infrutescens and pollinators, C. Seeds inside capsule, D. Aril covering the seed.

Annatto cultivar infrutescens: A. 'Yellow green', B. 'Spiny brown', C. 'Indio', D. 'Bico de pato', E. 'Ornamental red', F. 'Chino' (spineless), G. 'Yellow'.

the food product and on the pigment solubility. International market prices for seeds and extracts are variable from year to year and are often very difficult to obtain. World international market prices for 2006 oscillated from US$ 1.0 to 1.3 per kilo.

USES

Annatto produces the most common hydrophilic and oily dyes (bixin and norbixin) used in the food, bakery, cosmetics and dyeing industries, with ample use in sausages, dairy products such as cheese, butter, margarine, ice creams; cereals, snacks, doughs, wafers, oils, sauces, dry and smoked fishes, pickles, preserved meat, lipsticks, shoeshines, varnishes, fiber dyes, etc. Annatto seeds are also use in the poultry industry to prepare feed for egg laying hens. Annatto had also been introduced into all lower elevations tropical regions as an ornamental plant.

HORTICULTURE

Annatto has a large adaptation to different climates and soils, with precipitation and minimum temperatures being the principal factors that affect production. Annatto grows from sea level up to 1,200 m of altitude; requires about 600 mm of precipitation provided that rains are well distributed during the year. Sandy-loam soils with good drainage and medium to high fertility with low aluminum levels with a pH between 5.5 to 7.0, are best suited for annatto.

Annatto is susceptible to the presence of some pests and diseases; in addition, it is an allogamous plant, so there are enormous variations in yields per plant and seed quality as well as disease resistance. Due to the short juvenility period of the seedlings, sexual propagation is the most common and economic way to propagate annatto. Annatto could be propagated asexually through budding, cuttings or air layering, but few growers, if any, use asexual propagation.

If the orchard is well-managed fruit production can start from two years of age, but the largest production is generally between 4-5 years. In all tropical producing countries, growers have planted a mixture of types with the subsequent variation in yields due to the lack of cultivars. The first crop yields around 300-400 g/plant 2-3 years after planting, but after six years yield varies between 1,500-2,000 kg of dry seeds per ha. Besides yields, growers must take into consideration bixin percentage, seed moisture content, odor, and presence of impurities, foreign materials, molds, overall presentation and packing before offering the product to the industry.

Annatto commercial development: A. Annato nursery, B. Commercial orchard, C. Annatto tree in full production.

CHALLENGES

Even if annatto has been cultivated in the Amazon basin for thousands of years, it is still an underdeveloped crop, but it has a significant commercial potential, because it is the second most important dye worldwide. This potential is going to continue to develop if growers and agricultural investors dedicate more resources to research. Research is urgently needed to solve many problems, either by genetic improvements or those related to management practices, pest and diseases control, aiming to increase yields and pigment quality. In addition, annatto could be adapted to multiple cropping with fruit crops and pastures, so growers would not have to risk income on one single crop due to market fluctuations. Annatto world production derives from seedling trees, so many of the limitations in annatto production could be overcome by the use of asexual reproduction.

The expanding of the annatto industry will occur if demand continues to rise in industrial countries, as it seems to be, and if no other natural dyeing product is developed. Growers need to develop new orchards, of high yielding plants and high quality bixin cultivars, so international markets can be satisfied.

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About the Authors

Freddy Leal

Claret Michelangeli de Clavijo

Freddy Leal is a Horticulturist at the Universidad Central de Venezuela, Facultad de Agronomía working with tropical fruits. Apartado Postal 4736, Maracay, Aragua, 2101A, Venezuela. Email: flealpinto@hotmail.com

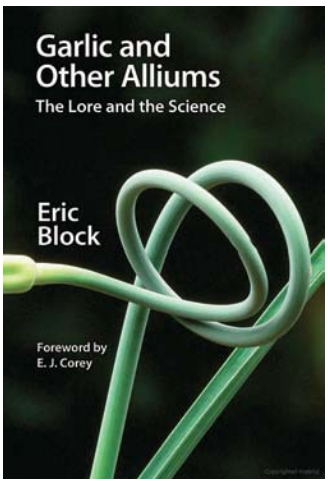
Claret Michelangeli de Clavijo is a Horticulturist at the Universidad Central de Venezuela, Facultad de Agronomía, Centro de Investigaciónes de Biotecnología Agrícola (CIBA) working in Plant Biotechnology. Apartado Postal 4579, Maracay, Aragua, 2101A, Venezuela.
Email: claremiche@gmail.com

New Books, Websites

BOOK REVIEWS

The books listed here are non-ISHS-publications. For ISHS publications covering these or other subjects, visit the ISHS website www.ishs.org or the Acta Horticulturae website www.actahort.org

Garlic and Other Alliums: The Lore and the Science. Eric Block. Foreword by E.J. Corey. 2010. RSC Publishing, Cambridge, UK. 454p. ISBN 978-0-85404-190-9 (hardback). $49.95 / £29.95. www.rsc.org



Garlic is one of those vegetable crops for which everyone has an opinion, often without compromise or equivocation, and almost everyone thinks they know something about garlic, and to some extent the other alliums. This engagingly written comprehensive treatise on garlic and other alliums provides those who really want to know the facts and history of this fascinating collection of crops an opportunity to do so.

In the first 60 pages of this book the author covers the natural geographic origins, botany, and history of cultivation of the alliums up to modern times, and a fascinating review of the role alliums have played in the written, visual, and architectural arts. The next 160 pages provide an extensive and detailed treatment of the chemistry behind the lasting impression these crops have on consumers and the last 100 pages of text provide an extensive evaluation of the real and imagined health, medicinal, and pest repelling properties of alliums. This book is filled with numerous facts about garlic and other alliums. Do you know the origins of pungency and tearing response of alliums? What role have new developments in organic analytical chemistry played in broadening our understanding of allium chemistry? Can garlic treat tuberculosis? What did U.S. Grant say about onions as he was moving troops in the U.S. Civil War? Where is it illegal to eat onions while attending church? Can garlic repel birds? The middle two chapters on allium chemistry provide a very thorough overview of the complex organic chemistry behind the organoleptic mystique of alliums. While the detailed chemistry will exceed the comprehension of those without a few college courses in organic chemistry, this section is largely written as it happened historically, and liberally laced in the chemistry we find the faces and personalities of the scientists who were making these discoveries, photos of the equipment they used, and comments by the author about the correct and the erroneous conclusions they drew about the data they were interpreting. This makes for exciting reading that engages the reader with a clear sense of the thrill and exasperation that can come with doing scientific research. This is exciting not only to the established researcher, but also to the less-seasoned reader who has not had this experience. Even an advanced high school stu-

dent could read and enjoy this book, and perhaps be tantalized to a career in science.

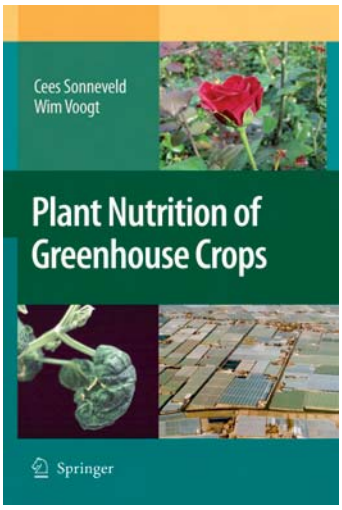
Both the style and substance of presentation makes this book easy to read. It is very well illustrated and has an extensive bibliography of nearly 70 pages. Each chapter has several quotations from famous and not-so-famous authors about garlic, onions, or their attention-getting odoriferous properties, and humor is interjected in anecdotes and even chapter headings like "Allicin Wonderland". Appendices list major flavor precursors of diverse *Allium* species, antibiotic and anticarcinogenic properties of alliums, and present 27 color plates of *Allium* by the 19th century scientist and artist Ludwig Reichenbach. The index is extensive and well-organized.

Garlic and other alliums have not only been important in agriculture and human health, but they have also captured the attention of civilizations since their first cultivation. Eric Block has taken the broad range of lore and science surrounding the alliums and compiled it into a very informative and readable book.

Reviewed by Philipp Simon, USDA, ARS, University of Wisconsin, USA

Plant Nutrition of Greenhouse Crops. Cees Sonneveld and Wim Voogt. 2009. Springer. 431p. ISBN 978-90-481-2531-9 (hardcover). € 149.95 / £ 135.00 / US$ 199.00. www.springer.com

Written by two of the world's leading authorities on plant nutrition in soilless growing systems, this book is a comprehensive, detailed treatise on fertilisation and nutrient relationships in growing media and hydroponics. There is also a surprising amount of detail on soil-based systems of growing in glasshouses, given that the authors extol the benefits of raising plants in soilless systems. Introductory chapters on greenhouse horticulture and fertilisers/soil improvers are followed by accounts of soil solutions (which also includes much detail on substrate solutions), substrate and soil testing, water uptake and salinity effects: the last mentioned is, as expected, particularly noteworthy in the light of Dr. Sonneveld's vast experience in this area. Rather more specific topics of crop



responses to variations in ionic concentrations in media, and calcium nutrition follow. At this stage in the book, a diversion into the effects of sterilisation procedures, mainly in soil, is taken. A basic account of substrates is then given, followed by several chapters on nutrients and fertigation in soilless culture, substrates and soils. These latter chapters give a thorough overview of plant nutrition in glasshouse crops.

Throughout, the authors have drawn on their vast experience to compile detailed evaluations of research and development into the nutritional aspects of glasshouse culture: from mathematical calculations and formulae for water relations to critical evaluation and interpretation of nutrient interactions in soil, substrates and hydroponic systems. In this sense the book is of most value to research workers in soilless culture and substrate methods of growing under glass, and students on final year horticulture and applied plant science courses.

The text should have been proof-read for grammar and English in a far more rigorous fashion, and the publishers must take some responsibility for this, bearing in mind the cost of the book. Nevertheless this book is likely to form the standard reference work on plant nutrition in glasshouse crops for many years. The reviewer looks forward to a grammatically correct second edition!

Reviewed by Bill Carlile, Bord na Móna, Ireland

NEW TITLES

Hennecke, Stefanie and Gröning, Gert (eds.). 2010. Kunst - Garten - Kultur (Art-Garden-Culture). Dietrich Reimer Verlag, Berlin, Germany. 319p. ISBN 978- 3-496-01423-2. (in German). € 39,00 (Germany) / € 40,10 (Austria) / SFr 61,90 (Switzerland).

Palaniswami, M.S. and Peter, K.V. 2008. Tuber & Root Crops. Vol. 9. Horticulture Science Series. New India Publishing Agency, New Delhi, India. 510p. ISBN 8189422537. US$ 99.95.

Pauly, Philip J. 2008. Fruits and Plains. The Horticultural Transformation of America. Harvard University Press, Cambridge, MA, USA / London, UK. 352p. ISBN 9780674026636 (hardcover). $42.00 / £31.95 / € 37.80. www.hup.harvard.edu

Peter, K.V. (ed.). 2008. Underutilized and Underexploited Horticultural Crops. Vol. 3. New India Publishing Agency, New Delhi, India. 468p. ISBN 8189422855. US$ 120.00.

Peter, K.V. (ed.). 2008. Underutilized and Underexploited Horticultural Crops. Vol. 4. New India Publishing Agency, New Delhi, India. 440p. ISBN 8189422901. US$ 120.00.

Pradeepkumar, T. 2008. Management of Horticultural Crops. Vol. 11. Horticulture Science Series. New India Publishing Agency, New Delhi, India. 1012p. ISBN 8189422499. US$ 119.95.

Sheela, V.L. 2008. Flowers for Trade. Vol. 10. Horticulture Science Series. New India Publishing Agency, New Delhi, India. 391p. ISBN 8189422510. US$ 99.95.

Tesi, Romano. 2010. Orticoltura Mediterranea Sostenibile (in Italian). (Sustainable Mediterranean Vegetable Production). Patron Editore Bologna, Italy. 503p. ISBN 978-88-555-3062. € 42. www.patroneditore.com

Valsalakumari, P.K. 2008. Flowering Trees. Vol. 12. Horticulture Science Series. New India Publishing Agency, New Delhi, India. 306p. ISBN 8189422502. US$ 95.50.

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

KAVB Symposium: Plant names, global challenges, 11-13 October 2010, Amsterdam, The Netherlands. Info: Mrs. Saskia Bodegom, email: Bodegom@KAVB.nl

Conference on Innovative ideas in pest and weed control in field vegetables, 25 November 2010, Harpenden, UK. Info: Bernadette Lawson, Association of Applied Biologists, The Warwick Enterprise Park, Wellesbourne, Warwick, CV35 9EF, UK, Phone: +44 (0) 2476 575012, Fax: +44 (0) 1789 470234, Email: bernadette@aab.org.uk, Web: www.aab.org.uk

2nd International Research Conference on Huanglongbing (HLB), 10-14 January 2011, Orlando, FL, USA. Info: www.irchlb.org

Section Medicinal and Aromatic Plants

Second Int'l Symposium on Medicinal and Nutraceutical Plants

Participants of 2nd ISMNP-2009 after valedictory ceremony.

The 2nd International Symposium on Medicinal and Nutraceutical Plants (ISMNP) was held from 25-27th November, 2009 at All India Institute of Medical Sciences (AIIMS), New Delhi, India. The symposium was organized by the Nutrition and Phytomedicine Laboratory, Department of Physiology, AIIMS, New Delhi in collaboration with ISHS. The event was attended by more than 70 participants from more than 20 countries. During the conference participants had the opportunity to exchange their views and to explore possibilities of future interdisciplinary collaborations.

Opening and lamp lighting ceremony, from right to left: Prof. R.C. Deka, Director, AIIMS, Prof. Rani Kumar, Dean (Academics), AIIMS, Mr. S.K. Shah, ISHS representative, Prof. S.C. Mahapatra (lighting lamp), Convener and Dr. R.K. Yadav, Finance Secretary, 2nd ISMNP.

The aim of this 3-day symposium was to provide a common efficient academic platform to the persons/groups involved in research on various aspects of medicinal and nutraceutical plants. Apart from horticultural scientists and botanists, the symposium was attended by scientists / groups from modern medicine, *Ayurveda*, and other systems of medicine, and by analytical chemists from all over the world. AIIMS is a premiere medical institute of India with the motto to achieve excellence in medical education, research and patient care and organizing the second ISMNP in this institute was a great opportunity to bring about an integrated approach to highlight the role of medicinal and nutraceutical plants in modern day medicine. In the second ISMNP, invited guest lectures by eminent scientists were arranged to cover different aspects such as, growing of medicinal and nutraceutical plants, methodologies for extraction of chemical constituents, investigation of medicinal properties in experimental models, and use of medicinal and nutraceutical plants in modern medicine. The guest lectures were followed by parallel oral and poster presentation sessions. The participants had the opportunity to interact with the presenter after every presentation and they enjoyed the scientific sessions as this was an interdisciplinary forum to integrate almost every aspect of medicinal and nutraceutical plants.

During the symposium, participants presented research papers and discussed topics ranging from cultivation conditions to improve quality and yield, genetic modification to improve yield of medicinally important chemical constituents, extraction methodologies, in vitro assessment of antimicrobial properties, animal model experiments to investigate different clinically important topics such as diabetes, antioxidants, anticataract, immunology and clinical trial results of patients and healthy individuals.

Mr. S.K. Shah, ISHS representative, presenting the ISHS medal and certificate to Prof. S.C. Mahapatra, Symposium Convener, 2nd ISMNP-2009.

On 26th November, Swami Ramdev, highly respected Yoga guru of India gave a live demonstration of Yoga, which the participants enjoyed the most. The participants had the opportunity for informal interactions during the conference gala dinners on 25th and 26th November.

The valedictory session and closing ceremony were from 12:30 to 1:30 pm on the last day of the symposium. The main outcome of the symposium was a consensus among the participants that there should be interdisciplinary close collaboration between scientists involved in plant cultivation, extraction and analysis of chemical composition, pharmacologists and medical doctors for a better future to meet the modern medical challenges. It was agreed upon that the 3rd ISMNP will be held in Brazil under the leadership of Prof. Narendra Narain (narendra.narain@gmail.com).

S.C. Mahapatra

Contact

Prof. S.C. Mahapatra, MD, Nutrition and Phytomedicine Laboratory, Dept. of Physiology, All India Institute of Medical Sciences (AIIMS), New Delhi, 110029, India, email: scmahapatra@gmail.com

Fourth Int'l Symposium on Fig

Participants of the Symposium.

The IV International Symposium on Fig was successfully organized from 29 September to 3 October, 2009 by the National School of Agriculture of Meknès (ENAM), Meknès (Morocco) under the auspices of the Moroccan Ministry of Agriculture and Fisheries (MAPM), the International Society for Horticultural Science (ISHS) and the Centre for Advanced Mediterranean Agronomic Studies (CIHEAM).

Opening ceremony.

The symposium was supported by different organizations such as 'Wilaya de Meknès-Tafilalet', 'Crédit Agricole du Maroc', 'Centre Régional des Investissements de Meknès-Tafilalet', 'Agence pour le Développement des Provinces du Nord', 'Coopération Technique Belge', 'Groupe Aicha', 'Groupe Brahim Zniber', 'Groupe Tizi de Meknès' and 'Groupe Pépinières Chaymae'.

The inaugural session started with a welcome lecture by Prof. Dr. Boulif Mohamed, Director of ENAM, in which he welcomed the participants and gave a general view about ENAM. The second presentation was made by Prof. Dr. Messaoudi Zerhoune, Convener and Chairman of the Symposium, who extended his thanks and gratitude to all participants particularly those coming from abroad. He also thanked the ISHS and the fig scientific community for allowing ENAM to organize this symposium and CIHEAM and other supporting organizations for the financial support brought to this event. His special thanks went also to the Scientific and Organizing Committee members. He underlined the importance of this meeting in improving and exchanging scientific and technical information in the domain of fig growing.

Professor Dr. Uygun Aksoy (right), ISHS representative, handing out the ISHS medal and certificate to Professor Dr. Messaoudi Zerhoune (left), Symposium Convener.

Finally, he presented the overall program and activities scheduled for the symposium. The third presentation was made by Prof. Dr. Uygun Aksoy, ISHS representative, who gave a short

history about the international symposium on fig and addressed the main ISHS activities since its creation. She also invited the participants to join ISHS in order to give more strength to this society. The fourth speech was made by Dr. Antonio Lopez, CIHEAM representative, who focused on the importance of such kind of meeting in exchanging scientific and technical information on species particularly those cultivated in the Mediterranean basin and addressed the efforts of CIHEAM in supporting organization of such events around the world within the framework of CIHEAM mission. The last speech was given by Mr. Bourfoun, Moroccan Ministry of Agriculture and Fisheries representative, who thanked the fig scientific community for allowing the organization of this symposium and detailed some of the characteristics of fig sector in Morocco. At the end of this session, Prof. Dr. Uygun Aksoy handed out the ISHS medal and certificate to Prof. Dr. Messaoudi Zerhoune to recognize his service to the ISHS as Convener of this Symposium.

The symposium was attended by more than 130 participants from 23 different countries (of which 70 participants came from Morocco). A total of 67 papers were presented for the occasion: 46 oral communications and 21 poster presentations.

The scientific program of the symposium covered four topics namely 1- Fig industry over the world, 2- Genetic resources, Germplasm characterization, Molecular markers utilization and Biotechnology, 3- Crop production and pest management and 4- Postharvest, transformation, valorization and economics. Six, 25, 24, and 12 communications were presented for the first, the second, the third, and the fourth topics, respectively.

Visit of the participants to Volubilis archeological site (Moulay Driss Zerhoune).

During the symposium, technical visits were organized to the national collection of figs hosted by the National School of Agriculture (Meknès), to two nurseries for fig plant production, to a fig orchard owned by Aicha society in the Sais Plateau and to Al Kifane fig drying unit in the area of Moulay Driss Zerhoune.

Social events were also organized such as visits to Volubilis archeological site in Moulay Driss Zerhoune and different places in the ancient Medina of Meknès.

The last session of the program was devoted to the evaluation of the symposium and the designation of the country where the fifth edition of the symposium will be held. During this session, participants highlighted the importance of these kinds of meetings in spreading and upgrading knowledge in regard to fig growing and developing collaborative research on fig. They also recommended the necessity to strengthen information exchange between the ISHS Figs Working Group members. Therefore, five sub-commissions were created within the group. These sub-commissions are as follows 1- Genetic resources, Germplasm characterization, Molecular markers utilization and Biotechnology, 2- Crop production, 3- Pest management, 4- Transformation and valorization and 5- Marketing and economics. The participants to the symposium decided that Dr. Moshe Flaishman will act as the Chairperson of the Figs Working Group for the four next years and the fifth edition of the International Symposium on Fig will be organized in 2013 conjointly by the University and the CIHEAM of Bari (Italy) with Professor Dr. Resta (University of Bari) and Dr. Albaiano (CIHEAM of Bari) acting as Co-Conveners.

Visit to Aicha fig orchard (Meknès).

Messaoudi Zerhoune

Contact

Prof. Dr. Messaoudi Zerhoune, Department of Arboriculture-Viticulture, Ecole Nationale d'Agriculture de Meknès, B.P. S-40, 50000, Meknès, Morocco, GSM: 00 212 (0) 6 61 35 36 53, Fax: 00 212 (6) 5 35 30 02 38, Email: messaoudiz@yahoo.fr

First Int'l Orchid Symposium

Orchids are among the most diverse and largest plant families, growing on all continents except Antarctica. Orchids are also among the most widely cultivated ornamentals, commercially grown for cut flower production, as potted flowering plants, and less often, for their decorative foliage. The I International Orchid Symposium (IOS), held in Taichung, Taiwan from January 12-15, 2010, was the first worldwide scientific conference devoted specifically to orchids. There were 172 participants from 18 countries, including academics, government scientists, commercial growers, and hobbyists.

The IOS was held at the National Museum of Natural Science and was co-organized by Yung-I Lee (Botany Department, National Museum of Natural Science) and Erik Runkle (Department of Horticulture, Michigan State University). They were assisted by a fine team of Taiwanese colleagues and staff, who with the Organizing Committee, made all of the local arrangements, coordinated registration, and ensured a flawless symposium.

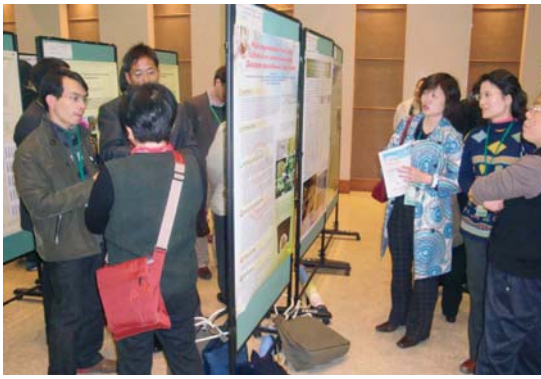
Three days were devoted to scientific presentations, which included 39 oral presentations (13 of which were invited speakers) and over 50 posters. The featured invited speaker was Dr. Joseph Arditti, Professor Emeritus from University of California – Irvine, who presented an informative yet entertaining (and slightly risqué) presentation on sexual and clonal propagation methods for orchids. A wide range of topics were discussed, including: orchid anatomy and morphology, ecology, genetics and breeding, micropropagation and seed germination, production (including pest and virus control), postharvest and marketing, and biotechnology. The abstract book has been posted on the IOS website and is available to all at http://hrt.msu.edu/ios.

Following the meeting, there was a one-day technical tour. Participants visited In-Charm Orchids Laboratory, a specialized *Paphiopedilum* grower; Ching Hua Orchids, a large commercial grower of multiple orchid genera; and greenhouses at Taiwan Orchid Plantation, which features modern *Phalaenopsis* plant cultivation and cut flower production. In conclusion, a visit was made to the Floriculture Research Center, which performs breeding and environmental control research on a wide range of Oriental ornamental plants.

Social activities included a welcome reception that featured a traditional 12-course Chinese dinner and a Farewell Party at the adjacent Tropical Rainforest Greenhouse. During the farewell party, a large buffet of foods and beverages were served and participants could observe hundreds of flowering orchid plants that were being judged for a local competition.

There was a graduate student poster competition in which the American Orchid Society provided honorariums for first, second, and third prize. Posters were evaluated by members of the Scientific Committee and by invited speakers. The first, second, and third place winners were Yu-Lin Chung (National Cheng Kung University, Taiwan), Dong Poh Chin (Chiba University, Japan), and Yun-Ru Luo (National Cheng Kung University), respectively.

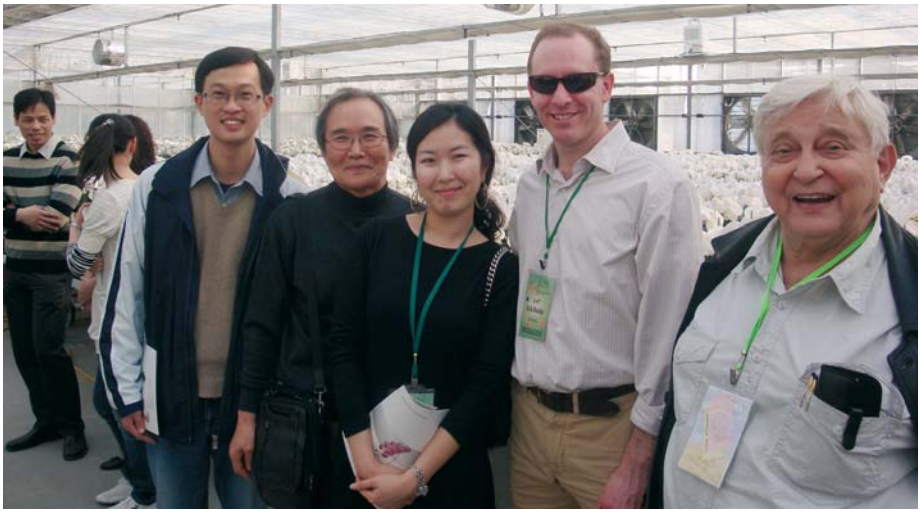
A business meeting of the ISHS Orchid Working Group was led by Dr. Richard Criley (Chair of ISHS Section Ornamental Plants). At the meeting, Dr. Apiradee Uthairatanakij (King Mongkut's University of Technology, Thailand) was elected Chair of the Orchid Working Group (replacing Yung-I Lee) and Dr. Fure-Chyi Chen (National Pingtung University of Science and Technology) was elected Vice-Chair (replacing Erik Runkle). In addition, a team of delegates from Thailand agreed to host the II International Orchid Symposium in Bangkok, Thailand, with dates to be determined.



Participants of the IOS review the scientific poster presentations and discuss the information.

The technical tour featured visits to several commercial orchid producers in Taiwan, including here at the Taiwan Orchid Plantation in Tainan County.

Participants take a break at the Taiwan Orchid Plantation during the technical tour. From left to right: Yung-I Lee (Co-Convener), Kee-Yoeup Paek, Yoonjin Kim, Erik Runkle (Co-Convener), and Joseph Arditti (featured invited speaker).



Erik Runkle and Yung-I Lee

Contact

Dr. Erik Runkle, Department of Horticulture, Michigan State University, A288 PSSB, East Lansing, MI, 48824, USA, email: runkleer@msu.edu

Dr. Yung-I Lee, Botany Department, National Museum of Natural Science, N0 1, Kuan-Chien Rd., Taichung 404, Taiwan, email: leeyungi@hotmail.com

Third Int'l Symposium on Loquat

Participants of the Symposium.

The Third International Symposium on Loquat held 3-6 May, 2010, in the historical city Antakya, the capital of Hatay Province, Turkey was extremely successful. The symposium was organized by the Department of Horticulture, Faculty of Agriculture, University of Mustafa Kemal under the auspices of the International Society for Horticultural Science (ISHS). The symposium attracted 62 participants (53 foreign, 9 domestic) from 14 countries (Albania, China, India, Iran, Iraq, Israel, Italy, Japan, Libya, Pakistan, Spain, Syria, Turkey and the USA) as compared to 20 foreign participants from 7 countries in the I International Loquat Symposium held in Spain (2002) and 25 foreign participants from 7 countries in the II Symposium held in China (2006). The increase in participation and number of countries indicates that loquat is a rising fruit species!

Jules Janick (right) handing over the ISHS medal to Symposium Convener A. Aytekin Polat (left).

The Symposium consisted of 8 sessions: Germplasm, Genetics, Breeding and Biotechnology, Production and Marketing, Orchard Design and Management, Biology and Physiology, Cultivars, Rootstocks and Propagation, Post-Harvest Physiology, Handling and Processing. There were 44 invited and contributed oral presentations and 43 posters.

Two and a half days were devoted to scientific sessions and 1.5 days to a cultural trip to the historical places of Antakya City and a technical excursion to Tarsus. The opening ceremony started with a welcome address by Prof. Dr. A. Aytekin Polat, Convener of the Symposium, in which he extended his thanks and gratitude to the participants and the members of the Scientific and Organizing Committees. The second presentation by Prof. Dr. Jules Janick, ISHS representative, presented information about ISHS activities followed by presentation of the ISHS medal to A. Aytekin Polat, Convener of the Symposium.

After the welcoming ceremony, Jules Janick (USA) gave the keynote address entitled

Tarsus Governor presenting plaques to invited presenters. From left to right: M. Agusti, A. Aytekin Polat (Convener), M. Gödekmerdan (Governor of Tarsus), J. Janick (ISHS representative), W. Yongqing.

"Prediction for the Loquat Improvements in the Next Decade". Dr. Janick underlined that the production of the seedless loquat is expected to revolutionize the loquat culture in the next decade. In the first session on Germplasm, Genetics, Breeding and Biotechnology, the invited speaker, Prof. Shunquan Lin (China), presented a lecture on the "Origin and Evolution of *Eriobotrya* - Based on the Identified Fossils of *Rosaceae* and the Geographical Distribution of the Wild Loquat Species". In the fifth and sixth sessions on Biology and Physiology, the invited speakers, Prof. Manuel Agusti (Spain) and Prof. Xuming Huang (China), presented a lecture on "Fruit Physiology: Control of Growth and Development" and "Fruit Creasing Disorder in Loquat: Occurrence and Mechanisms", respectively. In the last session on Post-Harvest Physiology, Handling and Processing, the invited speaker, Prof. Sisir Mitra (India), presented "Recent Development of Postharvest Technology of Loquat".

During the symposium several important aspects of *Eriobotrya* culture, biology and genetics were discussed. There were several presentations regarding the evolution of the *Eriobotrya* species and their evaluation for utilization as rootstocks. The formations of new triploids were promising as they have attractive, large seedless fruits following GA application.

We were very fortunate to have supports of the Mediterranean Agronomic Institute of Zaragoza/CIHEAM, and the Scientific and Technical Research Council of Turkey (TUBITAK). During the meeting and city tours, hospitality was generously supported by Antakya Trade and Industry Chamber, Antakya Agriculture Chamber, Antakya Commodity Exchanges, Mediterranean Exporter Unions, Governor of Tarsus and Municipality of Tarsus, Fresh Fruit and Vegetable Commissioner Association of Tarsus, Simge Market, İnci Bulgur, and Has Coach Company. There were splendid gala dinners and participants enjoyed the rich variety of the cuisines from Turkey, the Middle East, and Europe, as well as music and dancing at the final dinner.

Business meeting of Working Group on Loquat unanimously supporting Sicily bid for the symposium in 2014.

There was a one-day field excursion to Tarsus, Mersin where symposium participants were welcomed by folk dances. In the Tarsus part of the symposium, Drs. Janick, Yongqing and Agusti delivered presentations on loquat culture and future predictions as well as basic biology and physiology of the loquat. Later, several loquat orchards were visited with local producers. The participants also visited historic and touristic places in Tarsus. At the end of the day, the participants enjoyed their dinner at the beautiful Tarsus Falls.

The Working Group on Loquat had a business meeting on the last day and chose a venue for the next symposium. The Fourth International Loquat Symposium will be held in Sicily, Italy in 2014, hosted by Dr. Francesca Barone.

Technical visit to loquat orchard in Tarsus.

At the end of the last day afternoon session, the closing ceremony was held, led by A. Aytekin Polat, and Jules Janick, who summed up the scientific achievement of the Symposium and the fellowship of horticulture. At the end of the symposium, a basket prepared by the Organizing Committee containing Turkish souvenirs were given to all participants. The basket included dried apricot, halvah, hazelnut, mixed nuts, pistachios, raisin, red hot chili pepper, Turkish delight and some local sweets.

In conclusion, the symposium gave a great opportunity to the researchers from different countries to present the results of their work, to share their experience, to establish close relations, and to discuss the possible development of activities regarding biotechnological studies on loquat. During the symposium, the participants and accompanying persons enjoyed several social events. Feedback from the participants indicated that they enjoyed the technically informative, warm and friendly feeling of the event. The photo gallery of the event is available on the official web site of the symposium http://loquat2010.mku.edu.tr/

The Proceedings of the Symposium will be published as a volume of *Acta Horticulturae*.

A. Aytekin Polat

Contact

Prof. Dr. A. Aytekin Polat, Mustafa Kemal University, Faculty of Agriculture, Dept. of Horticulture, Antakya Hatay, 31034, Turkey, Phone: (90)326 2455845/1088, Fax: (90)326 2455832, email: apolat@mku.edu.tr or loquat2010@gmail.com,
web: http://loquat2010.mku.edu.tr/

Sixth Int'l Symposium on Irrigation of Horticultural Crops

Section Pome and Stone Fruits – Section Vine and Berry Fruits – Commission Irrigation and Plant Water Relations

Participants of the Symposium.

The Sixth International Symposium on Irrigation of Horticultural Crops was organized in Viña del Mar (Chile) on November 2-6, 2009 by the Universidad de Talca, Instituto de Investigación Agropecuarias (INIA) and Comisión Nacional de Riego (CNR) under the auspices of the Ministry of Agriculture and ISHS. This symposium was convened by Dr. Samuel Ortega-Farias from Universidad de Talca, Dr. Gabriel Sellés from INIA and Mr. Nelson Pereira from CNR. The opening message was done by Mr. Nelson Pereira, Executive Director of CNR, who, in the name of the Agricultural Ministry, indicated the relevance of irrigation in Chile and its key role in the Chilean agricultural development.

This symposium brought together over 180 participants who had the opportunity to attend 6 keynotes, 107 oral and 73 poster presentations. In addition, 3 field trips were organized to visit important zones of vegetable crop production, fruits exportation, and crop and wine production industries. The scientific program addressed the following themes: a) Recent advances in crop coefficients and horticultural crop evapotranspiration, b) Plant-water relations and physiological indicators for irrigation management, c) Irrigation scheduling using soil water content measurements, d) regulated deficit irrigation and oxygation, e) Irrigation systems, water management and productivity, and f) Climate change impact on irrigation practices.

The keynote presentation by Nelson Pereira addressed the "Advances in irrigation in Chile". This presentation indicated that the Chilean government has made an important investment to increase the irrigated agricultural land, reinforce irrigation infrastructure, and improve the irrigation security, water quality, and the water use efficiency of irrigation systems.

The advances in crop evapotranspiration (ETc) studies were addressed by keynote speaker Dr. Richard Allen, who presented the new "hybrid" methods employed for estimating crop water requirements and irrigation scheduling that combine some of the useful 'conservative' features of the crop coefficient and reference evapotranspiration (ETo) with direct physiological models. Advances continue to be made in modeling bulk surface conductance, combination of soil evaporation with transpiration, and adjusting vapor pressure and temperature of the equilibrium boundary layer. Finally, procedures continue to evolve to 'condition' the 'non reference' weather data measured in many environments so that it better represents the reference condition.

The presentation made by Dr. Elías Fereres on "Designing and managing deficit irrigation (DI) in fruit trees and vines" indicated that knowl-

From right to left: Dr. Samuel Ortega-Farias (Convener); Raúl Ferreira (Scientific Committee member); Dr. Hérnan Paillan (Dean, Faculty of Agricultural Science, Universidad de Talca); Dr. Gabriel Sellés (Convener); Dr. Isabel Ferreira (Scientific Committee member); Mr. Nelson Periera (Executive Director of CNR); Mrs. Velia Arriagada (Organizing Committee member).

edge of the yield response to water deficits at the different developmental stages is essential to design DI strategies, in addition to the level of anticipated water supply. Equally important to plan the deficits and their intensity, is to know well the water holding capacity of the root zone, and the expected ETc rate. Also he made reference to new sensors and approaches that are now available to provide feedback on irrigation management.

The paper "Improvement of water use for agriculture at catchment level under drought conditions" presented by Dr. Bernard Itier compares the relative advantages of improvements in practices and changes in cropping systems patterns in order to manage water resources at catchment basin level and thus preserve the cropping systems over the long term.

Dr. Claudio Stockle in his keynote paper on "Impact of climatic change on irrigated agriculture" indicated that irrigated production, changes in water demand and water supply can be critical. Furthermore, population increase, energy price increase, decreasing groundwater levels, and competing demand for surface and ground water by multiple sectors will interact with climate change to produce a "perfect storm" affecting water supply for irrigation.

The keynote paper "Sustainable use of water in agriculture: recycling of sewage" by Dr. José María Quiroga focused on beneficial and advantages of wastewater reuse. The paper presented the different stages in the implementation of a wastewater reuse system, reclaimed water regulations and quality criteria.

Tablegrape vineyard (El Maitenal), Aconcagua Valley, Valparaiso Region.

Dr. Theodore C. Hsiao presented an overview of the potential use of FAO model AquaCrop for managing irrigation and productivity of vegetables. This presentation described features of the AquaCrop model and its potential application to vegetable crop production and irrigation management.

The standard of presentations during the conference was outstanding, creating continuous vibrant discussion. Feedback from delegates has been very positive and many new stimulating ideas have evolved from the symposium. These and much more will provide the impetus for future irrigation research and the potential for international collaboration. The next International Symposium on Irrigation of Horticultural Crops will be in Germany.

Samuel Ortega-Farias and Gabriel Sellés

Contact

Dr. Samuel Ortega-Farias, Casilla 747, Talca, Chile, email: sortega@utalca.cl
Dr. Gabriel Selles, Instituto de Investigaciones Agropecuarias, Santa Rosa, 11610 Santiago, Chile, email: gselles@inia.cl

Section Tropical and Subtropical Fruits

Fourth Int'l Date Palm Conference

The Fourth International Date Palm Conference was held under the High Patronage of His Highness Sheikh Khalifa Bin Zayed Al Nahayan, President of United Arab Emirates, in Abu Dhabi, UAE on 15-17 March 2010. The conference was organized under the auspices of UAE University, in cooperation with Ministry of Presidential Affaires, Khalifa International Date Palm Award, and Date Palm Friends Society.

The Fourth International Date Palm Conference was attended by Government officials, representatives of education and training institutions, scientists, technicians and private date growers. The conference was attended by approximately 400 participants representing the following 42 countries: Albania, Algeria, Austria, Australia, Bahrain, Bangladesh, Canada, China, Costa Rica, Egypt, Finland, France, Georgia, Germany, Greece, India, Indonesia, Iran, Iraq, Italy, Jordan, KSA, Kuwait, Libya, Malaysia, Morocco, Namibia, New Zealand, Nigeria, Oman, Palestine, Pakistan, Qatar, Spain, Sudan, Syria, Tunisia, Turkey, UAE, UK, USA and Yemen. Representatives from the following international organizations were present: Food and Agriculture Organization of the United Nations (FAO), United Nations Development Program (UNDP), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO), International Society for Horticultural Sciences (ISHS), Arab Authority for Agricultural Investment and Development (AAAID), Arab Organization for Agricultural Development (AOAD), Association of Agricultural Research Institutions in the Near East & North Africa (AARINENA), International Centre for Agricultural Research in the Dry Areas (ICARDA), and International Center for Biosaline Agriculture (ICBA).

The conference was co-sponsored by several institutions including Al Dhahra Agricultural Company, Department of Municipalities and Agriculture / Agriculture Sector, Abu Dhabi Food Control Authority, Abu Dhabi Municipality, Ministry of Environment and Water, Abu Dhabi Culture and Heritage, Liwa Dates Festival, Date Palm Global Network (DPGN), International Center for Genetic Engineering and Biotechnology (ICGEB), FAO, UNDP, UNEP, and ISHS.

The opening ceremony was attended by H.E. The former President of Namibia, their Excellencies Minister of Agriculture of Jordan and Sudan, several deputy ministers of Namibia, Bahrain, Oman and Qatar, H.E. Sheikh Abdallah Bin Khalid Al Khalifa / Chairperson of Board of Trustees of Issaa Cultural Center / Bahrain, Chancellor of University of California Davis, USA (UCD), President of University of Bahrain, and Directors Generals, CEOs, and 40 Ambassadors.

The head of the Organizing Committee, Dr. Abdelouahhab Zaid, presented the welcoming remarks. He stressed that this Fourth International Date Palm Conference was held to

Opening speech by Conference Convener Dr. A. Zaid.

Poster session.

show-case UAE's achievements in date palm production. The Chancellor of UCD delivered a key-note speech to scores of people interested in agriculture generally, and date palm cultivation specifically, from both the public and private sectors.

The Fourth International Date Palm Conference called attention to an important crop with significant production and marketing and addressed the networking needs of a unique cohort of scientists. It was appropriately located in an important date producing country, and it will greatly enrich the world literature devoted to date palm through publication of the proceedings in *Acta Horticulturae*.

All presentations at the Fourth International Date Palm Conference succeeded in achieving the objective to share the information of various date palm fields with the conference participants. The main topics of the conference are summarized as follows:

1. Current Status of Date Palm Cultivation in the World.
2. Date Palm Research and Development.
3. Date Palm Protection: Focus was on the most important diseases and pests.
4. Date Palm Processing and Marketing.
5. Organic Date Palm.
6. Substitutes for Methyl Bromide.

Conference participants found the one day Post Conference Tour (18 March, 2010) very useful and instructive. The conference was qualified as highly professional and well prepared.

The conference was a great success that was held with the aim of: Providing an opportunity for updating scientific information on different aspects of date palm production, propagation, protection, and marketing; Comparing the recent experiences in the United Arab Emirates with those of other date growing countries; and Fostering international technical cooperation on different aspects of date palm production chain.

The conference's recommendations were to:

- Create the Khalifa Chair for Date Palm in UAE University to promote research and studies in the field of cultivation of palm and production of dates.
- Issue a scientific journal published twice a year (under the supervision of the General Secretariat of the Khalifa International Date Palm Award, in collaboration with the Date Palm Global Network). That journal will be dedicated to publishing bilingual Arabic and English scientific research on the development of date palm.
- Intensify the scientific and technical cooperation between the various factors involved in the development of date palm, by encouraging the exchange of information and experiences. In this regard, the International Conference series on Date Palm can be considered a model where valuable opportunities for the desired exchange are created and the latest achievements in various aspects of agriculture, manufacture and trade of date palm exhibited.
- Launch a campaign of specialized workshops in the Arab region and the world to discuss the issues and local problems related to cultivation and production of date palm, through broader participation of global quality experiences in the transfer and adaptation of technical knowledge.

Abdelouahhab Zaid

H.H. Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, Chancellor of UAE University, attends the conference opening ceremony.

Contact

Prof. Dr. A. Zaid, Date Palm Research & Development Programme, United Nations Office for Project Services – UNOPS, UAE University, P.O. Box 81908, Al Ain, United Arab Emirates, email: zaid@uaeu.ac.ae

Fourth Int'l Cucurbit Symposium

Participants of the Symposium.

The 4th International Cucurbit Symposium was held in Changsha, Hunan, China on September 21-24, 2009. This symposium was organized by Hunan Agricultural University, Hunan Cucurbit Research Institute, Hunan Administration of Foreign Experts Affairs, the Chinese Society for Horticultural Science (CSHS), and the People's Government of Changsha County of Hunan. In total, 101 registered cucurbit experts and researchers from 19 countries together with their Chinese counterparts attended the 4-day symposium. The theme of the symposium was "Human Health and Cucurbits".

Prof. Kazim Abak, Chair of the ISHS Working Group on Cucurbitaceae (right), handing over the ISHS medal and certificate to Prof. Xiaowu Sun, Symposium Convener (left).

China is the largest country for cucurbit crop production and consumption in the world. This was the first time that an international cucurbit symposium, hosted by the International Society for Horticultural Science (ISHS), took place in China. The symposium was an important event in Changsha and China. Vice Governor of Hunan Province Xu Minghua declared the opening of the 4th International Cucurbit Symposium. Presidents of the Chinese Society for Horticultural Sciences, Hunan Agricultural University and Huazhong Agricultural University, and representatives of the Ministry of Agriculture, Administration of Foreign Experts Affairs and ISHS participated in the opening ceremony. After the opening ceremony, Prof. Mingzhu Wu, Dr. Penelope Perkins-Veazie and Dr. Xiuxin Deng made keynote speeches. There were 46 oral and 169 poster presentations during the symposium. These covered the newest research and development in the areas of genetic improvement & breeding, production techniques & crop physiology, bio and abio-stress management, postharvest, and biotechnology.

The presentations discussed methods and technologies of cucurbit genetic improvement through germplasm/native genetic variation utilization, ploidy manipulation, mutation induction, genomic tool deployment in breeding and biotechnology. Presentations also shared techniques and methods of production improvement through reducing bio-stress (viruses, fungi, bacteria and nematodes) and abio-stress (fertilization, irrigation, temperature, light, salinity, cultural method, protected production and mulching production). Grafting is a unique technique of enhancing genetic potential of cucurbit cultivars and increasing ability of commercial cultivars resistant to bio-stress and tolerant to abio-stress. New grafting methods were introduced and discussed by Dr. Richard Hassel of Clemson University during the symposium. Many presentations, led by the keynote speeches of Perkins-Veazie and Deng, discussed the health compounds offered by cucurbit crops. The messages of health benefits provided by cucurbits were well delivered and received during the symposium. During the closing remarks Dr. Xingping Zhang of Syngenta Seeds requested all cucurbit experts and scientists to do their job to educate our society, funding agents and policy makers of the benefits that the cucurbit industry offers to economy improvements of the countryside and human wellbeing.

Presentations were judged by participants for their scientific merit and clarity of presentation. Four oral presentations were given the "outstanding oral presentation" award and 16 poster presentations were given the "outstanding poster presentation" award, based on the votes received at the end of the scientific programs. The award receivers well represented the technical and geographical areas of cucurbit research.

Dr. Richard L. Hassell visiting the vegetable base in Hunan Agricultural University.

Dr. Sun's team (the Executive Secretariat of the Symposium).

The symposium provided numerous opportunities for participants to share up-to-date research information, discuss techniques and concerns with colleagues from around the world, and get to know the Chinese culture. The traditional performances of Hunan characteristics started at the welcome reception banquette, and the group dancing ended at the long farewell dinner with a lot of fun. Group dinners certainly provided a lot of opportunities for participants to do their networking and develop friendships.

The midweek tour included a production visit to Ganshan Township of Changsha County and a variety display visit to the experimental station of Hunan Agricultural University. The unique trellis + grafting production and long season watermelon production under plastic tunnel were well displayed and initiated a lot of discussions during the tour. Many varieties displayed at the experimental stations allowed participants to see the diversity of cucurbit varieties, particularly watermelon and cucumbers. The professional tour was very well organized and participants were grateful for the unique opportunity of learning and exchanging ideas. Participants further experienced the splendid Hunan hospitality during the tour, lunch at the university dining hall and dinner at the famous culture show restaurant.

Another key feature of the symposium was the participation of the 20 cheerful and helpful students from Hunan Agricultural University as volunteer conference staff. They were there because of their love of people and science, and English language skills. Many of them worked extra long hours to help the participants throughout the symposium. This is a very unique way to engage our future young cucurbit scientists. They were very inspired by what was discussed and presented at the symposium. They asked Dr. Xingping Zhang to speak at the student science corner of Hunan Agricultural University after the symposium.

This was a notably successful symposium that left a lot of good memories and truly provided an effective platform for networking, and especially for foreign scientists the symposium gave the opportunity to get to know Hunan culture and Chinese cucurbit industry. The participants were grateful for the excellent organization of the symposium by Dr. Xiaowu Sun and his team. The 5th International Cucurbit Symposium will be held in Egypt in 2013.

Xiaowu Sun

Contact

Professor Xiaowu Sun, Hunan Agricultural University, Changsha, Hunan, China, email: snowpeak618@126.com

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Australia: Mr. Mike Brown, Paul Casey, Dr. Cassandra Collins, Mr. Deryk Dorjee, Mr. Rolfe Ellem, Mr. Matthew Kleyn, Mr. Ian Logan, Mr. Adrian Rakimov, Mr. David Rickards, Dr. Garth Sanewski, Dr. Brady Smith, Mr. Marcus van Heijst, Mr. Qingfeng Xie; **Barbados:** Dr. Rajendra P. 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CARMINE DAMIANO

Carmine Damiano recently retired from his duty. After his degree in 1967, Dr. Damiano spent a period of research at the University of Naples, specialising in cytology and cell physiology. He spent almost all his career at the Istituto Sperimentale per la Frutticoltura in Rome and a few years at the Ornamental Plant Research Institute in Sanremo, serving as Director of the Propagation Section for more than 15 years, as Director of the Research Station of Caserta from 2004 to 2008, and concluding his career as Director of the Centro per la Ricerca in Frutticoltura (CRA). His main interest was in non conventional breeding, tissue and embryo culture and micro-propagation. Author of more than 300 scientific contributions, Dr. Damiano is a leading scientist of many national and international research projects. He is ISHS member since 1976 and served as Chair of the ISHS Commission Biotechnology, and as Coordinator of the WG on Propagation and Nursery of the Italian Society for Horticultural Science (SOI). He is an esteemed scientist and research partner of a multitude of universities and research centers throughout the world. We recognize the value of his contribution to horticultural research, being sure he will continue to assist young scientists in his field.

Paolo Inglese, SOI President

2010 ISHS Horticultural Economics and Management Best Doctoral Dissertation Award

The International Society for Horticultural Science Best Doctoral Dissertation Award is given to foster and disseminate research in Horticultural Economics and Management. It is presented annually to the person who has submitted the best doctoral dissertation for which a doctoral degree has been granted.

The ISHS Commission Economics and Management is pleased to announce the winner of the Best Doctoral Dissertation Award for 2010 is **Dr. Marcus Mergenthaler** of the University of Hohenheim, Stuttgart, Germany.

A summary of Dr. Mergenthaler' dissertation is presented below

THE FOOD SYSTEM TRANSFORMATION IN VIETNAM: CHALLENGES FOR THE HORTICULTURAL SECTOR POSED BY EXPORTS AND BY CHANGING CONSUMER PREFERENCES.

Food systems are in a process of profound changes on a global scale. Multinational food processing and retailing companies spread globally. This trend is driven by changing consumer demand for food with new safety and quality attributes and by liberalized trade and investment policies. While the influence of the public sector has gradually diminished, private companies bring about new approaches in supply chain governance including private food safety and food quality standards. These developments have important implications for all stakeholders involved in food supply chains, including smallholder farmers in developing countries.

In an empirical analysis, a dataset of 50 Vietnamese fruit and vegetable processing firms

Dr. Peter Oppenheim (left) handing over the Best Doctoral Dissertation Award to Dr. Marcus Mergenthaler (right) at IHC2010.

is employed. In a basic model specification, we explain the export status of a processing firm by a logistic regression approach. Significant positive impacts of QAPs on international market access are detected. The results in a disaggregated model show that the type of QAP differentiates between OECD and non-OECD markets. While the overall probability of exports at a given QAP status does not vary much at different levels of domestic sales, the relative probability of OECD versus non-OECD-exports decreases exponentially, particularly for firms with international QAPs.

Demand elasticities for high-value horticultural products are estimated and demand projections are made based on a survey of 499 households in Vietnam's two major cities. Disaggregated expenditure elasticities for fresh fruits and vegetables from emerging supply chains are significantly higher than the aggregate elasticity. This applies in particular for modern retailers and non-traditional imports. Likewise, these elasticities are higher than the disaggregated elasticities for products from traditional supply chains. Purchased quantities of fresh fruits and vegetables from modern supply chains are projected to grow rapidly over the coming years. Growth is particularly high for products from modern retailers, but also for imports from non-neighboring countries.

Contingent valuation methods are employed to estimate willingness-to-pay for innovative horticultural products. We exploit the potential to gain a more functional understanding of food attribute valuation and the underlying psychological process by employing a mediation framework that explicitly considers consumer perceptions. This framework was first developed within psychological research and recently applied in an analysis of consumer attitudes towards agrobiotechnology. Based on models considering socio-demographic and media predictors as well as consumer perceptions as mediators, we estimate the mean WTP for the food safety attribute to be 60% and for convenience to be 19% higher than the current market price of the respective vegetables.

The results of these studies have important implications for the horticultural industry and for rural development strategies in poor countries. Increasing export and domestic consumer demand for highvalue agricultural products offers new income earning opportunities, provided that actors in the food systems manage to adapt properly to the new market conditions.

ISHS HORTICULTURAL ECONOMICS AND MANAGEMENT BEST DOCTORAL DISSERTATION AWARD

The ISHS Commission Horticultural Economics and Management is pleased to announce that nominations for the Best Doctoral Dissertation in Horticultural Economics and Management are now being sought. To be eligible for the 2011 award, nominated dissertations must report a study, for which a doctoral degree was awarded in the year ending 31st December, 2010.

Applications close March 1, 2011.

Details of the award may be found by visiting:
www.ishs.org/awards/cmem

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YEAR 2010

- October 11-14, 2010, Bleiswijk (Netherlands): **International Conference on Organic Greenhouse Horticulture.** Info: Dr. Carin van der Lans, Research Organic Protected Horticulture, Wageningen UR Greenhouse Horticulture, Postbox 20, 2665 ZG, Bleiswijk, Netherlands. Phone: (31)317-485516, E-mail: carin.vanderlans@wur.nl Web: http://www.organicgreenhouse horticulture.com/

NEW

- October 17-22, 2010, Agadir (Morocco): **VII International Congress on Cactus Pear and Cochineal.** Info: Dr. Akka Oulahboub, Moroccan Assoc. Cactus Development, Av. Mohamed BeLaarbi Alaou, BP 6598, Rabat Instituts, Rabat, Morocco. Phone: (212)537776450, Fax: (212)537774667, E-mail: aoulahboub@yahoo.fr Web: http://www.cactus-congress.com/

NEW

- October 25-28, 2010, Leesburg, Virginia (United States of America): **International Workshop on Biological Control of Postharvest Diseases: Challenges and Opportunities.** Info: Dr. Michael Wisniewski, Usda-Ars, 2217 Wiltshire Road, 25430 Kearneysville, United States of America. E-mail: michael.wisniewski@ars.usda.gov or Dr. Samir Droby, Aro, The Volcani Center, P.O.Box 6, 50250 Bet Dagan, Israel. E-mail: samird@volcani.agri.gov.il Web: http://www.bard-isus.com/ws/ph/

NEW

- November 21-25, 2010, Campinas (Brazil): **I International Symposium on Genetic Research of Bamboos and Palms and III International Symposium on Ornamental Palms.** Info: Dr. Antonio Fernando Tombolato, Instituto Agronomico, Avenida Barão de Itapura 1481, Caixa Postal 28, 13012-970 Campinas SP, Brazil. Phone: (55)1932415188, Fax: (55)1932417570, E-mail: tombolat@iac.sp.gov.br or Prof. Kathia Pivetta, Rodovia Carlos Tonanni, Km 5, Departamento de Horticultura, 14870-000 Jaboticabal, Brazil. Phone: (55)163232500, Fax: (55)163224275, E-mail: kathia@fcav.unesp.br Web: http://www.infobibos.com/symbampalm/

- November 22-26, 2010, Kingston (Jamaica): **I International Symposium on Tropical Horticulture - TropHort2010.** Info: Prof. Dr. Noureddine Benkeblia, The University of the West Indies, Department of Life Sciences, Mona Campus, Kingston 7, Jamaica. Phone: (1)8769271202, Fax: (1)8767024203, E-mail: noureddine.benkeblia@uwimona.edu.jm Web: http://ocs.mona.uwi.edu/ocs/index.php/th/th1

- November 23-26, 2010, General Roca (Rio Negro) (Argentina): **XI International Pear Symposium.** Info: Dr. Enrique E. Sanchez, INTA Alto Valle, Casilla de Correo 782, 8332 General Roca, Rio Negro, Argentina. Phone: (54)29414439000, Fax: (54)2941439063, E-mail: esanchez@correo.inta.gov.ar Web: http://www.inta.gov.ar/altovalle/Pears2010/index.html

- December 5-9, 2010, Dakar (Senegal): **International Symposium on Urban and Peri-Urban Horticulture in the Century of Cities: Lessons, Challenges, Opportunities.** Info: Dr. Remi Nono-Womdim, FAO-AGP, Viale delle Terme di Caracalla, 00153, Rome, Italy. Phone: (39)0657052772, Fax: (39)0657056347 E-mail symposium: uph-symposium@fao.org Web: http://www.fao.org/agriculture/crops/core-themes/theme/hort-indust-crops/isd/en/

YEAR 2011

- March 14-17, 2011, Salatiga (Central Java) (Indonesia): **I International Symposium on Sustainable Vegetable Production in South-East Asia.** Info: Prof. Dr. Stefaan De Neve, University of Gent, Coupure Links 653, 9000 Gent, Belgium. E-mail: stefaan.deneve@ugent.be or Dr. Sri Rochayati, Indonesian Soil Research Institute, Jl. Juanda, Bogor, Indonesia. E-mail: sri.rochayati@gmail.com E-mail symposium: VegSEA2011@ugent.be Web: http://www.vegsea2011.ugent.be/

- March 19-23, 2011, Davis, CA (United States of America): **I International Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops.** Info: Dr. Mallikarjuna Aradhya, USDA Germplasm Repository, One Shields Avenue, University of California, Davis, CA 95616, United States of America. Phone: (1) 530-752-6504, Fax: (1) 530-752-5974, E-mail: aradhya@ucdavis.edu or Dr. Daniel Kluepfel, USDA ARS - 378 Hutchison Hall, Dept.Plant Pathology, Univ. Ca, Davis, One Shields Ave., Davis, CA 95616, United States of America. E-mail: dakluepfel@ucdavis.edu Web: http://www.wildcrops2011.org/

NEW

- March 24-26, 2011, Djerba (Tunisia): **IV International Symposium on Medicinal and Aromatic Plants SIPAM2011.** Info: Dr. Houcine Khatteli, Institut des Régions Arides, Route de Djouf, Km 22,5, 4119 Médenine, Tunisia. Phone: (216)75633121, Fax: (216)75633006, E-mail: h.khatteli@ira.rnrt.tn or Dr. Mohamed Neffati, Institut des Regions Arides (IRA), Route de Djorf Km 22,5, 4119 Medenine, Tunisia. Phone: (216)75633839, Fax: (216)75633006, E-mail: neffati.mohamed@ira.rnrt.tn E-mail symposium: sipam@ira.rnrt.tn Web: http://www.sipam.ira.rnrt.tn/

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- April 4-7, 2011, Adelaide (Australia): **International Symposium on Organic Matter Management and Compost Use in Horticulture.** Info: Mr. Johannes Biala, PO Box 74, Wynnum Queensland 4178, Australia. Phone: (61)7-39011152, Fax: (61)7-33962511, E-mail: biala@optusnet.com.au Web: http://compost-for-horticulture.com/

- May 8-12, 2011, Volterra (Italy): **VIII International Workshop on Sap Flow.** Info: Prof. Dr. Luca Sebastiani, S.S.S.U.P. Sant Anna, Piazza Martiri della Libertà, 33, 56127, Pisa, Italy. Phone: (39)050883111, Fax: (39)050883495, E-mail: l.sebastiani@sssup.it or Dr. Roberto Tognetti, Universitá degli Studi Molise, Dipartimento STAT - Univ. del Molise, Contrada Fonte Lappone, 86090 Pesche, Italy. Phone: (39)0874404735, Fax: (39)0874404678, E-mail: tognetti@unimol.it or Antonio Motisi, Dipartimento di Colture Arboree, Facolta di Agraria, Univ. Di Palermo, Viale delle Scienze, 11, 90128 Palermo, Italy. Phone: (39)0917049021, Fax: (39)0917049025, E-mail: motisi@unipa.it E-mail symposium: sapflow8th@sssup.it Web: http://www.sapflow8th.sssup.it/

- May 15-19, 2011, Puebla (Mexico): **II International Symposium on Soilless Culture and Hydroponics.** Info: Dr. María de las Ni Rodríguez Mendoza, Area de Nutriciòn Vegetal. IRENAT, Colegio de Postgraduados, Montecillo, Texcoco Edo. Méx, 56230, Mexico. Phone: (52) 595 95 51030, Fax: (52) 595 95 1 01 98, E-mail: marinie@colpos.mx E-mail symposium: issch@colpos.mx Web: http://www.soillessculture.org/

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