Chronica Horticulturae

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CHRONICA HORTICULTURAE

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Cover photograph: Marketable Bromeliads from Deroose Plants, Inc., Apopka, Florida. Photo by courtesy of Chris Fooshee, University of Florida, IFAS, Mid-Florida Research and Education Center, see article p. 9

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

ISHS

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Ian J. Warrington, ISHS Vice-President

Each annual meeting of the ISHS Executive Committee (EC), involving the Board and Chairs of all ISHS Sections and Commissions, is planned several years in advance. The invitation to host the June 2005 meeting came in 2002 from the ISHS Council members for Norway, Professor Roar Moe of the Agricultural University of Norway and Dr. Lars Sekse of the Ullensvang Research Centre of Planteforsk. It was purposely scheduled to overlap the Fifth International Symposium on Artificial Lighting that was held at the same venue in picturesque Lillehammer. As is normal practice, the ISHS Board met independently just ahead of the EC meeting. Every meeting room detail, tour and social event was carefully planned and executed by our Norwegian hosts - the result being a very productive and enjoyable week for all Symposium participants and Society leaders.

THE BOARD MEETING

Reports from the Secretariat and each Board member revealed the healthy financial state of the Society, the success we are having in improving web resources and diversifying our publications, the impressive growth in membership, and the smooth functioning of the Secretariat. The efficiency of the latter is illustrated by the fact that 22 of the expected 34 volumes of *Acta Horticulturae* to be published in 2005 were completed and distributed by mid-year.

We learned that recent efforts to attract new Country-State members from the developing

ISHS Board* and Executive Committee. From left to right: Lyle Craker, Ayman Abou-Hadid, Robert K. Prange, Johan van Scheepen, Gert Groening, Norman E. Looney*, Jules Janick*, Isabel Ferreira, Kim Hummer, Robert J. Bogers*, Uygun Aksoy*, Ian J. Warrington*, John Erwin, Alfons Vanachter, Víctor Galán Saúco, Omer Verdonck, Daniel J. Cantliffe, Ted DeJong, Peter Oppenheim, Geoffrey R. Dixon, Jung-Myung Lee*, Errol W. Hewett, Sadanori Sase, Gene Albrigo, Jozef Van Assche*, Ben Ami Bravdo, Carmine Damiano.

Scenic beauty of Norway.

world are proving very successful. With the addition of Indonesia, Nigeria, and Tanzania, the ISHS Council now represents 52 countries. Furthermore, the Executive Director reported that discussions are well advanced with five other countries. The Board is hopeful that the 2006 meeting of Council (at IHC2006 in Seoul) will set a new record for country representation. Every country that has expressed an interest in joining the Society will be invited to send observers. As per recent changes to the Rules, low income countries represented at Seoul will be granted Category IV membership status for one year.

Much discussion at this meeting related to rethinking the long-standing category of "Organizational Membership" in the Society. Efforts by this Board to extend the reach of ISHS through strategic partnerships with international development agencies and other organizations is largely behind this initiative. To illustrate, while ISHS has long had a healthy working arrangement with FAO, a United Nations body that supports several of our Working Groups, we have not had a way to recognize FAO as an official partner. This will change with the introduction of a new category of association to be called ISHS Partners. This designation will recognize those agencies and organizations with which ISHS has a negotiated agreement and a clear business relationship - Partners support the Society in some substantial way while ISHS contributes importantly to their business. Another good example is the International Horticultural Congress.

In addition to the FAO, we see several of the CGIAR Future Harvest Centers, the World Vegetable Center (AVRDC), the European Union's Technical Centre for Agricultural and Rural Cooperation (CTA), and France's Centre de Coopération Internationale en Recherche Agronomique pour le Développement - Département Productions Fruitières et Horticoles (CIRAD-Flhor) as being strong candidates for ISHS Partner recognition. It would also seem appropriate that our recently concluded arrangements with the International Society of Citriculture and the International Peat Society be recognized with the ISHS Partner designation.

What were previously called Organizational Members will now be called Institutional Members. For an annual fee the Society provides publications and access to web-based resources to research centers, libraries, and other public sector institutions.

And finally, in recognition of the growing proportion of ISHS members working in the private sector, there will be a new non-voting category of "membership" called Corporate Associates. Here, for an annual fee reflecting the package of products and services requested, Corporate Associates will be recognized as supporters of the Society and at the same time receive valuable products and services for their professional staff.

The next Board meeting is set for Rome in early December. In addition to dealing with the normal agenda of Society business the Directors will hold meetings with senior officials of FAO and its Global Forum for Agricultural Research (GFAR). They will also sign a Memorandum of Understanding with the Global Crop Diversity Trust - a document recognizing ISHS and its Commission on Plant Genetic Resources as key players in the community of scientists engaged in protecting and improving horticultural crop genetic resources. The GCDT is the "action arm" of the International Treaty for Plant Genetic Resources for Food and Agriculture and is administered by staff at FAO and at the International Plant Genetic Resources Institute (IPGRI), also in Rome.

These meetings are seen by the Board as being key to our goal of achieving greater cooperation with FAO and the CGIAR (represented in Rome by IPGRI). Thus, there was much discussion at Lillehammer about how to get the most from these consultations.

THE EXECUTIVE COMMITTEE MEETING

The Executive Committee, chaired by the ISHS Vice-President, also had a very full schedule of business to consider at the Lillehammer meeting. It was a pleasure to welcome to the meeting the Chairs of the new Section on Citrus (Dr. Gene Albrigo) and Commission on Sustainability through Integrated and Organic Horticulture (Dr. Robert Prange). The EC continues to review the depth and breadth of the Society's scientific activities. In that regard, an area of growing interest is the many contributions that fruits and vegetables make to human health and well-being. A major ISHS conference on this topic was recently held in Canada (Québec, August 2005). A new Working Group has now been formed to ensure that the momentum gained in this area is not lost and a proposal to launch a new Commission on Horticulture and Human Health will be before the EC at its next meeting (at IHC2006 in Korea).

The forward schedule of new symposia approved or re-confirmed at Lillehammer is very impressive - the essential information about each is posted at www.ishs.org (click on Calendar of Events). Every effort is made to avoid clashes in the overall symposia programme and feedback is welcomed at any time on improvements that might be considered.

Much attention was devoted to the next International Horticultural Congress and Exhibition to be held in Seoul on August 13-19, 2006. Members will now have received the Second Announcement and Call for Papers, a late draft of which was discussed in depth by the Board and EC at Lillehammer. The EC was pleased by the exciting line-up of scientific symposia, the very interesting colloquia and the intention to have a major exhibition on horticulture that will be open to the public throughout the Congress. The schedule of Workshops and Working Group Meetings is still very much under development - there is still time to forward suggestions to IHC President Lee and his organizing team for consideration.

It is important to point out that the ISHS Vice-President and Executive Committee have had significant input during the development of IHC2006. It will be a Congress that every horticultural science professional will want to attend!

The Rules of the Society require that leadership at all levels is renewed regularly. The leadership of our Sections and Commissions is no exception and some ten EC members will become ineligible to stand for re-election at the time of the Seoul Congress. Thus, it is certain that there will be new leaders of the three Sections dealing with Vegetables, Tropical and Subtropical Fruits, and Medicinal and Aromatic Plants. Likewise, the Chairs of seven Commissions: Economics and Management, Education and Training, Landscape and Urban Horticulture, Plant Protection, Plant Substrates, Protected Cultivation, and Quality and Post-harvest Horticulture, will retire at Seoul. Every Society member belonging to one or more of these Sections and/or Commissions is urged to watch for the Call for Nominations and to consider offering his or her energy, ideas and experience. One consideration to keep in mind during this leadership renewal process is that the number of women holding ISHS leadership positions is well below what it should be. Leadership of a Section or Commission is a rewarding experience and provides the opportunity to make an important contribution to our profession.

A Call for Nominations: ISHS Honorary Membership and Fellowship

Nominations for new Honorary Members and Fellows of the ISHS will be considered by the Council at its meeting in Korea next year. Any nomination for this should be received at the Secretariat not later than April 15th, 2006, for consideration by the ISHS Nomination and Award Committee and the ISHS Board prior to the meeting of the Council.

ISHS HONORARY MEMBERSHIP

Honorary Membership, the Emeritus Award of the ISHS, is given by the Council to a person who is a member of the ISHS, at the end of his/her career, in recognition of his/her outstanding service to the Society. A certificate will be given to the recipients of this ISHS Award.

ISHS FELLOWSHIP

The ISHS Fellowship is presented to any person, regardless of his/her age, ISHS member or non-member, in recognition of this person's outstanding contribution to horticultural science worldwide and/or for his/her meritorious service on behalf of the Society. A precious metal pin and a certificate is given to the recipients of this ISHS award. The total number of ISHS Fellows should not exceed 1% of the total membership, averaged over a period of 4 years.

PROCEDURE

The ISHS Nominations and Awards Committee (hereafter: 'The Committee') invites the members of the Society, through this announcement in *Chronica Horticulturae*, to bring possible candidates for an ISHS Honorary Membership and Fellowship to the attention of the Society. Nominations should be accompanied by five letters of support, giving reasons why a nominee is considered worthy of an honour; these letters must come from members in no less than three different countries. Nominations must be received by the Executive Director at least three months prior to the Council meeting. The Executive Director will collect the suggestions and will send these, together with the letters of support, to 'The Committee'. After consideration by 'The Committee' and the ISHS Board, the suggestions received and motivated recommendions will be presented to the Council, which will decide who will receive the Awards. The presentation ceremony will take place at the next Congress (IHC2006 Seoul, Korea) during the General Assembly of the ISHS.

Issues

The Challenge of Distance Learning in Horticulture

Geoffrey R. Dixon

Education in any discipline and at any level of attainment should increase the student's powers of understanding, deduction, integration and prediction based on an enhanced store of knowledge. It should not be the accumulation and regurgitation of information that is readily available in reference books and the World-Wide-Web. Learning how to use information to build knowledge and scholarship in an integrative manner is the essence of an effective education.

Most systems of education are dependent on public tax raised finance to a greater or lesser extent. As a consequence, political priorities for simplification (modularisation or unitisation), mass delivery, increased speed, reduced cost, and provision for career changes have become dominating and driving forces in the formulation of public education. These processes are frequently clothed in the framework of the "market economy" and encapsulated in terms such as "value for money," "satisfying customer demands," "achieving client satisfaction" and "student-centred learning." The underlying logic of pedagogical arguments that shift education towards learning as opposed to teaching have much to recommend them. This shift does, however, require greater provision of human and physical resources if it is to improve education and this adds to the overall costs of education. Without such increased financial investment the student-centred learning approach levels down education and erodes scholarship.

Some educationists and more particularly policy makers and politicians see electronic delivery at a distance as one route towards student-centred learning as opposed to teaching-centred learning that avoids the penalty of increasing costs. Experience shows that the reverse is true and that good quality, effective distance learning provided by electronic delivery demands an investment in teaching staff and resources that is at least on a par with face-to-face learning. This article considers the particular requirements for an education in horticulture and how these may be satisfied by electronic distance delivery using examples from leading centres of excellence.

WHAT IS EDUCATION IN HORTICULTURE?

Traditionally education in horticulture has integrated the relevant arts, sciences, humanities and husbandries into students' knowledge bases that allowed entry into widely differing careers with a considerable span of responsibilities (Dixon, 2005). Essentially this is not radically different to the education offered to engineers or architects.

Face-to-face education in each of these disciplines demanded the availability of a large tea-

ching staff composed of individuals possessing specialist knowledge and expertise. An additional luxury offered to horticultural students was that institutions attempted to maintain small areas of production for a multitude of different vegetable, fruit, and protected ornamental crops. The force of institutional finances has largely consigned the latter luxury to history except in a few cases of special provision such as the Niagara Parks Department, Canada (Klose and Whitehouse, 2004) (Fig. 1) or the Royal Botanic Gardens in Great Britain.

The essential elements for an education in horticulture are firstly, knowledge drawn from across a wide range of interrelating subjects and secondly, exposure to and involvement with the practical and sustainable manipulation of plant growth and reproduction. Delivery of the first part of these requirements at least should be amenable to electronic delivery at a distance.

WHAT IS DISTANCE LEARNING?

Distance learning is any situation whereby the teacher and student are separated by space and possibly by time. The greatest experience with this form of learning is probably in Australia which boasts a world renowned educational system for school-age children living in the "outback" based originally on the use of radio. In Great Britain the Open University was founded in the 1960s and continues offering very successfully high quality undergraduate education in most disciplines based initially on the use of television. Teachers across the USA pioneered the use of video systems from the late 1970s onwards. The advent of the World-Wide-Web (www) and easy availability of low cost electronic desk and laptop computers expands the opportunities for distance learning to an unlimited extent.

MANAGING THE DILEMMA OF QUALITY AND QUANTITY

The World-Wide-Web offers students access to oceans of information (Scott and Dixon, 2004) and a myriad of courses. It becomes ever more important that the student is capable of rejecting or ignoring irrelevant information and able to concentrate on nub issues and differentiate between valuable and useless courses. Huge numbers of educational institutions world-wide are now offering courses via electronic means. Students in one country can sign up and pay electronically for courses originating on the other side of the planet in the matter of a few minutes. This might be termed "fast-food education" (England, 2005). The plethora of courses raises the question of how the students differentiate between them especially as initially they will have only limited knowledge on which to make a quality judgement. It is feasible to take the free-market approach of "buyer beware" (*caveat emptor*) but is that fair to users who do not have the knowledge with which to make informed choices?

Certainly it is not possible to police or even mildly regulate what is placed on the web in the name of horticultural education. It does however, behove professionals such as members of the International Society for Horticultural Science (ISHS) to ensure that material for which they are responsible is fit for the purpose that is claimed. National horticultural professional bodies, especially those offering "Continuing Professional Development" (CPD) to their members, have responsibilities to ensure the veracity of web based courses accepted for such schemes.

The situation is more straightforward where web courses are offered by *bona fide* educational institutions as part of their existing provision for awards, such as colleges and universities, leading on to their degree structures. Here the institutions, particularly in Europe and increasingly Australia, are regulated for the quality of their provision. Alternatively the courses may adhere to a format and even content that has been designed by the awarding body and yet may be delivered by other organisations. This is the case with the development of a modularised form of the Master of Horticulture (M. Hort.) qualification of the Royal Horticultural Society of London, which is amenable to delivery in an electronic form.

SUCCESSFUL ELECTRONIC DELIVERY AT A DISTANCE

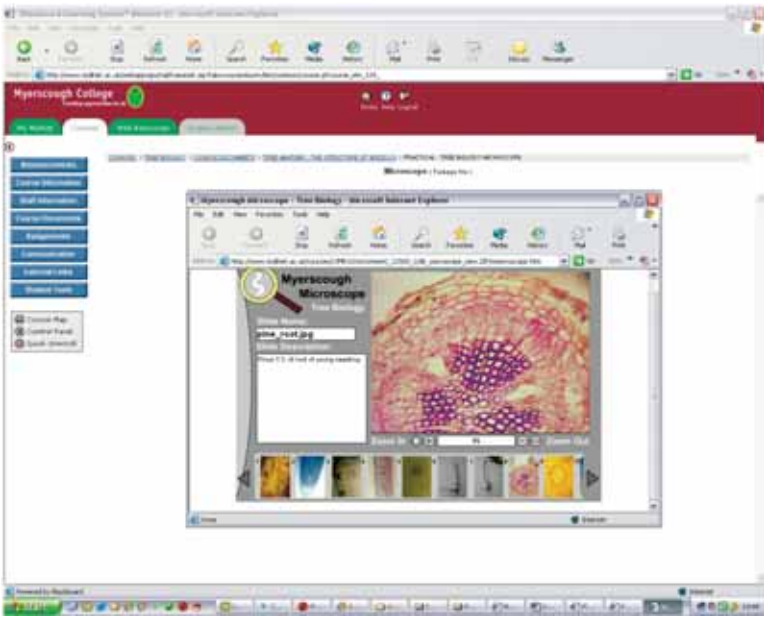
The key feature regarding the use of electronic delivery at a distance is that the original teacher should totally review and revise what is to be learnt and analyse the substance of the traditional course in great depth. It is essential to offer in the electronic format rounded core issues that form the key components of the topic being considered. Electronically delivered courses should not take the form of simply a set of lecture notes posted on the web. If they do then the teacher is short changing the student in a reprehensible manner. Many other aspects of electronic provision are similar to those for conventional delivery. Indeed where courses have been transferred to the virtual classroom, it is found that the problems thrown up by distance student are remarkably similar to those normally encountered in face-to-face delivery. There is of course a running-in phase when the electronic software is being tested for reliability and robustness but once this is concluded most problems can be resolved by access to appropriate members of staff, either in real time or via bulletin boards and email addresses. It is found that distance students make use of each other's knowledge and expertise in a similar fashion to those in a physical classroom. Experiences and abilities are shared and valued by the student body. This is important because it enables distance students to develop the camaraderie of conventional peer groups. Much the most important element is that students should have reliable and scheduled access to members of staff for mentoring and tuition. There should also be provision for a rapid response where there are software problems so that electronic faults do not impede the process of learning and submission of course work. The latter is of especial importance where assignments require to be submitted by specified dates.

ELECTRONIC COURSES FOR DISTANCE DELIVERY

Examples of courses leading towards a recognised award are typified by the Degrees awarded in Arboriculture, Horticulture, and Turf Science offered electronically by Myerscough College in collaboration with the University of Central Lancashire, Preston, UK (Anon, 2005). These courses have been transferred successfully from the traditional face-to-face full time classroom format to part time delivery by electronic means (Fig. 2). This requires the student to commit 15 hours per week for the duration of the course that may require several years. These courses are divided into an established framework of

Figure 1. The Niagara Parks Botanic Garden.

Figure 2. Teaching tree anatomy by electronic distance learning. Picture by courtesy of Dr. Julie Young and Myerscough College, UK.

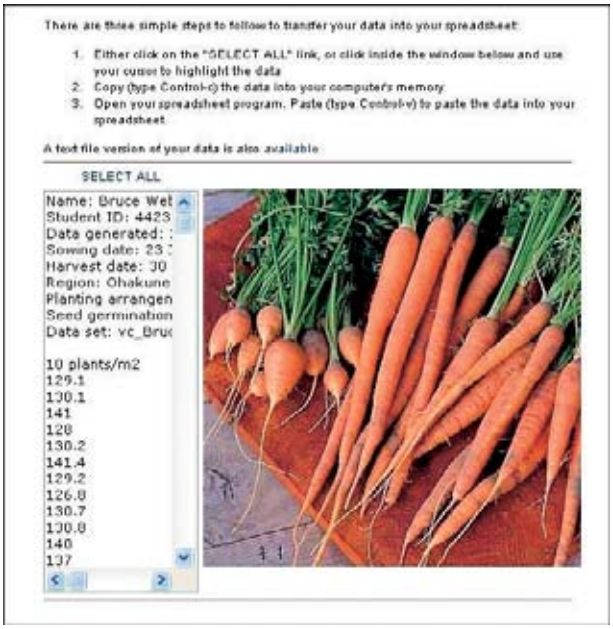


modules that are completed in a regulated manner. Progress is measured by the fulfilment of course work assignments and end of year examinations. Details of the courses can be obtained from: www.myerscough.ac.uk

At a higher level still the University of Melbourne, Australia offers masters courses in agribusiness by distance learning. These are especially suited to students who have several years experience and may be reaching the ranks of middle and upper management (Anon, 2004; McSweeney, 2005).

Alternatively single courses may be designed to achieve more limited but specific targets within a larger program. This provides an easy and effective means of teaching crop yield and density relationships to distance students. It enables students to examine a wider range of production variables that impact on crop yield than if real crops were grown. VirtualCarrots is an online tool designed to improve students' understanding and lecturers' teaching of yield-density relationships in field crops (MacKay et al., 2005, email: b.mackay@masey.ac.nz). With VirtualCarrots (Fig. 3) students "grow" crops of carrots under a range of production variables (e.g. required marketable size, time of year, location and density). VirtualCarrots generates sets of data and graphs that students evaluate and interpret based on their theoretical understanding of yield and density relationships. Students can, for example, examine the influence of sowing density, sowing dates, and cultivar differences for prescribed market yields and harvest dates by instantly "growing" crops of carrots on-line. They can examine relative outcomes for a range of prescribed conditions (e.g. how is root size distribution influenced by sowing pattern?). For each set of input variables, VirtualCarrots generates predicted yield quantity and quality data sets in a downloadable form for subsequent off-line analysis and interpretation by students.

Figure 3. Teaching plant density x yield relationships using the Virtual Carrot. Picture by courtesy of Dr. Bruce MacKay and Massey University, New Zealand.



A widespread failing of many on-line university courses is that they replicate passive and traditional pedagogical methods in an on-line environment. Without the opportunity to participate and interact with case studies and problem-solving activities students do not engage with on-line content. This results in poor learning achievement. Sites with good practice that avoid these pitfalls are found for example at: www.hort.purdue.edu.

New Zealand and USA researchers (MacKay and Fisher, 2005) have developed a case study based on nutrient toxicity symptoms for a glasshouse flower crop. This includes photographic and text descriptions of the problem and a series of laboratory tests that provide additional data. But there is a "cost" to purchase the added information. This case study was presented to students, growers, and educators using an internet based tool for case studies in horticultural education - the Ramosus maze. Ramosus is an active learning tool, based on the maze metaphor of a simulated situation created to mimic the strategic decision-making of real life (Fig. 4). Users commented that Ramosus provides users with "the feel of the real situation" and made them think "diagnostically." Ramosus encourages deep learning and adds value to on-line courses, by balancing the need to increase the student's knowledge base and their use of that knowledge. The ability to track student progress through the maze also provides additional feedback to instructors on the student's level of knowledge and ability to integrate concepts.

CAN SKILLS BE DELIVERED AT A DISTANCE?

Distance learning opens up opportunities for learning practical skills that require the use of tools and hand manipulation which have previously been taught by face-to-face instruction, demonstration, and practice with immediate (synchronous) feedback, e.g. budding and grafting. Hennigan and Mudge (2004) set up the course "The How, When and Why of Grafting" (http://www.instruct1.cit.cornell.edu/courses/hort494/mg/index.html) which embraces top

Figure 4. Teaching plant nutrient demand and fertiliser applications using the Ramosus Maze.
Picture by courtesy of Dr. Bruce MacKay and Massey University, New Zealand.

wedge grafting, chip budding and t-budding. Student grafting was evaluated by them on basis of pressure, avoidance of desiccation, and cambial alignment. This program was tested in a statistically validated experiment that showed that students could effectively learn grafting by distance learning equally as well as by face-to-face methods.

The Maryland Nursery Crops Nutrient and Water (Lea-Cox et al., 2004) program provides tuition for campus based and off-campus students and industry professionals. There is a problem-based approach by which students analyse, synthesise, and evaluate information enabling them to create and implement on site water and nutrient management plans for individual nursery and glasshouse operations. The course consists of six content modules covering science or subject matter necessary to understand the nutrient and water management planning processes. These modules are supported and enhanced by text resources, hypertext links to external websites and resources, photographs, graphic illustrations, powerpoint presentations and video clips.

An unusual part of this scheme is that growers, consultants, extension professionals and students are partnered into teams. Each team writes a management plan for a real nursery or glasshouse (usually the operation of the grower on the team) during the course. By interacting as teams students not only apply theoretical knowledge from the course, but also learn from the experiential knowledge of the various professionals on the team, in situations where they are faced with solving real-life challenges. The actual nursery or glasshouse site used in the case study is a unique resource that is integral to the course. Students are not given a theoretical paper-based case study to work on but a real operating nursery or glasshouse site from which to collect data and prepare a nutrient management plan. The assignments are therefore based in reality. Student progress is evaluated by several means including quizzes, the quality of participation in discussion forums, individual and team assignments posted to the students and ultimately the quality of the team project - the water and nutrient management plan. There is no final examination for this course. The nutrient management plan is the main assessment tool that is used to ascertain whether a student is competent. Final plans are signed by a certified nutrient management planner and submitted for final review by officials of the Maryland Department of Agriculture, the regulatory authority in Maryland. This electronically delivered course makes particularly admirable use of the interactions between students; the manner by which they learn from the experiences of others is especially good practice.

THE FUTURE

Electronic delivery at a distance is a major addition to the manner by which horticultural education is provided around the world. It provides many new opportunities for a discipline that provides the intellectual base and drive for a major global industry. Educationists specialising in the discipline of horticulture have responsibilities to ensure that such courses are of the highest possible quality and fitness for purpose. This can only be achieved by dialogue within our peer group. The ISHS provides the opportunity for this dialogue through Symposia such as that held in Perth, Western Australia in 2004 and at the International Horticultural Congresses. At the IHC planned for Seoul, Korea in 2006 there will be opportunities for scholars and educationists in horticulture to discuss this and related topics. Come along and benefit from and contribute to these meetings.

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The World Foliage Plant Industry

Jianjun Chen, Dennis B. McConnell and Richard J. Henny

During the last century and a half, the foliage plant industry has become truly global. The current situation can be simplified as four centers of foliage plant origins (Africa, Asia, Australia, and Central and South America), four regions producing propagules (Asia, Central and South America, Europe, and North America), and three regions of finished plant production (Asia, Europe, and North America). Today someone living in Poland may be watering a *Dieffenbachia* cultivar in his home that was initially propagated in a tissue culture laboratory in China, finished in the United States, and then sold at the Aalsmeer auction in the Netherlands. That scenario omits the fact that the *Dieffenbachia* species used to develop the cultivar were collected in Brazil and Colombia and then hybridized in England!

Foliage plants, defined literally, would include all plants grown for their beautiful leaves rather than for flowers or fruits. In general horticultural terms, foliage plants are those with attractive foliage and/or flowers that are able to survive and grow indoors (Fig. 1). Thus, foliage plants are used as living specimens for interior decoration or interior plantscaping (Fig. 2). In common terminology, foliage plants are referred to as houseplants. However, in the tropics they may also be grown under shade as landscape plants (Fig. 3).

Starting from cuttings, tissue cultured liners, or seeds, foliage plants are generally produced in soilless media confined by containers in shaded greenhouses or shadehouses. Some foliage plants used as interiorscape trees are grown in full sun for the first part of their production cycle, and then grown under shade. Regardless of their specific production protocols, all plants have to be managed properly including light, temperature, water, fertilization, and pest control until they approach marketable sizes called finished plants (Chen et al., 2005). The plants are then acclimatized, graded, and shipped to destinations for interiorscaping. Acclimatization is a seriate procedure in which light intensity, nutrient supply, and irrigation frequency are reduced to anatomically and physiologically alter the plant so that it will survive and even thrive after shipping and placement in an interior environment. Small pot plants may require several weeks to acclimatize, while large interior trees may require a minimum of six

Figure 1. Potted foliage plants: (A) *Codiaeum,* (B) *Monstera,* (C) *Cordyline,* (D) *Tacca,* (E) *Nepenthea,* (F) *Dracaena,* (G) *Anthurium,* (H) *Alocasia,* (I) *Syngonium,* (J) *Vriesea,* (K) *Aglaonema,* (L) *Chlorophytum,* (M) *Calathea,* (N) *Spathiphyllum,* (O) *Guzmania,* (P) *Philodendron,* (Q) *Dieffenbachia,* (R) *Schefflera.*

Figure 2. Foliage plants used for interiorscaping: (A) Hotel lobby in Orlando, Florida, (B) Convention center, Kissimmee, Florida, (C) *Anthurium* with water fall in hotel in Nashville, Tennessee, and (D) Bamboo palm (*Chamaedorea elegans*) in office lobby.

months. Therefore, the complete foliage plant cycle comprises: (1) plant propagation via tissue culture, rooting of cuttings, or seed germination; (2) production of marketable plants from tissue cultured liners, rooted cuttings, or seedlings; and (3) postproduction plant care, including shipment, interiorscape installation, and maintenance.

Because of their varied growth habits, multitude of foliar charms, brilliant patterns of leaf variegation and texture, elegant flower shapes and colors, as well as tolerance to low light levels, foliage plants have become an integral part of contemporary design for building interiors and play an important role in our daily lives. Plants bring beauty and comfort to our surroundings, contribute to the psychological well-being of people, and remind us of nature (Manaker, 1997). In addition, plants in building interiors reduce dust, act as natural humidifiers (Lohr and Pearson-Mims, 1996), and purify indoor air. A NASA-funded project concluded that foliage plants can remove nearly 87% of air pollutants from sealed chambers within 24 hours. For example, each Peace Lily (*Spathiphyllum* 'Mauna Loa') plant removed 16, 27, and 41 mg formaldehyde, trichloroethylene, and benzene, respectively, from sealed chambers after a 24-hr exposure to the respective chemical (Wolverton et al., 1989). Later, researchers at the Oak Ridge National Laboratory (Cornejo et al., 1999), from Germany (Giese et al., 1994), Australia (Wood et al., 2002), and Japan (Oyabu et al., 2003) also demonstrated that foliage plants are able to abate toxic levels of air-borne pollutants in building interiors.

The esthetic and psychological enhancement of interior environments and purification of indoor air have become catalysts in promoting foliage plant production and increasing their wholesale value. For instance, the wholesale value of foliage plants in the United States (U.S.) increased from $13 million in 1949 to $663 million in 2002, which was a 51-fold increase in 53 years. With increasing worldwide urbanization and an innate desire for naturalistic environments within our building interiors, foliage plant production and utilization have become a truly globalized industry. Propagation, production, and interior use of foliage plants as well as plant related transportation, retail sales, and services contribute significantly to the world economy and our sense of well-being.

FOLIAGE PLANT ORIGINS

Most foliage plants are native to the world's tropical or subtropical regions. It is estimated that plants from more than 100 genera and at least 1,000 species have been and can be grown as foliage plants (Chen et al., 2005). Important genera of foliage plants indigenous to tropical Africa include *Aloe, Asparagus, Chlorophytum, Chrysalidocarpus, Coffea, Crassula, Cyanotis, Dracaena, Haworthia, Hypoestes, Kalanchoe, Leea, Pandanus, Saintpaulia, Sansevieria, Senecio, Strelitzia,* and *Zamioculcas*. Asia is the origin of *Aeschynathus, Aglaonema, Alocasia, Aspidistra, Asplenium, Aucuba, Begonia, Chlorophytum, Codiaeum, Coleus, Cordyline, Epipremnum, Fatsia, Ficus, Gynura, Homalomena, Hoya, Phoenix, Pittosporum, Polyscias, Sansevieria, Schefflera,* and *Spathiphyllum*. The distinction of foliage plant origin between Australia-Oceania and Southeast Asia is difficult. It is generally believed that *Araucaria, Asplenium, Blechnum, Cissus, Cordyline, Dizygotheca, Howea, Platycerium, Polyscias,* and *Schefflera* are largely native to the Australia-Oceania region. The warm and humid climate of South and Central America nurtures diverse foliage plants including *Adiantum, Aechmea, Anthurium, Ananas, Aphelandra, Billbergia, Calathea, Chamaedorea, Dieffenbachia, Episcia, Fittonia, Guzmania, Maranta, Monstera, Neoregelia, Nephrolepis, Nidularium, Nolina, Peperomia, Philodendron, Pilea, Polypodium, Ruellia, Senecio, Spathiphyllum, Stromanthe, Syngonium, Tillandsia, Vriesea, Yucca,* and *Zebrina*. A few foliage plants, chiefly *Agave, Peperomia, Yucca,* and some Bromeliaceae and Cactaceae genera, are native to North America. *Hedera* is probably the only important foliage plant genus indigenous to Europe.

Foliage plants that are native to tropical regions are generally tolerant of low light intensities, sensitive to chilling temperatures, and day-neutral to photoperiod since they grow either as understory plants shaded by giant forest trees or as vines climbing on trees. In subtropical climates, both temperatures and humidity may vary with the seasons; foliage plants originating in this climate tolerate limited degrees of heat, drought, and chilling temperatures and may also show dormancy in winter. Some plants used indoors are native to climatically extreme conditions, such as deserts, and have evolved mechanisms to adapt to heat and drought stresses. These plants, predominately succulents and cacti, often have unique leaves or distinctive shapes and/or flowers.

A BRIEF HISTORY

The Sumerians and ancient Egyptians started growing plants in containers about 3,500 years ago, and writings on ornamental cultivation of container plants in Chinese date back to 3,000

Figure 3. Foliage plants used as landscape plants in the tropics with *Philodendron bipinnatifidum* planting and *Epipremnum aureum* vine.

Figure 4. Wardian case invented by Dr. Nathaniel Bagshaw Ward in 1833 used for shipping collected tropical plants to Britain.

Figure 5. *Dieffenbachia* x Bausei was a hybrid selected from a cross between *D. maculata* and *D. weirii* in 1870 (A) and *D.* x Memoria-corsii was a hybrid developed from a cross of *D. maculata* and *D. wallisii* made in 1881 (B).

to 4,000 years ago. However, there is no known record as to precisely when humans first started to use foliage plants for interior decoration. A likely scenario for the early use of foliage plants could be that these plants were initially collected as curiosities due to their varied forms, styles, colors, and textures; when used to esthetically enhance building interiors, they actually survived for extended time periods. Although the definitive beginnings of interior plant use is not clear, it is known that during the Renaissance, plant collectors in Holland and Belgium imported plants from Asia Minor and the East Indies, and wealthy merchants of Florence, Genoa, and Venice introduced plants from the East into Europe in the late 15th century (Smith and Scarborough, 1981). A desire for exotic plants developed among the aristocracy of France and England by the middle of the 16th century, and orangeries and conservatories became commonplace on the estates of the nobility and wealthy class by the 17th century. By the following century, an estimated 5,000 species of exotic plants had been brought into Europe from the world's tropics. The number of plants brought to Europe from the tropics increased after the invention of the Wardian case in 1833 (Fig. 4). The protected environment of the Wardian case dramatically increased the number of living specimens that survived the long sailing voyage from the tropics to Europe. The availability of diverse and exotic plants that could tolerate the environment typical of Victorian homes promoted the use of living plants indoors and gave birth to the modern foliage plant industry. During the second half of the 19th century, foliage plants became a symbol of social status, and the grand drawing rooms of Victorian houses all had their fill of palms and ferns. Plants from conservatories, botanical gardens, and private estates were brought into commercial production, and bought for use in middle- and upper-class households. Hybridization of *Dieffenbachia* species dates to almost the same time period as hybridization of peas by Gregor Mendel. The oldest known *Dieffenbachia* hybrid is 'Bausei', a cross between *D. maculata* and *D. weirii* made in 1870 in the greenhouses of the Royal Horticultural Society of London at Chriswick, while 'Memoria-corsii' is a cross between *D. maculata* and *D. wallisii* made in 1881. Both are still in cultivation in the industry (Fig. 5). Within a decade, shiploads of foliage plants from greenhouses in England and mainland Europe were sold to greenhouse growers in the Northeast U.S. for either immediate resale or for "growing on" and subsequent resale. These shipments may be considered as the beginning of globalization of foliage plant production.

PROPAGATIVE MATERIALS

The majority of propagative materials used in the industry are cuttings and tissue culture

Figure 6. Tissue culture facilities in Sunshine Horticulture LLC., Quanzhou, Fujian Province, China: (A) culture room, (B) employees transferring culture, (C) tissue culture plantlets shipped to the U.S., (D) liners grown in shaded greenhouses.

Figure 7. Stock plant and cutting production in Central America: (A) *Dieffenbachia* production in Honduras and (B) *Sansevieria trifasciata* divisions arriving in the U.S. from Costa Rica.

liners, with seeds used for just a few selected genera. Currently, there are four main regions of foliage plant propagule production: Asia, Central and South America, the European Union (E.U.), and the U.S.

Asia is a region predominately providing massive numbers of tissue culture plantlets (Fig. 6). Dongguan Agristar Biotechnoloy Co., Ltd., Guangdong Province, China, produces 20 million tissue culture plantlets of foliage plants, including *Aglaonema, Alocasia, Anthurium, Calathea, Cordyline, Dieffenbachia, Dracaena, Ficus,* and *Syngonium* as well as various Bromeliads, ferns, and *Musa* species. Almost all these plantlets are exported to Australia, E.U., and Southeast Asia. Sunshine Horticulture LLC., Quanzhou, Fujian Province, China exports 68% of its tissue culture plantlets of *Anthurium, Alocasia, Ficus, Spathiphyllum,* and bare rooted 'Lucky Bamboo' (*Dracaena sanderiana*) and 'Money Tree' (*Pachira macrocarpa*) to the U.S. Other countries involved in tissue culture plantlet production include India, Singapore, Sri Lanka, and Thailand. Commercial tissue culture firms in India export more than 40 million tissue culture plantlets to the U.S. and other countries (Govil and Gupta, 1997).

Many foliage plant species are native to Central and South America, and commercial nurseries are mainly located in Brazil, Colombia, Costa Rica, Guatemala, and Honduras. Climatic conditions are favorable for extensive stock bed plantings to produce vast numbers of *Aglaonema, Codiaeum, Cordyline, Dieffenbachia, Epipremnum, Dracaena, Peperomia, Philodendron, Sansevieria,* and *Schefflera* cuttings which are exported to the U.S., E.U., and several Asian countries (Fig. 7). According to the USDA Foreign Agricultural Service, the wholesale value of unrooted foliage plant cuttings imported from Central and South America to the U.S. was $29 million in 2002.

Although there are few foliage plants native to Europe, the collections made during 17th to 19th centuries provided diverse germplasm for propagation and production. The Netherlands emerged as the predominant European country for foliage plant propagation during the 20th century. For example, Anthura B.V. in Bleiswijk has developed an extensive breeding program and uses modern facilities for *Anthurium*, Bromeliad, and *Palaenopsis* propagation. Uniform and healthy propagative materials are exported to other European countries, China, Japan, Australia, and the U.S. Several nurseries in the Netherlands produce hybrid seeds of *Spathiphyllum* cultivars sold to other European countries and the U.S.

In the continental U.S., large nurseries in California and Texas produce numerous foliage plant propagules, but the greatest numbers are produced in Central Florida, primarily in the vicinity of Apopka, Florida, often considered the indoor foliage capital of the world (Fig. 8). There are more than 900 certified nurseries, largely for foliage plants, clustered in Apopka vicinity. Agri-Starts, Inc. and Twyford Plant Laboratories, Inc., in the Apopka area, and Oglesby Plant International, Inc., in Altha, Florida, have an annual production capacity of more than 50 million tissue culture liners of various foliage plants including *Alocasia, Anthurium, Calathea, Dieffenbachia, Ficus, Musa, Philodendron, Syngonium, Spathiphyllum,* and different species of ferns and Bromeliads. In addition to meeting the needs of foliage plant producers in Florida and other states, tissue culture liners are also exported to Canada, E.U., and Asian countries. Hawaii with its tropical climate produces propagative materials of *Anthurium*, orchids, and *Dracaena* cuttings and sells to the U.S. mainland, Japan, and E.U. markets.

FOLIAGE PLANT PRODUCTION

The E.U.

Commercial production of foliage plants started in Europe and was based on the extensive collection of foliage plants made during the 17th to 19th centuries. The availability of foliage plants capable of surviving extended periods indoors promoted the widespread use of living plants for interior decoration. The demand for plants provided the stimulus for construction of commercial greenhouses to supply this burgeoning market. As production output increased, additional markets were sought and large shipments of foliage plants were sent to the U.S. in

Figure 8. Indoor foliage capital of the world, Apopka, Florida: (A) city of Apopka slogan and (B) fern statue commemorating Boston Fern (*Nephrolepis exaltata)* that started foliage plant production in Apopka, Florida.

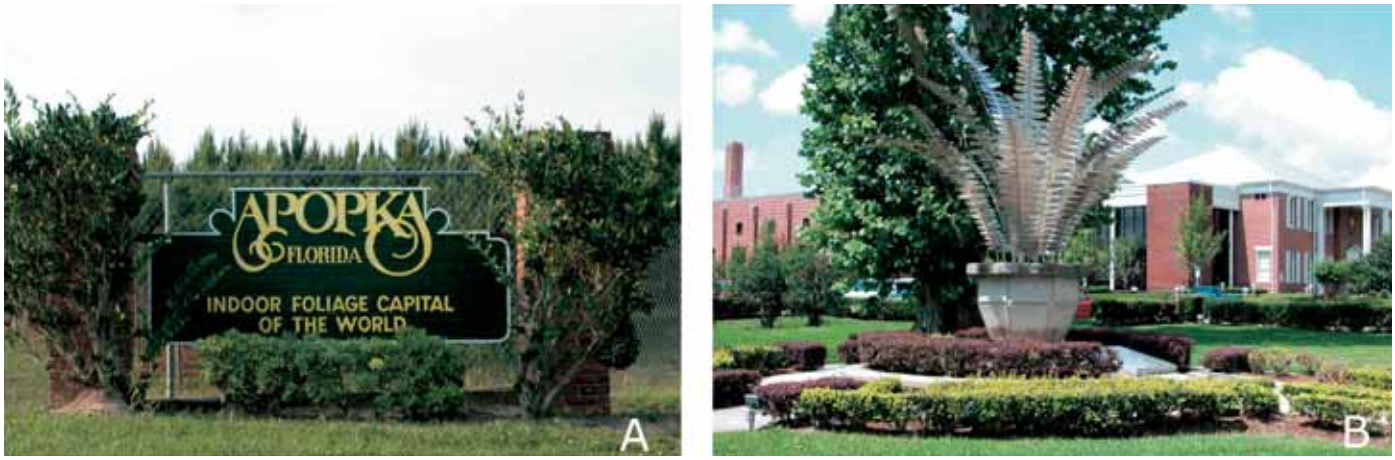

Figure 9. Foliage plant production and trading in the Netherlands: (A) Dutch greenhouse production of foliage plants, (B) *Anthurium* production, (C) Aalsmer auction building, and (D) auction of plants.

the late 19th and early 20th century. The E.U. is still a major region of foliage plant production. In addition to the Netherlands, Belgium, England, France, Germany, and Italy are significant producers of foliage plants for the European and international markets (Fig. 9). Almost all foliage plants produced in the E.U. are sold through a wholesaler or auction houses. The floriculture auction houses in the Netherlands play a crucial role in the trade of foliage plants. Through their concentration of supply and demand, they act as a price-setting mechanism for the trade and have developed into a major center for the distribution of domestic and foreign grown products to the markets of the E.U. Major foliage plants in Dutch auctions include *Anthurium, Dracaena, Ficus, Hedera, Saintpaulia, Phalaenopsis, Howea,* as well as ferns and Bromeliads. In addition to plants from domestic production, about 14% of the Netherlands' foliage plants were imported, of which India, Italy, and Germany accounted for 26%, 14%, and 14%, respectively, in 2000 (EU Market Survey, 2002). A great part of the Netherlands' imports was re-exported to other countries. The Netherlands exported about 21%, 22%, and 52% to Germany, United Kingdom, and France, respectively. Although there is no data available for foliage plants per se, the Netherlands' auctions now handle 89% of the Netherlands' production and 80% of imported floricultural crops including foliage plants with a total value of US $3.0 billion in 2001 (EU Market Survey, 2002).

Figure 10. Foliage plant production in the U.S.: (A) *Dieffenbachia* and *Epipremnum* production in shaded greenhouse in Apopka vicinity, Florida, (B) *Anthurium* production in Dade county, Miami area, Florida, (C) Tropical plant industry exhibit (TPIE) in Ft. Lauderdale, Florida, and (D) interior of TPIE in 2003.

The U.S.

The resale or planting of foliage plants shipped from Europe to the Northeast U.S. in the 19th century were the beginning of the foliage plant industry in the U.S. Because of favorable climatic conditions, large scale production of foliage plants moved to California and Florida within the first two decades of the 20th century. Predominant plants grown in California during the 1920s include Kentia palm (*Howea forsterana*) and Pothos (*Epipremnum aureum*), followed by *Philodendron* and *Araucaria* in the 1940s. Production in Central Florida was confined to Boston Fern (*Nephrolepis exaltata*) from 1912 to 1928 until Heart-leaf Philodendron (*Philodendron scandens oxycardium*) was introduced. The primary foliage plants grown in South Florida during the same time period were Snake Plant (*Sanservieria trifasciata*) and Screw Pine (*Pandanus veitchii*). During the 1930s, Chinese Evergreen (*Aglaonema modestum*), Rubber Plant (*Ficus elastica*), and Oval-leaf Peperomia (*Peperomia obtusifolia*) became widely grown in Florida (Smith and Scarborough, 1981). Florida produced $1.8 million of the national foliage plant wholesale value of $13 million in 1949. However, 10 years later, Florida supplanted California as the leading state in the nation in production of foliage plants, and has accounted for more than 55% of the national wholesale value since the 1960s. Foliage plant wholesale value in Florida increased from $1.8 million in 1949 to $459 million in 2002, which was a 255-fold increase. Other important U.S. foliage plant producing states include Hawaii and Texas. Foliage plant marketing in the U.S. is through trade show contacts and direct sales to mass merchandisers, mainly super markets, wholesale stores, and interior plantscape firms. One of the most important trade shows is the Tropical Plant Industry Exhibition (TPIE), organized by the Florida Nursery, Growers, and Landscape Association (Fig. 10) and held every January in Ft. Lauderdale, Florida. The TPIE features booths filled with living and vibrant plants creating a virtual indoor garden. Other booths display a multitude of products necessary for production and utilization of foliage plants. With more than 500 exhibiting companies from different coun-

tries, TPIE offers wholesale buyers an extensive selection of foliage plants and associated products in one location.

Asia

Many foliage plants are associated with good luck or fortune in Asian culture; for example, *Aglaonema* is believed to bring good fortune to life, *Dracaena sanderiana* is called Lucky Bamboo, and *Pachira macrocarpa* is known as the Money Tree. However, commercial production of foliage plants in Asia is a more recent trend. An accidental discovery of *Aglaonema alumina armandi* on a mountain in the province of Rizal on Luzon Island of the Philippines in 1976 sparked a large scale search for new species in Southeast Asia. New *Aglaonema* species were found in Thailand in the south along the Malaysian border and in the west along the border with Burma. New species not only enriched the gene pool of *Aglaonema*, but also led to the establishment of active breeding programs in Thailand, Philippines, and India. In the early 1980s, Sithiporn Donavanik of Thailand successfully crossed *A. rotundum* with *A. marantifolum* 'Tricolor' resulting in a cultivar with colors so vibrant in shades of red that the plant strongly resembles a *Codiaeum variegatum*. In Thailand, this new cultivar was named *A. sithiporn*. Twyford Plant Laboratories, Inc., of Apopka, Florida, procured several plants of *A. sithiporn*'s new hybrids in 1998. Sunshine Foliage World, Zolfo Springs, Florida, introduced more than 30 new *Aglaonema* hybrid cultivars developed by breeders in Thailand. These cultivars have different leaf sizes, shapes, and variegation patterns, and white, green, or pink petioles. 'Emerald Star' and 'Jewel of India' are two cultivars developed by breeders in India that, along with 'Stars', have been identified as highly tolerant to chilling temperatures (Chen et al., 2001). Cacti are a unique group of foliage plants. There are about 15 million grafted cacti sold yearly in the international market, of which Korea produces 10 million (Jeong et al., 2004). Other foliage plant genera produced in Asian countries include *Aglaonema, Anthurium, Calathea, Ficus, Phalaenopsis,* Bromeliads, and ornamental gingers as well as braided Lucky Bamboo (*Dracaena sanderiana*), Money Tree (*Pachira macrocarpa*), Buddha's Hand (*Alocasia cucullata*), and Ginseng Fig (*Ficus macrocarpa*). Much of this production is exported to other countries including the U.S. In 2000, the values of foliage plants exported to the E.U. from India, China, and the Philippines were $9.7, 3.6, and 1.7 million, respectively. These values should increase significantly since China has joined the World Trade Organization. To facilitate the rapidly expanding production and marketing of foliage plants, China and Japan have adopted the Dutch auction model. Currently there are functioning flower auctions in Kunming and Guangzhou, China, and the Flower Auction Japan in Tokyo has over 1,400 registered buyers.

Other Regions

In addition to the production and export of propagative materials, commercial foliage plant production in countries of Central and South America has started to shift from domestic or regional markets to the international market. Although many foliage plants are native to tropical Africa, foliage plant propagation and production is primarily limited to South Africa. The export value of foliage plants from South Africa to the E.U. was $3.4 million in 2000. Precise export figures for the Australian foliage plants are not available but their largest foreign markets are Japan, the U.S., Germany, and the Netherlands. New Zealand's greenhouse and nursery industry has focused primarily on exportation of cut flowers and foliage plants are currently a minor commodity in international trade.

INTERIOR PLANTSCAPES

The final destination for finished foliage plants is a building interior. Throughout the international community, interior plantscapes are commonplace in commercial public spaces, such as airports, convention centers, hospitals, hotel lobbies, libraries, offices, and shopping malls. Botanical conservatories may have large plantings featuring many genera and species while residential private homes may have just a few favorite foliage plants. No matter where they are used, the installed foliage plants are expected to adapt to the new environmental conditions and maintain their esthetic appearance for a prolonged time, several months to several years. Proper nutrient, irrigation, and pest management are required, and maintenance of large interiorscape plantings is generally handled by commercial firms that specialize in interior plants. These firms employ professionals who are familiar with characteristics of individual plant species and are often specialized in interior design to maximize esthetic features of individual and collective grouping of the plants. Installation of varied colors, forms and styles of foliage plants indoors provides a feeling of physiological well-being to the individuals utilizing these facilities, reduces stress levels associated with urbanized environments, and also increase property values.

THE FUTURE

The evaluation of the effects of events and trends in the distant and near past may help foresee what will happen in the years to come. Most of the past changes in the foliage plant industry have been interlinked with changes that affect our daily lives. These include changes in transportation, population demographics, architectural innovations, application of new technologies to production processes, and economic factors. In many countries of the world, the number of people living in urban areas is increasing. China, India, and the U.S. are three examples of this trend. Increasing urbanization will undoubtedly increase urban population densities as clustered housing units (apartments, townhouses, etc.) will increase. Historically, increased urbanization has been coupled with an increase in use of interior plants if economic factors permit. Consequently, the world market for foliage plants will increase. The future of the foliage industry looks bright because interiorscaping has become an integral part of contemporary life. New architectural technology may incorporate a critical number of plants within a structure to serve as living air purifiers and ameliorate psychological stress associated with high population densities. One very clear long term trend is the expansion of the socio-economic groups that can afford and use indoor plants. For thousands of years, only top echelons of society collected and displayed plants. Societal and demographic changes that began during the mid 19th century and continued during the 20th century dramatically broadened the socio-economic segments of the population purchasing plants. As foliage plant production practices become more cost efficient and the world economies continue to grow, the purchase and use of foliage plants will become an international commonality.

The foliage plant industry needs to respond to this expanding demand by providing high quality and durable plants with increased drought and low light tolerance, and improved leaf color and growth habits. These 'plants of the future' can be developed by exploiting centers of foliage plant origins for new germplasm and using traditional breeding and/or genetic engineering technologies to incorporate desired traits into new cultivars (Henny and Chen, 2003). Expanding tissue culture facilities for propagating more foliage plant species and refining protocols for propagating true-to-type liners and creating desired somaclonal variants will not only increase the availability of healthy and disease-free propagative materials but also generate new cultivars (Chen et al., 2003). Changes in production technology have progressed quickly. Automation of greenhouse environmental control systems and potting, spraying, irrigation and fertilization has greatly reduced production cost and improved the quality of finished plants. The recent introduction of grading machines to select plants for shipping may help standardize foliage plant quality entering the world's markets. Increased professionalism of interiorscapers will aid in installing the right plants in the right locations and using scientific-based guidelines to provide best management practices.

Marketing is the process of converting products into capital, and the continued growth of the foliage plant industry is dependent on efficient and effective marketing methodologies. The auction model developed in the Netherlands appears to be the dominant method in the near future for marketing plants on an international basis. In addition to China and Japan, Hungary

has just opened a floriculture auction house to better serve neighboring countries. Transportation logistics and economic considerations may increase the number of regionally located facilities. However, a new trend that may affect future marketing of foliage plants is the use of direct sales via images transmitted on the internet from the foliage grower's greenhouse. The effects of new technology will continue to alter past production and sales practices.

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Taxus spp.: A Genus of Ever-Useful and Everlasting Evergreens

John M. DeLong and Robert K. Prange

The yew (*Taxus* spp.) appears in the historic, sacred, mythic and folkloric literature of the people of western Europe in particular. References to yew occur in ancient Greek, Nordic, Celtic, Germanic and Himalayan cultures. The name yew is derived from the Celtic word '*Iω*' (pronounced 'if'), which denotes verdure - an obvious allusion to the evergreen nature of the yew (Chadwick and Keen, 1976). Yew wood was prized for its utility and was symbolically associated with pre-Christian and then Christian religious belief. Pagans often venerated the yew, ascribing to it magical powers of protection against fairies and witches. The yew was viewed as the most powerful sacred tree of Ireland; Druids even made their wands of divination from its wood. The Roman poet Ovid stated that the yew tree marked the entrance to Hades and the underworld, while the ancient Greek botanists Dioscorides, Theophrastus and Nicander, as well as Pliny the Elder, recorded the botanical and toxic attributes of yew; some claimed that simply sleeping under a yew tree caused sickness and sometimes death (Gerard, 1633; Gunther, 1968). As Europe became increasingly Christian, the symbolism of the yew took on different meaning: its longevity and evergreen nature came to be associated with themes of immortality, resurrection and new life (Hartzell, 1991).

Many ancient yews can still be viewed in English churchyards, where they were planted at the founding of the parish, or even pre-date its establishment. In Fortingall, Perthshire, Scotland, a magnificent specimen, split in two since the middle 1700s, is believed to be 3,000 years old, which would make it the oldest living tree in Europe (Fig. 1). Legend has it that Pontius Pilate was born at Dun Gael, an escarpment fortress at Fortingall. If true, the Fortingall yew would have been 1000 years old at the time of Pilate's birth. King John signed the Magna Carta at Runnymede in June of 1215 near or in the shade of the Ankerwyke yew, which is still flourishing and is thought to be at least 1400 years old (Fig. 2). From the 12th to the 16th century, the yew wood longbow gained an eminent place in English military history due to its unsurpassed field range, penetrating power and accuracy in the hands of skilled bowmen. In North America, indigenous people have used the bark, foliage and fruit of the yew for tool and weapon-making and for ceremonial and medicinal purposes for generations. The hard, decay-resistant, yet springy wood has been valued for making canoe paddles, fish hooks, archery bows, spears, digging sticks and ceremonial items, and more recently, for gunstocks, boat decking, furniture, snowshoe frames and musical instruments (Small and Catling, 1999).

Figure 1. 3000+-year old Fortingall yew, Perthshire, Scotland. Permission for use granted by Michael McCluskey, Perthshire, Scotland, UK.

Figure 2. 1400+-year old Ankerwyke yew, Runnymede, England. Permission for use granted by Edward Parker Photography, Dorset, UK.

BOTANY

Taxus spp. are widespread and native to moist, temperate forests of the world, particularly the Pacific and Atlantic coasts, the mid-Atlantic and Great Lakes regions of North America, western, northern and southern Europe, Algeria, southeastern Russia, eastern China, Nepal, Burma, Laos, Thailand, Vietnam, Iran and as far south

as Sumatra and Celebes (Voliotis, 1986; Hartzell, 1991; Patel, 1998). Although six to 20 *Taxus* species have been recognized (Small and Catling, 1999), eight or nine, indigenous to the northern hemisphere, usually appear in most taxonomic descriptions: *T. brevifolia* (Pacific yew), *T. baccata* (English yew), *T. canadensis* (Canadian yew, ground hemlock), *T. cuspidata* (Japanese yew), *T. chinensis* (Chinese yew), *T. floridana* (Florida yew), *T. wallichiana* (Himalayan yew) and *T. globosa* (Mesoamerican yew) (Bailey and Bailey, 1976; Spjut, 2003). Although the *Taxus* genus is distinguished by its cone (aril) and leaf morphology (Spjut, 2003), differentiating *Taxus* species in cultivation is difficult due to lack of adherence in applying universal taxonomic standards, the morphological similarities among species and the vast number of varieties within species (Patel, 1998; Spjut, 2003). Nonetheless, *Taxus* spp. are described as evergreen trees and shrubs with reddish to brown bark having spreading and ascending branches with green branchlets. Leaves are glossy or dull-dark above and lighter green below, flat and needle-like, abruptly pointed or tapering and acute, and radially arranged or lie in a flat plane. Winter buds are small and scaly. Plants are mainly dioecious with globose male flowers and female flowers that appear as small stalked conical buds in the leaf axils. Seeds are brown and nut-like and are covered with a red fleshy aril, ripening in the first year (Fig. 3) (Dirr, 1990). Chadwick and Keen (1976) report that both dioecious and monoecious plants are found in the species and cultivars of *Taxus*; interestingly, yews have been known to change sex as they mature (e.g. a plant changes from producing female to male flowers) (Hatfield, 1929).

Figure 3. *Taxus baccata* leaves, flowers and fruiting structures. 1A: Immature female flowers. 1B: Mature female flower following fertilization. The red cup-like covering (aril) surrounding the seed is forming. 2A: Immature fruit. 2B: Mature aril fruit with fleshy outer aril and a single seed at the centre. 2C: Mature fruit (aril and seed) cut longitudinally. 3A & 3B: Male flowers. 4: Leaf spray with male flowers in the axils. 5: Leaf spray with mature aril fruit.
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ORNAMENTAL *TAXUS*

During the 1860s, Japanese yews were imported into the United States from Japan by Dr. George Hall following a plant collection trip. The plants were then made available to the nursery trade through Parson's Nursery, Flushing, Long Island, New York. Around 1866, H.H. Hunnewell (Wellesley, Mass) received specimens of *T. cuspidata* and *T. cuspidata* var. *nana* from the Parson's Nursery and planted them on his estate as he had a keen interest in evergreen species not previously available in the U.S. (Cochran, 1999, 2001).

In 1886, Theopholius D. Hatfield (1855-1929) began working for the Hunnewell family and was a major influence in introducing and developing ornamental *Taxus* in the United States. He studied the imported species of Japanese yew growing at the Hunnewell estate and reported that the spreading varieties 'nana' and 'brevifolia' (later given the name 'Densa') were the first to become popular in the nursery industry (Cochran, 1999). Also growing at Hunnewell was the English yew, which possessed a fine appearance for a few years, but was susceptible to winter injury resulting in foliage browning and a disfigured appearance, traits which led Hatfield to conclude that the Japanese yew was a superior ornamental plant for his region (Cochran, 1999). About 1904, he began a series of experiments growing *Taxus* from seed, which resulted in what was the largest yew plantation of its kind at that time. From this work, Hatfield concluded that many forms would come true from seed. He identified a probable cross of *T. baccata* var. *fastigiata* (Irish yew) and *T. cuspidata* - likely some of the first specimens of the *Taxus* x*media* hybrid (Anglojap yew). Eventually, the varied forms that he selected from his seedling experiments were introduced in the American nursery trade (Hatfield, 1921, 1929; Cochran, 1999).

At the same time that Hatfield was growing seedlings at the Hunnewell estate, Henry Hicks was experimenting with *Taxus* seedlings at his Long Island nursery (Nassau County, 25 miles from New York City). In 1924, the Hicks yew (*T.* x*media* 'Hicksii') (Fig. 4) became available to the landscape industry following a 1902 seed collection from the Dana Arboretum (Long Island, NY). It soon replaced the red cedar as the premier hedge species and has since become the standard yew of the nursery trade in North America (Cochran, 1999). Hicks described the Hicksii yew as an interrogative point form (question mark-shaped), fruiting, dark green and handsome; it was known as a female selection (Cochran, 2001). Dirr (1990) describes Hicksii as a spreading, broad-pyramidal tree or shrub that may possess a cental leader. The taxonomist, Alfred Rehder, first proposed the name *T.* x*media* for the hybrids of *T. baccata* and *T. cuspidata* and recognized that a wide variety of forms was possible (Chadwick and Keen, 1976). *Taxus* x*media* is the hybrid designation for most of the cultivars that have been introduced since Hicks and Hatfield; however, the definitive genetic basis for *Taxus* x*media* needs to be determined through gene analysis (Cochran, 2001).

Approximately 190 ornamental cultivars of yew have been identified to date (Cope, 1998). Yews have become the most popular of narrow-leaved evergreen ornamental plants in the 2nd half of the 20th century in North America and will likely retain their popularity well into the 21st century (Cochran, 1999). The most important ornamental cultivars are found within the species *T. cuspidata* and the Anglojap hybrid, *T.* x*media*. The handsome, lustrous, dark, evergreen foliage and the varied physical forms of the commercially available cultivars, which range from low-profile, compact and dense types to the taller columnar and pyramidal forms, have played an indispensable role in establishing the yew's landscape popularity (Chadwick and Keen, 1976; Dirr, 1990; Cochran, 1999).

Figure 4. *Taxus* x*media* 'Hicksii': upright with ascending branches.

CULTIVATION

Taxus spp. grow in a wide range of cultural conditions but thrive best on loamy soils of a slightly acidic or neutral pH having adequate moisture. According to Dirr (1990), good soil drainage is critical for yews and anything less than excellent drainage results in marked reductions in growth or eventual death of the plants. In poorly drained soils, root rot can be a problem (Taylor et al., 1996). Yews will flourish in open sun or partial shade, but should be kept out of sweeping, desiccating winds, and generally do not tolerate extreme cold or heat well. Depending on the species, yews grow in most hardiness zones, ranging from USDA zone 2 (*T. canadensis*) to zone 8 (*T. floridiana*) (Dirr, 1990; Gilman and Watson, 1993; Taylor et al., 1996). Since many of the cultivars have a compact and symmetrical form, little corrective pruning is required. Dirr (1990) recommends pruning rather than shearing to retain the natural shape and habit of the particular yew cultivar, although *Taxus* spp. can be sheared or pruned severely into topiary forms. The size and shape of the ornamental *Taxus* spp. varies greatly, ranging from the upright tree form of *T. baccata* 'Fastigiata' (Irish yew) (Fig. 5) to the low spreading cultivars of *T. xmedia* ('Densiformis', 'Chadwickii') (Fig. 6), attributes that have led to the wide use of *Taxus* in the landscape (Dirr, 1990).

Figure 5. *Taxus baccata* 'Fastigiata' - Irish yew: rigidly upright branches. Permission for use granted by Buckingham Nurseries, Buckingham, UK.

Figure 6. *Taxus xmedia* 'Densiformis': dense, low and shrub-like. Permission for use granted by Waynesboro Nurseries, Waynesboro, VA.

Woody ornamental or Christmas tree fertilizer guidelines can be used for *Taxus* spp. Application of fertilizers having N, P (as P_2O_5), K (as K_2O) ratios of 4:1:1, 3:1:1, or 3:1:2 are recommended and can be top-dressed around the base of the shrub's drip line in the early spring for established plants. An N only fertilizer can be applied if there are adequate levels of P and K, or slow release fertilizers can also be used. Organic materials such as compost and manure can also be utilized and will improve soil structure; however, nutrient levels are often variable and should be determined through laboratory analysis. During site preparation just prior to planting, incorporate P and K if tests show deficiency, and leave N application for the next year or use compost or well-rotted manure to avoid root burning. Split applications of N fertilizer during the growing season will reduce the likelihood of root burn and will lessen the potential for ground water contamination. Lime applied at the time of planting will help correct low soil pH and should be thoroughly mixed with the soil in the root zone area. (Kujawski and Ryan, 2000).

Although yews are resistant to many pests and diseases, the *Taxus* mealybug (*Dysmicoccus wistariae*), the *Taxus* scale (*Pulvinaria floccifera*), the yew-gall midge (*Taxomyia taxi*), the black vine weevil (*Otiorhynchus sulcatus*) and nematodes (*Pratylenchus* spp.) have been known to cause plant damage (Gilman and Watson, 1993; Taylor et al., 1996).

THE DISCOVERY OF TAXOL®

Taxol® is likely the most well known chemotherapeutic agent in medical history, which is ironic as *Taxus* spp. have garnered little other modern interest except as landscape plants. The discovery of Taxol® [generic name: paclitaxel] as a unique anti-cancer compound occurred in the early 1960s following a screening program initiated by the National Cancer Institute (NCI), which emphasized discovery of new plant-based, anti-tumor agents (Stephenson, 2002). Arthur Barclay, a botanist at the United States Department of Agriculture (USDA), and three student assistants collected 650 plant samples in California, Washington and Oregon, which included the bark, twigs, leaves and fruit of the Pacific yew tree (*T. brevifolia*) (Wall and Wani, 1995; Patel, 1998). Although the yew samples showed only modest anti-tumor activity initially, later testing using different bioassay standards resulted in paclitaxel being selected for further development. Formidable chemical and sociological obstacles were encountered as this promising raw resource was moved along the drug development path, including: paclitaxel's water insolubility; minute paclitaxel tissue concentrations; and the requirement to harvest yew bark at the cost of destroying the tree. The latter issue resulted in confrontation between those that desired to harvest the species for drug development and conservation groups who wanted the seemingly relentless destructive

harvest of the Pacific yew halted (Hartzell, 1991; Kingston, 2000). Fortunately, the Pacific yew is not presently endangered, in part due to a shift from harvest of bark (required tree destruction) to renewable needle harvest of wild native stands or yew plantations (Mark Savage, Washington State Department of Natural Resources, personal communication).

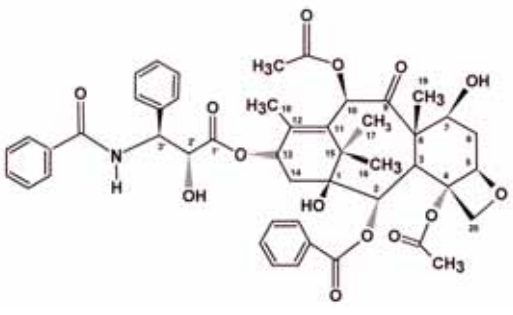
PHARMACOLOGY

Paclitaxel has shown anti-cancer activity against a broad spectrum of human tumors, including: ovarian, breast, head, neck, small-cell and non-small-cell lung (Parekh and Simpkins, 1997; Gautam and Koshkina, 2003), gastric (Roth and Ajani, 2003) and prostate cancers (Beer et al., 2003). It is presently approved for the treatment of breast, ovarian and non-small-cell lung cancers and AIDS-related Kaposi's sarcoma (BMS, 2004). [Taxotere® (see below) has recently received FDA approval for treatment of advanced metastatic prostate cancer.]

The unique anti-tumor properties of Taxol® (Fig. 7) and the semi-synthetically synthesized Taxotere® (Taxol®-like activity) (Fig. 8) are based upon their ability to promote the assembly and the subsequent stabilization of mitotic spindle microtubules during the late G2/early M phases of mitosis. As the taxanes bind to the microtubule protein subunits, depolymerization or disassociation of the microtubules is prevented, cell division is thus blocked and the cell dies. Interestingly, other plant-based anti-mitotic agents such as vinblastine and vincristine (from *Catharanthus roseus*), colchicine (from *Colchicum* spp.) and podophyllotoxin (from *Podophyllum hexandrum*), promote microtubule depolymerization or destabilization, which prevents the mitotic spindle from fully forming, a mode of activity in stark contrast to that of the taxanes (Desbene and Giorgi-Renault, 2002; Gordaliza et al., 2004; Jordan and Wilson, 2004).

The microtubule-stabilizing activity of the taxanes is presently being exploited for non-chemotherapeutic uses. For example, a paclitaxel-coated stent used in balloon angioplasty surgery, reduces the degree of post-operative tissue regrowth (restenosis) in the region of the artery where the stent is placed. The paclitaxel eluting from the stent causes mitotic arrest in the cells of the arterial wall, which effectively halts any tissue proliferation (Angiotech, 2004; Cooper Woods and Marks, 2004). The taxanes are also being tested for treatment of urethral cancer and kidney disease (Woo et al., 1997; Vaughn et al., 2002; Gitlitz et al., 2003), severe psoriasis (Ehrlick et al., 2004) and rheumatoid arthritis (Angiotech, 2004).

Figure 7. Paclitaxel (Taxol®).

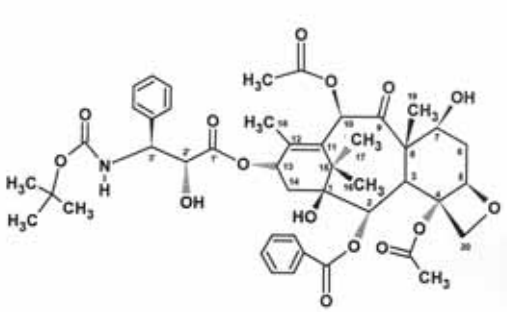


TAXANE SUPPLY

Presently, taxanes for pharmaceutical development are supplied through biomass (needle, bark, root) harvest from yew plantations or native wild stands throughout the world, or from cell culture. Although taxanes extracted from yew tissue dominate the supply chain, *Taxus* cell culture yields may result in a higher portion of taxanes being produced from bioreactor/fermentation technology in the future. Nonetheless, active harvest of wild and plantation yew tissue currently occurs worldwide. Though not an exhaustive list, those presently involved in procuring biomass to produce taxane extract include: Atlantis BioActives Corp., BioExx Extraction Technologies Inc., Bioxel Pharma Inc., Biolyse Pharma Corp., Chaichem Pharmaceuticals Inc. and Chatham Biotec Ltd. in eastern Canada, Phytogen Life Sciences Inc. in western Canada and Natural Pharmaceuticals Inc. (NPI) in Massachusetts (Stewart Cameron, Natural Resources Canada, personal communication). The Mayne Group (Australia-based) acquires biomass from Ohio, Michigan and Massachusetts, NPI uses yew grown in Michigan, while Dabur harvests in India and Indena in Italy and North America. In China, the privately-run Beijing Taxus Ltd. (Beijing) and its sister facility Yantai Taxus (Yantai), are dedicated to greenhouse and nursery production of various cultivars of *Taxus xmedia*. In the future, China will likely contribute significant *Taxus* biomass for cancer pharmaceuticals although extensive information concerning the many companies involved is presently unreliable (Stewart Cameron, Natural Resources Canada, personal communication).

In general, the process of manufacturing pharmaceutical grade taxane drugs involves several basic steps: 1) harvest of biomass or cell cultures; 2) extraction of taxanes in crude form. Partial purification of extract resulting in 1-50+% taxanes may occur at this point; 3) purification of crude extract; 4) final purification to 99.5% active pharmaceutical ingredient (API) grade; and 5) formulation of high quality pharmaceutical drug, including fill and finish processes. Historically, different entities have been involved at these stages. For example, Chatham Biotec Ltd. (New Brunswick, Canada) harvests and dries *Taxus canadensis* biomass and then sends it to Paxis Extraction Ltd. (Boulder, Colorado) for refinement (Stewart Cameron, Natural Resources Canada, personal communication). However, a greater degree of vertically integrated management is currently possible as single businesses better co-ordinate and control more of the harvest and extraction phases. Natural Pharmaceuticals Inc. (Fall River, Massachusetts) controls several procurement and refinement steps, i.e. they harvest and dry yew biomass in Michigan, extract crude taxanes in a Mexican plant and then ship the crude product to Massachusetts for further refinement and release. Also, Atlantis BioActives Corp. (Prince Edward Island, Canada) contracts out for harvesting and drying yew tissue, then extracts crude taxanes (50%) that are then sold for further purification and eventual formulation into drugs. As taxane extracts from natural sources are secured, pharmaceutical companies having the legal right eventually manufacture commercial products for chemotherapeutic purposes [e.g. Bristol Myers Squibb (USA, Taxol®), IVAX (USA, Onxol™) and Aventis (France, Taxotere®). These 3 large pharmaceutical entities are also involved at various stages in biomass or extract procurement, although detailed information is not available].

Figure 8. Docetaxel (Taxotere®).



It is also common practice for pharmaceutical companies to manufacture paclitaxel semi-synthetically from the natural taxane precursor molecule 10-deacetyl baccatin III (10-DAB), which is structurally similar to paclitaxel but does not possess the side chain emanating from carbon 13; the active side chain is then added via chemical synthesis. As 10-DAB is present in *Taxus* needles in equal or greater concentrations compared with paclitaxel, the semi-synthetic route is an economically feasible method for producing more anti-cancer drug from the same biomass yield and is responsible for much of the paclitaxel that is available in the finished drug form.

FUTURE PROSPECTS

Taxus spp. will remain popular as ornamentals for foundation, single specimen and hedging plants for many years to come due to their lustrous, dark, evergreen foliage, interesting morphological variation, and minimal maintenance and pest control demands of the commercially available cultivars. Demand for the unique compounds in *Taxus* tissue as treatments for human carcinomas is not likely to abate as new applications are tested and exis-

ting ones refined as stand-alone or combination therapies. Hence, the pressure to harvest wild *Taxus* will likely intensify worldwide, particularly in developing countries, e.g. China and India, where the economic incentive to harvest and extract *Taxus* compounds for cancer drug development has spawned a black market. Hopefully, the harvesting pressure on wild yew stands can be controlled through the establishment of large horticultural plantations, thus saving germplasm and rare, unique specimens. Also, present and future efforts to evaluate the taxane content of promising cultivars and the manipulation of fundamental plant biochemistry will likely lead to higher extraction yields of API grade taxane. While bioreactor-based fermentation technology is still nascent, future prospects are promising that this mode of production will become a more significant contributor to the supply of taxanes and other promising *Taxus* compounds.

The yew has enjoyed a fascinating journey with humanity: from being highly venerated or feared as a religious symbol while concomitantly used for weapons and tools, to being employed as a superior ornamental, and now highly regarded for its utility yet again as a source of superior toxin to fight one of humanity's scourges. To watch what else this plant offers in the years ahead will be most interesting.

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Tree Fruit Growing in Kazakhstan

Raul K. Karychev, Yvgenny Salnikov, Marat T. Nurtazin and Diane Doud Miller

The historical roots of tree fruit growing in Kazakhstan are connected with the wild apple and apricot forests on the slopes of the Tien Shan (Zailiskii Alatau, Dzhungarskii Alatau and Tarbagati) mountain ranges in south and southeast Kazakhstan, centered around Almaty. These wild fruit forests contain *Malus sieversii*, the progenitor of the cultivated apple (*Malus xdomestica*), an occasional *Malus niedzwetzkiana* (red-fleshed species), and *Armeniaca vulgaris*, the species from which most apricot cultivars are directly derived.

It is hypothesized that seeds of these wild species were moved along the Silk Road by travelers from antiquity (Forsline et al., 2003) and from this germplasm apple cultivars were selected, which were adapted to environments encountered throughout the world. The native range of apricot is wider and germplasm from many areas has been included in cultivar development.

Map of Central Asia.

Apples of Kazakhstan: (A) 'Almaty Aport' cultivar; (B) 'Golden Delicious' x *Malus niedzwetzkiana* seedling; (C) selections from apple breeding program; (D) fruit market in Almaty.

The rich diversity of fruit germplasm in Central Asia (motherland of apple, pear, apricot, plum, grape, walnut, and myrobalan plum) was described by Vavilov (1930) in an International Horticulture Congress held in London. He described Alma-ata (now Almaty), Kazakhstan, as the "center of origin" of cultivated apple, finding in the wild here apples of commercial quality. A.D. Dzhangaliev established main areas of wild apple and apricot in this region at 1200-1500 ha and dedicated his career to conservation of these valuable genetic resources (Dzhangaliev, 2003; Dzhangaliev et al., 2003).

During the Soviet era, the region around Almaty was an important center of apple production, especially for 'Alexander Aport', a Russian cultivar. *Malus sieversii* seedlings were commonly used as rootstocks for the Russian cultivars. 'Almaty Aport', a large-fruited cultivar with high demand in Russia, was trucked to Moscow. Large state-run orchards were located around Almaty. Cultivars grown were domesti-

Dr. Aimak Dzhangaliev - wild apple authority in Kazakhstan.

cated apples, from Soviet breeding programs in Russia or Kazakhstan, from Europe, or other countries. During the 1970s and 1980s there were more than 100,000 ha of tree fruits produced in Kazakhstan, predominately apples. Yields were approximately 4-5 tonnes (t)/ha.

The collapse of the Soviet Union in 1991 had a negative effect on tree fruit growing in Kazakhstan. Suddenly there was an oversupply of fruit and a lack of organization and care of orchards. The move from a centralized economy to a market-driven economy resulted in the abandonment of many orchards. Poor quality fruit is still gleaned from these unkempt orchards and marketed at bazaars. Lack of knowledge of orchard production practices including pruning techniques, unavailability of suitable chemicals for pest control, and the breakdown of irrigation schemes have resulted in reduced yield (1-2 tonnes/ha) on remaining orchard lands (estimated at 63,000 ha).

Kazakhstan is striving to develop an orchard industry based upon private production and ownership of orchards, but it will take some time to find the proper balance. Both the amount of fruit consumed, and knowledge assistance to the growers, must be increased. Currently, annual tree fruit consumption (12-15 kg/person) is below the amount considered healthful (76 kg/person). We also know that improved fruit quality will increase consumption and that growers must be educated on production practices and new cultivars and rootstocks.

The Kazakhstan Ministry of Agriculture and Ministry of Education and Science are providing assistance in fruit research and education, and a non-government organization "Central Asia Harvest Project" is providing "extension" type education to a limited number of growers in the most southeastern area of the country. A new United Nations Project in Central Asia, through the International Plant Genetic Resources Institute, seeks to advance biodiversity conservation and fruit grower education. In addition, scientists of the Agricultural Research Service of the United States Department of Agriculture are involved with local scientists on germplasm preservation of local cultivars. Contacts with scientists from Southern Illinois University, Colorado State University, and Ohio State University in the United States are also serving to increase fruit production knowledge in Kazakhstan.

Research efforts are underway to intensify tree fruit production in Kazakhstan focusing on high density orchards of dwarf trees. We calculate optimum orchard size to be 5-7 ha with an upper range of 20 ha. Optimally such farms would be widely located in the south and southwest of Kazakhstan, where climate is best for fruit growing and where fresh fruit can quickly be available to the population centers. We expect this region can support at least 500 fruit production farms.

At the present time, small farm technologies need to be developed for tree fruit production adapted to local climate and current economic condition. Important keys are cold resistance of flower buds, compact tree growth form, orchard precocity, improved cultivars, and inexpensive orchard establishment. Improved cultivars are needed for orchards at the base of the mountains and also for terraced orchards on the mountain slopes. These sites are in different ecological zones and will either require cultivars with different adaptabilities or wide adaptability. New cultivars need to have disease resistance to reduce chemical inputs required. To encourage high density orchards we need to have inexpensive trees and are working on propagation technologies to reduce tree cost. As amount of rainfall is limiting in fruit production, and old Soviet irrigation systems are in disrepair, drip irrigation technology is being investigated.

Tissue culture laboratory and technician at Talgar Pomological Garden.

Apple rootstocks, their ease of propagation, and their performance at base or mountains sites are under evaluation. Arm-18, B-7-35, B16-20, and 62-396 are rootstocks of current interest having dwarfing traits and ease of propagation.

As important as development of our commercial tree fruit industry is, we also highly value the conservation of our wild genetic tree fruit resources. Recent government legislation has eliminated commercial orchards at high elevation (above 1200 m) and the wild germplasm will be protected in these areas. *Malus sieversii* is currently in the Kazakhstan Red Book of endangered species due to cross-pollination and genetic decline with commercial apples, and due to its status as a relic species. A new UN project will specifically target reforestation

Fruit industry in Kazakhstan: (A) dried apples used for tea; (B) bulk boxes used for harvesting; (C) nursery production of chip-budded trees; (D) precocious cultivars bearing fruit in the nursery; (E) cherry cultivars under test; (F) plum cultivars under test.

Wild apples and new orchards: (A) *Malus sieversii* in gorges in protected land reserves at elevations above 1200 m near Taraz; (B) *Malus sieversii* selection retaining fruit after leaf-fall; (C) view from protected *Malus sieversii* area near Taraz to commercial orchard in Jabagly; (D) commercial orchard in arid land near Jabagly.

of *M. sieversii* and *Armeniaca vulgaris* at higher mountain elevation in south and south-eastern Kazakhstan using specially selected seedling and grafted trees as reforestation material. These sites will be in protected natural areas.

Although it will take time, and Kazakhstan is a new country, we believe by collaboration between forestry and horticulture, with support by national and international agencies, Kazakhstan horticulture can both preserve its past - important wild genetic fruit tree resources, and develop its future - a balanced commercial tree fruit industry to provide healthful fruit for its citizens.

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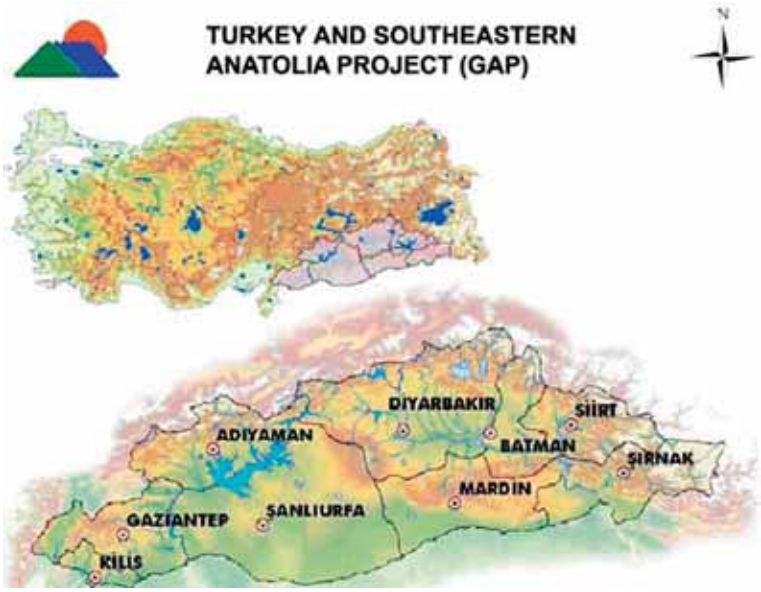
Southeast Anatolia Project of Turkey: Implications for Horticulture

Semiha Güler

The Southeast Anatolia Project (in Turkish *Güneydogu Anadolu Projesi* or GAP), the largest regional development project in Turkey and one of the major projects in the world, is a multi-sector and integrated regional development effort covering 9 administrative provinces in the basin of the Euphrates and Tigris and in Upper Mesopotamia. This region, about 10% of the total area of Turkey, consists of 9 provinces (Adiyaman, Batman, Diyarbakir, Gaziantep, Kilis, Mardin, Siirt, Sanliurfa and Sirnak) that border Syria and Iraq.

The area brought under irrigation will be equal in size to the total area so far brought under irrigation by Turkey and can be expected to bring about significant changes in agricultural output and crop design. The GAP administration estimates that substantial increases in crop production will ensue: wheat 90%, barley 43%, cotton 600%, tomatoes 700%, lentils 250%, and other vegetables 167%.

The water resources development component of the program envisages the construction of 22 dams and 19 hydraulic power plants and the irrigation of 1.7 million hectares of land. The total cost of the project is estimated at 32 billion US $. The total installed capacity of power



Turkey and the Southeast Anatolia Project.

plants is 7476 MW and projected annual energy production reaches 27 billion kWh.

GAP has been supported by many countries and organisations including United States, Canada, Israel, France, other countries from Europe, and some international funds and credit institutions including the World Bank. The GAP Administration is engaged in cooperation with many international organisations, universities and civil society organisations to share information and experience including a number of US universities (Arizona State University, San Diego University, Tennessee Valley Authority, Kent State University, Portland State University, Oklahoma State University), the Packard Humanities Institute, HASNA Inc., the Syria-based International Center of Agricultural Research in Dry Areas (ICARDA), the Sri Lanka-based International Water Management Institute (IWMI), Egypt Southern Valley Development Administration (TOSHKA), the Bari (Italy) based Mediterranean Agricultural Research Organisation (CHIEAM-IAMB), and Syrian General Organisation for Land Development (GOLD). At present, a protocol is being drafted for cooperation with the International Cooperation Center of the Foreign Ministry of Israel (MASHAV) focusing on rural development issues.

The GAP region extends over an area of 75.000 km^2 and a wide range of crops requiring different climatic conditions are raised in this area including olive, pistachio, hazelnut, and persimmon. The region has 3.5 million hectares of land (10% of the country total) fit for crop culture. Forested areas make up 1.3 million hectares while 2.3 million hectares of land consists of pastures and ranges. The region accounts for 47.8% of the country total cotton production.

Wheat, barley, chickpeas, lentil (red), dry pepper, sesame, and cotton are the most important field crops of the GAP region. A wide range of fruit crops from olive to pomegranate are produced in the GAP region but they account for only a small portion of the country total production owing to unfavourable climatic conditions. Total vegetable area of the GAP region (82,204 ha) is about 10% of the country total vegetable area (831,255 ha). Between the new jobs in industry, agriculture, and construction of the dams, roads, and other facilities, the GAP expects to be able to employ 3.8 million people.

The Council of Ministers set 2010 as the target year for the completion of the project and ordered the preparation of the "GAP 2010 Integrated Plan and Implementation Program" by the GAP-Regional Development Administration with other governmental units supplying necessary inputs to the Administration.

Semiha Güler

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New Books, Websites

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

BOOK REVIEWS

Hybrid Vegetable Development. P.K. Singh, S.K. Dasgupta and S.K. Tripathi (eds.). 2005. Food Products Press, The Haworth Press, Inc., New York. xvi + 441p. ISBN 1-56022-118-6 (hardback). $79.95. ISBN 1-56022-119-4 (paperback). $59.95. www.haworthpress.com

There is no doubt that hybrid breeding has become the major breeding method for vegetable crops produced under advanced horticultural systems. Growers are more than willing to pay substantially higher seed prices in return for uniformity and high productivity and seed producers find this is a way to control intellectual property and to insure repeated seed purchases. Hybrid breeding consists of techniques to exploit heterosis. The present work, seemingly aimed at students, is composed of 20 chapters, mostly authored by Indian scientists, which review hybrid vegetable development. Coverage includes solanaceous crops (tomato, eggplant, hot and bell peppers); cruciferous vegetables (cabbage, broccoli, cauliflower, kohlrabi, radish, and turnip); okra; cucurbitaceous vegetables (bittergourd, bottle gourd, cucumber, loofah, melon, and watermelon); garden pea; and root vegetables (carrot and beet). There is a brief chapter on hybrid breeding mechanisms. A small chapter on transgenic vegetable crops seems out of place. Unfortunately many of the chapters do not appear up-to-date and the professional breeder will find this work superficial. This reference work has been co-published simultaneously in the *Journal of New Seeds*, another Haworth Press imprint.

1421: The Year China Discovered America. Gavin Menzies. 2002. Perennial, HarperCollins Publ., New York. 650p. ISBN 0-06-054094-X. Available from Amazon for $10.85.

That Chinese Treasure ships sailed to India and Africa in the 15th century is uncontroversial. The theory that four large Chinese fleets with 30,000 crew including concubines under the general command of Admiral Zheng He, a Moslem eunuch, circumnavigated the world between March 1421 and October 1423; that Chinese sailors and their consorts settled in North and South America, Australia, New Zealand and on Pacific Islands; that part of the fleet traveled to Antarctica and the North pole - is mind boggling to western sensibilities. Author Gavin Menzies, a British submarine captain, has written a large, compelling book that claims exactly that, reducing the Spanish and Portuguese explorers to followers of maps derived from Chinese sources. The evidence brought to bear is voluminous and includes maps, wrecks, DNA analysis, historical accounts, and horticulture. While the combined case as presented is powerful, one yearns for the smoking gun: irrefutable physical evidence that the Chinese landed on the coast of Australia or America prior to 1492. The presented evidence does not yet pass the test in my judgment, although as an iconoclast I want to believe. As a non-historian, I am not in a position to critically analyze all the data but I can comment on some of the crop evidence proposed. For example, in support of his theory, the author includes pre-Columbian evidence of sweetpotato in Polynesian and pre-Magellan evidence of maize in the Philippines (based on the first hand account of Antonio Pigafetta). The presence of sweetpotato (kumara) in New Zealand is more likely due to Polynesian migration from a much more ancient introduction. In addition, my reading of the Dover edition of Pigafetta (*Magellans' Voyage: A Narrative Account of the First Circumnavigation*, 1969) does not support the assertion that maize was observed in the Philippines by Magellans's crew.

Above books are reviewed by Jules Janick, Purdue University, USA

Currants, Gooseberries, and Jostaberries. A Guide for Growers, Marketers, and Researchers in North America. Danny L. Barney and Kim E. Hummer. 2005. Food Products Press, The Haworth Press, Inc., New York. 266p. ISBN 1-56022-296-5 (hardback). $59.95. ISBN 1-56022-297-2 (paperback). $34.95. www.haworthpress.com

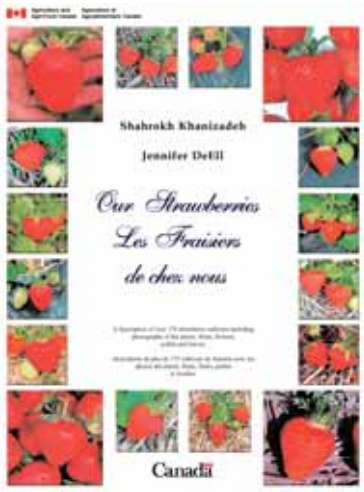
Dr. Danny Barney, a Professor of Horticulture, University of Idaho, and Dr. Kim Hummer, Research Leader, USDA-ARS National Clonal Germplasm Repository, Corvallis, Oregon, have written a comprehensive, useful book on gooseberries, black, red, and white currants, and jostaberries. This book should be a valuable resource for those interested in *Ribes* species worldwide, even though, as its title indicates, it is written from a North American perspective. The authors start with a history of cultivation, worldwide, including a wide range of references. A chapter on genetics, growth and development, and fruit composition has very good taxonomic information and a sub-section on flowering, pollination, and self-fertility that includes a list of self-fertile and self-sterile cultivars. The section reviewing the nutritional and antioxidant properties of *Ribes* fruit is very interesting. The authors' experience and familiarity with these crops is no more evident than in the cultivar chapter. Here they have used information from germplasm trials in Oregon and Idaho and evaluations of the *Ribes* collection at the National Clonal Germplasm Repository collection in Corvallis, Oregon, USA to provide practical information on cultivars including fruit size, shape, color, flavor, fruiting season, bush vigor, presence or absence of spines, and resistance to disease (particularly powdery mildew, *Sphaerotheca mors-uvae* and/or *S. macularis*, and White Pine Blister Rust, *Cronartium ribicola*). Tables provide detailed ratings on the mildew resistance, vigor, and picking ease and give values for fruit pH, total soluble solids content, and weight and beginning and end bloom and ripening season and thus allow easy comparison amongst cultivars. Although there is currently no *Ribes* breeding program in the USA, the authors include a chapter on breeding currants, gooseberries, and jostaberries highlighting the goals of leading breeding programs worldwide, drawing heavily upon the opinions of breeders in the United Kingdom. The tables in this chapter list suggested parentage for currants and gooseberries to breed for improved fruit and juice quality, disease or frost resistance, or improved adaptability for machine harvest.

The chapters that include site considerations, propagation, designing a farm, preparing a planting, planting management (fertilization, weed control, pruning and training, pollination, winter protection, and a calendar of management activities), harvesting fruit, and insect and disease management provide practical, thorough information for a grower audience. A section on marketing contains some good ideas for fruit and other *Ribes* plant products (leaves, buds). Finally, the authors have provided a very important enterprise budget showing the typical costs for producing gooseberries and currants for fresh market in the USA. This book is a valuable resource for any grower or researcher interested in *Ribes*.

Reviewed by Bernadine Strik, Oregon State University, USA

Our Strawberries/Les Fraisiers de chez nous. S. Khanizadeh and J. DeEll (eds.). 2005. Agriculture and Agri-Food Canada/Agriculture et Agroalimentaire Canada. 556p. ISBN 0-660-62338-2. $130. http://cyberfruit.info/ or http://publications.gc.ca

Our Strawberries is an illustrated book that describes over 170 strawberry cultivars using information collected during 1989-2005 from the Agriculture and Agri-Food Canada experimental growing sites in L'Acadie (Quebec) and includes information gathered from published scientific literature. The book is intended for strawberry breeders, scientists interested in strawberry culture, extension workers, growers, and home gardeners. The information on winter hardiness, disease resistance, and ripening dates will be valuable for cold climates with short growing seasons. Contributors include N.J. Bostanian, O. Carisse, J. Cousineau, A. Dale, H. Daubeny, J. DeEll, J. Hancock, K.E. Hummer, S. Khanizadeh, A. Levasseur, M. Luffman, J.L. Maas, G.R. Nonnecke, M.P. Pritts, A.J. Sullivan, and C. Vincent.



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Chopra, V.L. and Peter, K.V. (eds.). 2005. Handbook of Industrial Crops. Food Products Press, The Haworth Press, Inc., New York. xiv + 536p. ISBN 1-56022-282-4 (hardback). $99.95. ISBN 1-56022-283-2 (paperback). $59.95. www.haworthpress.com

WEBSITES

www.bharatbook.com: Bharat Book Bureau, India. Information on the publication of 6 volumes 'Advances in Ornamental Horticulture'.

http://www.horticultureworld.net/content.htm: Journal of Applied Horticulture

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

6th International Cool Climate Symposium for Viticulture and Oenology, 6-10 February 2006, Christchurch, New Zealand. Info: Symposium Secretariat, Professional Development Group, PO Box 84, Lincoln University, Canterbury, New Zealand, Phone: +64 3 325 3849, Mobile: +64 27 275 0123, Fax: +64 3 325 3685, email: info@iccs2006.org.nz, web: www.iccs2006.org.nz

Third International Rosaceae Genomics Conference, 19-22 March 2006, Napier, New Zealand. Info: Sue Page, Encore Events Management Ltd, 13a Charles St, Westshore, Napier, New Zealand, Phone/fax: +64-6-835-9549, email: encore.events@clear.net.nz

"Royal Flora Ratchaphruek 2006", 1 November 2006 - 31 January 2007, Chiang Mai, Thailand, is the International Horticultural Exposition devoted to the 60th Anniversary of His Majesty the King of Thailand's Accession to the Throne and His Majesty's 80th Birthday Anniversary. Info: Ms. Boonchira Putthisri, Public Communications Division, Project Management Office, Phone: +66 2686 7319, Fax: +66 2659 5920, email: info@royalfloraexpo.com, web: www.royalfloraexpo.com

14th World Fertilizer Congress, 22-27 January 2006, Chiang Mai, Thailand. Info: Dr. Pitayakon Limtong or Mrs. Waraporn Boonsorn, Land Development Department, Phahonyothin Rd., Chatuchak, Bangkok 10900, Thailand, Phone: 66 2941 2724 or 66 2579 5571, Fax: 66 2579 7687 or 66 2579 0772, email: pitaya@ldd.go.th or pld_7@ldd.go.th or wfc14th@ldd.go.th, web: www.ldd.go.th/wfc14th

Opportunities

Virologist, International Potato Center (CIP)

Director AVRDC's Asian Regional Center, Bangkok, Thailand

For more information visit www.ishs.org/general/index.htm

Symposia and Workshops

Section Nuts and Mediterranean Climate Fruits

Fourth Int'l Symposium on Pistachio and Almond

The 4th International Symposium on Pistachio and Almond under the auspices of the International Society for Horticultural Science (ISHS) was very successfully held in Tehran, Iran from 22 to 25 May 2005. The number of participants from Iran and all continents of the world was amazingly outstanding. The symposium was organized by Agricultural Research and Education Organization (AREO), Iran's Pistachio Research Institute (IPRI), Deputy of Horticultural Affairs, Ministry of Jihad-e-Agriculture, Seed and Plant Improvement Research Institute (SPII), Faculty of Agriculture/University of Tehran, Agricultural Biotechnology Research Institute of Iran, Farmer's House, Iranian Society for Horticultural Science and sponsored by Agricultural Bank and Rafsanjan Pistachio Producer's Co-operative (RPPC).

The opening ceremony started with a welcome lecture by Dr. Amanollah Javanshah, convener of the symposium and head of the Iran's Pistachio Research Institute (IPRI), in which he extended his thanks and gratitude to the distinguished participants, particularly those from other countries, and also very cordially thanked the members of Scientific and Executive Committees and Editorial Committee and his colleagues of the Iran's Pistachio Research Institute.

He stated that science shouldn't be restricted to a person, a country or a religion but to humanity as a matter of fact. He believed the presence of the scientists at any meeting meant "science for better life". He very briefly explained the role of pistachio and almond in human life all over the world and hoped that such symposia under the auspices of ISHS would lead to more sincere ties and exchange of knowledge among all dear researchers in the world.

The second presentation was delivered by H.E. Dr. Ali Ahoonmanesh, Hon, Deputy Minister and head of AREO. At first he extended his warmest welcome to the prominent participants and the esteemed scientists participating in this symposium. He stated that Iran is the oldest and biggest producer and exporter of pistachio and the fourth producer of almond in the world and Iran demands for higher contribution regarding policy making of these crops at international level. Then he gave a brief description of AREO's organizational chart, mandate, responsibility and research activities of its affiliated national research institutes and centers. He also stated that Iran is one of the richest countries in the world with regard to plant genetic resources.

Participants of the Symposium.

The third statement was presented by Dr. R. Socias i Company, ISHS representative. At first he warmly welcomed all the distinguished guests and expressed his deep appreciation and thanks to all organizers of this symposium. He stated that this could be a good opportunity for exchanging the latest research highlights, meeting participating researchers and other participants and getting more acquainted with advances and new technologies. He invited all participants to join the ISHS for more strengthening this international society.

The next statement was presented by the Iran Pistachio Producers Cooperative representative. He propounded for solving the most causes of damages in agricultural production, the farmers should have access to advanced technologies and research highlights for enhancing the quality and quantity of their products and in this regard making a close collaboration among national research institutes.

The first keynote lecture was presented by Prof. Talaei, dean of the Faculty of Agriculture at Tehran University. At first he gave some general information about the strategic and geographic position of Iran, population and other relevant information. He stated that Iran has many horticultural crops due to vast diversity in its climatic conditions. Further he mentioned two main mountain ranges in Iran, Alborz and Zagros, with many fertile lands in these areas. He also stated agriculture plays an important role in Iran's national economy: 18% of GNP belongs to this area and 20% of manpower is working in this sector. Then he demonstrated some statistics comparing Iran with other countries in total horticultural crops, pistachio and almond cultivars, production and quality.

The second keynote lecture, entitled "Aflatoxin and its global strategies", was presented by Dr. Alavi. He mentioned that mycotoxins, fungal metabolites exhibiting toxic effects in higher organisms, are produced by over 100 fungal species. Approximately 25% of the world's food crops are affected each year by mycotoxins. He also spoke about aflatoxin, which is produced significantly in storage commodities such as dried nuts (peanut, Brazilian nut, pistachio, almond, hazelnut and walnut), grains (maize, millet, sorghum) and dried fruit (especially fig).

The last keynote lecture was presented by Dr. S. Chaichi in the field of analysis on almond breeding in Iran. He stated that the main origin of this crop is in Iran and central Asia. A vast diversity of almond wild species, of which around 15 date back to ancient times, is available in Iran. The cultivation of this crop in Iran dates back to ancient times. Then he called the USA the main almond exporter in the world, which possesses 43% of global production, and Iran as fourth rank with a total production of 100,000 tons.

A total of 141 oral presentations and 175 posters were divided into eight sessions, including:

1. Cultivars and Breeding
2. Propagation and Rootstocks
3. Physiology and Nutrition
4. Pollination and Fruit Set
5. Orchard Management
6. Harvesting and Processing
7. Phytopathology
8. Economics and Marketing

Visit to almond's orchards.

Visit to IPRI.

The symposium's exhibition contained 14 stands on different pistachio and almond industries, such as pesticides and fertilizers, vacuum packed pistachio and almond, processing tools and machines, Iran handicrafts and research.

At the end of the second day a splendid dinner party, hosted by Dr. Kalantari, Director of Khaneh Keshavarz, was organized and guests were entertained with traditional delicious Iranian dishes.

On the third day in a special ceremony an ISHS medal was awarded to Dr. Amanollah Javanshah by Dr. R. Socias i Company, ISHS representative, and all those researchers already retired in the field of pistachio and almond were appreciated for their valuable and effective efforts with special gifts. Then Dr. Kalantari very briefly wished all participants good luck and apologized for any probable failure or shortage. He also suggested that more growers should participate in a symposium face to face to researchers.

At the end of the afternoon session, the closing ceremony was held. First Dr. Javanshah explained about the tours and once more he thanked the prominent participants and all those involved in the symposium. Then Dr. Company took the floor and presented a brief introduction and description about its mandate, activities and other relevant information. He also gave some information about sections, commissions, and working groups of ISHS. Then he invited Dr. Louise Ferguson to join him and she stated the panelists received two proposals for the 5th Symposium: one from Syria and another from Turkey. Finally, because of the number of participants, Turkey was selected as the host for the next symposium.

The day after the closing session, a three day tour was organized, which started in Isfahan and progressed down the south of Iran to Kerman and Rafsanjan. The tour provided a range of different experiences. The first day involved visits to Saman region almond orchards in the Shahr-e-kord. The tour progressed to the city of Isfahan for a number of cultural and tourist activities, including the Chehelsotoon and other ancient and historical places. The participants were in Kerman province during the following two days. First they visited a typical pistachio orchard and also one of the Iran's Pistachio Research Stations located in Rafsanjan suburb. All visitors were impressed by pistachio genetic resources. RPPC (Rafsanjan Pistachio Producer Cooperative), which is the greatest cooperative in the Middle East, was the next place visited. A visit to Rafsanjan Food Control Lab (RFCL) was also very interesting. Finally all curious participants were invited to visit Iran's Pistachio Research Institute. In a friendly gathering with IPRI researchers, the various aspects of the symposium were evaluated by a representative of the delegations.

The results of the evaluation were satisfactory, especially the message of Dr. Kaiser from the United States of America in Persian language evoked the emotional feelings of all participants present in the meeting.

Finally all Executive and Scientific Committee members wished good health, success and prosperity for all dear participants.

Amanollah Javanshah and Hossein Hokmabadi

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Tenth Int'l Symposium on Plant Bioregulators in Fruit Production

Participants of the Symposium.

The Tenth International Symposium on Plant Bioregulators in Fruit Production was successfully held in Saltillo, Mexico on June 26-30, 2005. The symposium was organized under the auspices of the Universidad Autonoma Agraria Antonio Narro (UAAAN) and the International Society for Horticultural Science (ISHS). The institutions SAGARPA, Biocampo S.A. de C.V., Laboratorios Agronzymas S.A. de C.V., Valent, Fundacion PRODUCE Coahuila and COECyT made an important financial support. More than 130 participants from 29 countries attended this event. The high standards of the organization and the scientific impact of the 43 oral and 57 poster presentations substantiated the worldwide interest on bioregulators in fruit production.

Opening Ceremony. From left to right: H. Ramírez, T. Webster, L.A. Aguirre, D. Greene, F. Valenzuela and A. Benavides.

Previous to the opening ceremony, a Steering Committee meeting took place with the participation of D. Greene (USA), T. Webster (UK), J. Retamales (Chile), G. Costa (Italy), D. Woolley (NZ), A. Basak (Poland), S. Bound (Australia), H. Ramirez (Mexico), F. Bangerth and W. Rademacher (Germany). The group discussed several aspects related to the actual situation of the ISHS Working Group on Bioregulators in Fruit Production and analyzed strategies to strengthen their presence in the society.

The event was inaugurated by Dr. Luis A. Aguirre, dean of the University. The symposium was organized in 8 sessions and was opened with a very stimulating paper: "The Fruit Cuticle - First Contact", presented by Dr. Eric Curry. Sessions on Biochemical and Molecular Aspects of Bioregulators; Propagation; Control of Vegetative Growth; Dormancy; Flowering and Fruiting; Thinning and Alternate Bearing; and Ripening and Fruit Quality were initiated by keynote lectures.

Tony Webster presenting the ISHS medal to Homero Ramirez.

Dr. Takahito Nomura (Japan) spoke about the importance of brassinosteroids on gene biosynthesis. Dr. Don Elfving (USA) presented useful tools for plant propagation using PGRs. Dr. Wilhelm Rademacher (Germany) covered all aspects of growth retardants with particular emphasis on Prohexadione-Ca. The actual concept of dormancy and hormones was presented by Dr. Jorunn E. Olsen (Norway), whereas Prof. Fritz Bangerth (Germany) made an extensive review of the process of flower induction in

Farewell dinner. From left to right: H. Ramirez, N. Looney and J. Osborne.

Field trip to Huachichil fruticulture region.

perennial fruit trees. The topic of thinning, including practical, physiological and molecular aspects, was presented by Prof. Guglielmo Costa (Italy). Fruit ripening and fruit quality were covered by Drs. Anthony Webster (UK), Eric Curry (USA) and Terence Robinson (USA).

Contributed papers (oral and posters) were related to the above sessions and linked to several fruit species such as apple, cherry, peach, pear, pecan, grape, pistachio, avocado, loquat, fig, pomegranate, mango, kiwifruit, longan, persimmon, papaya, melon and mandarin.

The closing lecture was presented by Dr. Norman Looney (ISHS President). His excellent presentation was based on the role that ISHS plays in world horticulture and how bioregulators can improve food production and quality. The use of PGRs, he said, continues to be an important alternative for horticultural crops according to market demand. Although genetic engineering, biotechnology and transgenic technology continue to be important lines of research, PGRs maintain their importance among researchers and growers. He also pointed out the necessity to strengthen the link between ISHS and universities and research centers with the purpose to increase professional opportunities for young researchers and to serve developing countries.

A business meeting of the working group was held. Prof. Duane Greene (USA) resigned as a Chairman and Prof. Guglielmo Costa (Italy) was elected as a new Chairman. After some discussion and analysis, it was agreed to hold the next symposium in Italy in 2009.

Visits to UAAAN campus and Huachichil fruticulture region were organized for the participants. In these places, they learned about the education system in agriculture and research management for temperate fruit production.

A welcome reception and social events, including "Noche Mexicana" were quite enjoyable for the participants. The accompanying persons programme included visits to Historic Saltillo, bird museum, desert museum and Villa de Arteaga.

At the farewell dinner the participants had the opportunity to establish new professional and friendly links for the following symposium.

A post symposium 2-day tour to Parras took place. Vineyards, pecan orchards, nut processing industry, winery and a melon packing house were visited, combined with a sightseeing city tour. The group spent one night at "Casa Madero", an old style Hacienda.

Post symposium tour to Parras vineyard.

Homero Ramirez

Contact

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Second Int'l Symposium on Sweetpotato and Cassava

Ranking sixth and seventh in production as leading food crops in the world, cassava and sweetpotato contribute to the energy and nutritional requirements of a significant proportion of the world population. They are also two of the most important sources of starch to the food and non-food industries.

The 1st International Symposium on Sweetpotato with the theme "Sweetpotato - Food and Health for the Future" was held in Lima, Peru in 2001. This event provided a strong link among sweetpotato scientists from around the world, enabling them to meet with their peers to review the status of research on the crop. Following this tradition, this 2nd symposium, jointly organized by the Malaysian Agricultural Research & Development Institute (MARDI) and ISHS in Kuala Lumpur, Malaysia on 14-17 June 2005, expanded its focus to both sweetpotato and cassava. The venue being in Asia was certainly appropriate as China is the world's largest producer of sweetpotato, while Thailand leads in the export of cassava products.

While a lot of research has been conducted in various areas to support the quantity and quality of these crops as demanded by the market, there are still gaps in technology development that hamper commercialization. Thus, the theme was "Innovative Technologies for Commercialization".

The objectives of the 2ISSC were:

- To highlight research achievements in sweetpotato and cassava, as well as to enhance future research activities, ranging from field production to product development so as to promote and create value-added downstream industries,
- To formulate strategies in gaining trade and market access in the global scenario,
- To promote R&D collaboration between the public and private sectors, as well as among countries, in finding solutions to research and industry-related problems.

Technical tour to Kampong Kuala Bikam: sweetpotato grown on tin-tailings.

The scope of the symposium was defined by six sessions, viz.

Session 1: Success Stories in Commercialization

Session 2: New Varieties for New Markets

Session 3: Combating Biotic Constraints

Session 4: Innovative Production Systems

Session 5: Value-adding for Better Health

Session 6: Novel Uses

To achieve the first two objectives, 25 papers on specific topics relevant to certain sessions were invited from prominent scientists and industry leaders. Of particular interest and in line with the theme were the invited papers in Session 1 - "R&D collaboration with industry: The Japanese sweetpotato story" by K. Komaki and O. Yamakawa of the National Institute of Crop Science, Japan; "Sweetpotato products in a modern world: The New Zealand experience" by S. Lewthwaite of New Zealand Institute for Crop & Food Research Ltd.; "The role of the Kawagoe Friends of Sweetpotato in popularizing the crop in Japan" by B. Duell of the Tokyo International University; "The survival of the cassava industry in Thailand" by C. Chutharatkul of the Thai Tapioca Development Institute; "CLAYUCA: An innovative approach to empower Latin American countries in determining cassava research and development agendas" by B. Ospina of CLAYUCA, Colombia; and "Linking small-scale cassava and sweetpotato farmers to growth markets: Experiences, lessons and challenges" by R. Best of Global Forum on Agricultural Research, FAO, Italy. It may be expected that important lessons on how to achieve commercialization success will be learnt by all participants from these papers.

Corresponding to the needs of old and new markets, as well as to those of producers and processors, were papers covering sweetpotato varieties improved by biofortification, and those having unique quality characteristics (altered starch structure and flavour); status of sweetpotato virus and cassava diseases; sweetpotato-based cropping systems; successes from working with cassava farmers using the farmer participatory approach; new drying technologies for root crops; nutritional food products from sweetpotato roots and leaves; anthocyanin production from a sweetpotato cell line; as well as the production of biodegradable plastics and ethanol from cassava.

Technical tour 2: demonstration of cassava harvester at MARDI.

The invited papers were supplemented by 30 selected by the Technical Advisory Committee from a total of 91 contributed papers. The remaining 61 papers were presented as posters. Each participant received the abstracts of all the papers.

Two satellite meetings, dedicated to sweetpotato genetic resources and to starch respectively, were held in tandem with the symposium, while participants had a choice of two technical tours on the last day. The first tour visited a sweetpotato-producing area sited on tin-tailings, while the second tour to MARDI covered demonstration of sweetpotato and cassava planting and harvesting machines.

A total of 145 participants, hailing from 24 countries, were in attendance. Four (from Uganda, Tanzania and Cameroon) were fully sponsored by the Technical Centre for Agricultural and Rural Cooperation (CTA), and one (from Brazil) by the Organisation for the Prohibition of Chemical Weapons (OPCW), while MARDI fully sponsored one participant (from Vietnam) and partially sponsored three others (from India and the Philippines).

Tan Swee Lian

Contact

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Fifth Int'l Pineapple Symposium

Premier of the Eastern Cape, Nosimo Balindlela, who opened the symposium.

Our Fifth International Pineapple Symposium, held from 11 to 15 April 2005, was a resounding success. The venue, Port Alfred, South Africa, was situated in the heart of the Eastern Cape pineapple growing region. The symposium was attended by 160 delegates from all over the world. Most pineapple growing regions of the world were represented at the meeting - South Africa, Australia, Benin, Brazil, France, Malaysia, Indonesia, Mexico, the Philippines, Portugal, Swaziland, Sri Lanka, Thailand, Taiwan, Republic of China, Costa Rica, Ivory Coast and the United States. The symposium was organized into tours, technical sessions and social activities.

Participants toured farms growing 'Smooth Cayenne' for canning and the Bathurst Pineapple Research Facility. The farm tour was marred by a heavy hail storm, which affected a number of growers in the Bathurst area. Some attendees also took advantage of the pre-conference tour of the 'Queen' pineapple growing region in Zululand. The symposium also had a rest day, which enabled delegates to visit areas of interest or do more networking.

Delegates enjoying themselves. Top: on the right is Dr. Chan, one of the keynote speakers.

The technical sessions highlighted challenges that face the pineapple producers around the world. Some problems are local in nature, whereas others are international in scope. Internal browning was one example of a problem faced by more growers as low acid cultivars replace the traditional 'Smooth Cayenne' cultivar. The keynote speakers delivered messages that were informative and stimulating. The pineapple community received a daring call to adopt minimal tillage practices from one speaker. Other speakers explored pest control, genetics, breeding, and molecular biology. The quantity of research in pineapple was impressive given the scarcity of funding available. The questions and discussions following each presentation were lively, sometimes challenging, and oftentimes unanswerable. Several workshops were held, which explored pest control and organic pineapple production. The poster session echoed the oral presentations in the breadth of information presented. We know lots about pineapple, but there is certainly more to be learned!

Three pineapple growers attending the symposium. From left to right: Cyril Tyson, Greg Pike and Gary Fletcher.

Our South African hosts treated the participants to two major social gatherings. These dinners served more than food - they allowed interaction and networking among attendees. They also showed off the culture and traditions and cuisine of the South African people. At the opening dinner, we were honored to have the Eastern Cape Premier Nosimo Balindlela attend and speak. Her message highlighted the success of the Peddie Pineapple Project, a cooperative program among Summerpride and Collondale pineapple canneries and small-scale previously disadvantaged farmers.

Allen Duncan

From left to right: Duane Bartholomew, Ngenesi Langwenya, Graham Petty and Madeline Petty. Duane is a tower of strength with all the Pineapple symposia and has been involved in the organisation since inception.

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Fifth Int'l Symposium on Artificial Lighting in Horticulture

Participants of the Symposium.

The Fifth International Symposium on Artificial Lighting in Horticulture was held at the Olympic city of Lillehammer (Norway) from 21-24 June 2005. The ISHS Board and Executive Committee meetings were partly held parallel to the symposium and they joined part of the scientific and social programs at the symposium. After the meetings, the Board and Executive Committee visited the Department of Plant and Environmental Sciences at the Norwegian University of Life Science (UMB) and the Norwegian Crop Research Institute (NCRI).

The programme of the symposium was organized by Prof. Roar Moe together with the Norwegian representatives of the ISHS Council, Dr. Lars Sekse and Dr. Trine Hvoslef-Eide. They provided a brief introduction to the research and teaching activities in Horticultural Sciences at the University Campus.

NORWEGIAN HORTICULTURE

Norway is situated far north extending from 59°N to 71°N latitudes. The winter production of greenhouse plants becomes rather limited without the use of supplemental lighting. The global radiation values calculated as PAR (mol m-2 day-1) inside a greenhouse with 60% light transmission at 60°N (Ås, Norway) during the year based on mean PAR values for ten years (1995-2004) are presented in the table below.

Norwegian horticulture has a production value paid to the growers close to NOK 3 billion/year (1 € = NOK 7). The annual contribution from the different sectors is listed below:

- Flower production in greenhouse: NOK 1.2 billon, of which pot plants and cut flowers account NOK 0.5 billon each and bedding plants NOK 0.2 billion.
- Greenhouse vegetables: NOK 400 million.
- Vegetables in open fields: NOK 700 million.
- Fruit and berries: NOK 300 million.
- Nursery stock: NOK 300 million.

One quarter of the greenhouse area is located in the west of Norway around Stavanger, where about 85% of the tomato production is located. The pot plant and cut flower production are mainly located around the densely populated areas. This includes both pot plant and cut flower production far north of the polar circle around the University City of Tromsø.

The research with artificial light started around 1930 with incandescent lamps, followed by the work with fluorescent tubes and high pressure mercury lamps in the 1950's for propagation and pot plant cultivation. In the late 1970's, high pressure sodium lamps were introduced that made possible supplemental lighting in

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1.4	4.4	10.1	14.7	22.3	24.2	24.7	20.2	10.7	4.9	1.8	1.0

Prof. Roar Moe, co-convener and responsible for the scientific program (left) and Prof. Hans R. Gislerød, convener (right) in national costumes. Photo by Randi Setrom Brunborg, UMB.

greenhouses. However, in growth chambers fluorescent tubes are still necessary for some species in order to obtain a normal growth habit.

Commercial use of supplemental light for cut flowers and vegetables in Norway started in the late 1980's. In the last decade, the improvement in light-emitting diodes (LED) and cold cathode fluorescent lamps (CCFL) has opened new opportunities related to improve growth and plant quality by light quality manipulations.

By increasing the light intensity (photosynthetic photon flux), light quality seems to play a less important role for plant growth. The light intensity used for plant growth today in Norway ranges from 50 to 300 μ mol m^{-2} s^{-1} for the different crops, stage of development and growers. The lowest level of supplementary light is applied to some foliage plants and plant species within Gesneriaceae. The main part of the pot plants and cut flowers are given a supplementary lighting of 100-150 μ mol m^{-2} s^{-1}. For roses and cucumber, the light intensity is up to 300 μ mol m^{-2} s^{-1}. The lighting period is usually 20 hours a day except in the growth period when short-day-plants are exposed to short days. For roses, we are working on 24 h lighting. The results show that the growth rate is linear with increasing daily light integral, and at the same time, the incidence of powdery mildew can be significant reduced.

LIGHT SYMPOSIUM

The "Light symposium" was held at the brightest time of the year that gave the participants a chance to celebrate the mid-summer night in the traditional Lillehammer way at Maihaugen, a famous open-air museum. A total of 140 participants from 23 countries attended the symposium.

The scientific programme comprised the following topics:

1. Introduction to Horticultural Lighting. New Developments.
2. Biological Aspects of Lighting on: a) Photosynthesis, Growth/Yield and Product Quality; b) Integrated Optimization of Light and Other Growth Factors; c) Light Regulated Plant Growth and Development.
3. Biological and Technical Aspects of Lighting: a) Regulation of Plant Morphogenesis, Flowering and Quality; b) Photoperiodic Lighting.
4. Technical and Economical Aspects of Lighting.

Following is the list of plenary speakers from different parts of the world: A.H. Halevy (Israel), E. Heuvelink (The Netherlands), R. King (Australia), T. Kozai (Japan), E. Runkle (United States), C. Mènard (Canada) and J. Aaslyng (Denmark). In total there were 34 oral presentations and 66 posters and exhibitions on various aspects of lighting at the symposium. Some of the highlights of the symposium are summarized below.

Mobile Lighting

In the last light symposium held in Canada in November 2000, 'mobile lighting' was the 'in thing' and it was supposed to be the future. At the light symposium in Lillehammer there were presentations on research with mobile lighting on pot plants and cut flowers. They all showed that mobile lighting had the same effect or less on growth compared to static lighting. This was true for production, photosynthesis and in a simulation model.

Interlighting

When growing cucumber or tomato with a high wire system, the light intensity decreases rather quickly downwards in the canopy due to shelf-shading. This is true even if a high irradiance of 200-300 μ mol m^{-2} s^{-1} is applied at the top of the plants. This question was addressed by giving a part of the light between the plants. The results presented indicated that in some experiments there was a better efficiency in using interlighting in combination with top lighting, while in some cases there were no differences in yield of cucumbers. However, interlighting improved fruit quality.

Light-Emitting Diodes (LED)

Light-Emitting Diodes (LED) have been in the market for several years, but have not reached any commercial value in greenhouse production because of their high cost and low efficiency. However, improved technology has increased their efficiency and reduced the cost. The general opinion was that in 5-10 years this lamp type will also be important in commercial production. Today this lamp is used in specialized production and research; there were several papers dealing with the topic.

Light Integration/Light Use Efficiency

Natural light is still the most important for plant growth and will probably be so for most crops in the future. There was a discussion on specialised plant production in growth rooms with only artificial lighting. The main questions addressed were related to efficient use of artificial light in addition to natural light for increasing production and quality.

The cost of energy is steadily increasing. This raises the question on the use of light together with other climatic factors in the most optimal way. The general rule says 1% increase in light gives 1% increase in growth/yield and still seems to be about right when the light level is far below the saturation point of photosynthesis and growth. An interesting observation was to let the temperature increase as the sunlight increased during the day and decrease at other times of the day to maintain the average daily

Coffee break and poster discussion. Photo by Randi Setrom Brunborg, UMB.

temperature. However, it is important to keep a high CO_2 level while increasing temperature under good light conditions.

Light Quality

The results presented indicated that diffuse light would give a 10% increase in growth, compared to more direct light at the same level. Thus, greenhouse covering material should give more diffuse light and at the same time have very high light transmission.

Light quality does influence the plant morphology as blue light reduces elongation, and this is the light spectrum that some specific LED lamps emit. They could be of interest for studying the impact of blue light on plant morphology.

UV-light affects plants differently, by increasing the pigmentation in some lettuce crops and flower plants. For other crops it has no or a negative effect on growth.

Both light level and light quality influence flower induction and development. There was a presentation on irradiance response curve for promotion of flower initiation. Also, research work was presented that showed light could substitute for the vernalization requirement related to flowering.

Photoperiodic lighting for flower induction is still an important area both for research and commercial. Some work was presented related to the role of photoperiodic lighting in flowering.

Light quality of day-extension light has an impact on elongation and flowering. Low light intensity from FR-enriched incandescent lamps increases the content of gibberellins in association with promotion of stem and petiole elongation, and flowering. Therefore, FR-enriched light seems important for flowering in some LDP. High light intensity may result in flowering under non-inductive short days in some LDP, and carbohydrate level seems to play a role for floral induction.

Excursion to cucumber operation with supplemental lighting.

New Crops in Greenhouse Production

New cultivars of 'old' crops of pot plants, cut flowers and not to forget bedding plants are released at an increasing speed. New growing programs for herbaceous perennials have been developed by a research group in Michigan in order to market the plants as bedding plants. In addition we have seen herbs being grown to a greater extent. Several papers also dealt with the use of lighting for growing medicinal plants and the effect of light on the content of bioactive compounds of interest.

Hans R. Gislerød and Roar Moe

Contact

Prof. Dr. Hans R. Gislerød and Prof. Dr. Roar Moe, Norwegian University of Life Sciences, Norway, email: hasns.gislerod@umb.no and roar.moe@umb.no

Silke Hemming, the new Chair of the Working Group on Light in Horticulture (formally called Working Group on Artificial Lighting) received her Ph.D. (Dr. rer. hort.) from the Faculty of Horticultural Sciences of the University of Hanover. She is currently engaged as a scientist at Wageningen University and Research Centre, and member of the Agrotechnology and Food Sciences Group.

From the Secretariat

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW ORGANISATION MEMBERS:

Australia: Berrimah Farm Library, DPI, Darwin

Australia: Dept. Of Primary Industries & Fisheries, Brisbane, QLD

Jordan: National Center for Agricultural Research &Technological Transfer, Baq'a

New Caledonia: Direction Développement Rural, Noumea

NEW INDIVIDUAL MEMBERS

Australia: Jodie Anne Campbell, Mr. Mark Collins, Mr. Luke Devitt, Mrs. Wendy Erhart, Dr. Audrey Gerber, Todd Hall, Ms. Hannah James, Dr. David Johnson, Mr. Dale Keily, Mr. Hemant Kumar, Ms. Vicki Lane, John Lunghusen, Mr. Lachie Mckenzie, Mr. Jamie McMaster, Steve McNaughton, Ms. Malou Midgley, Mr. Tim Ring, Mr. Shane Ryan, Mr. Solomon Tonga, Dr. Guijun Yan, Dr. Isa Yunusa; **Austria:** Wolfgang Prommegger; **Barbados:** Dr. Louis Chinnery; **Belgium:** Ed Stynen; **Brazil:** Ms. Rivanildo Dallacort, Jairo Teixeira Morais; **Canada:** Dr. Joseph Arul, Dr. William Brown, Mr. Rob Keates, Mr. Henryk Madler Kron, Dr. Christoph Neeser, Mr. Titus Tao, Mr. Joe Wong; **Chile:** Mr. Ignacio del Rio, Ms. Pia Delpiano, Prof. Marlene Gebauer, Mr. Gonzalo Morales, Matias Rodriguez, Sonja Ungar, Prof. Juan Pablo Zoffoli; **China:** Lijun Wang; **Costa Rica:** Dr. Donovan Brown; **Croatia:** Goran Kumric; **Denmark:** Dr. Erik Bjorn Jensen, Mr. Holger Kaempe; **Ecuador:** Mr. Crisologo Matos; **Finland:** Mr. Sampo Tukiainen; **France:** Mr. Laurent d'Orey, Dr. Ela Frak, Sami Hosagasi, Ms. Asmaa Khariji, Mr. Jean-Paul Onesto; **Germany:** Ivo Jegielka, Steffen Lodder,

Bernhard Manz, Anett Mueller, Anja Mueller; **Greece:** Mr. Nikolaos Tsotakos; **Hungary:** Sándor Istella, Noémi Kappel; **India:** Dr. Prem Kumar Dantu, Mr. Rohan Dominick, Mr. Anantha Reddy Kaukuttla, Mr. Vilas Patki, Mr. Dharmender Singh; **Indonesia:** Mr. Mashuda Huda, Mr. Tri Winarso; **Ireland:** Mr. Richard Hayden, Mr. Mark Taylor; **Israel:** Dr. Yuval Cohen, Dr. Avi Sadka; **Italy:** Linda Donato, Monica Ms. Locatelli, Isabelle Tomasi; **Japan:** Dr. Shnji Harima, Dr. Tsuneo Ogata; **Jordan:** Mr. Ali Al-Khasawneh; **Kenya:** Dr. Kamau Ngamau, Dr. John Bosco M. Njoroge, Dr. Willis Owino; **Korea (Republic of):** Dr. Sang Kuk Kim, Dr. Ki-Byung Lim; **Malaysia:** Dr. James Chan, Dr. Siang Hee Tan; **Malta:** Ms. Monique Hili; **Mexico:** Dr. Elia Nora Aquino-Bolaños, Dr. Kalina Bermúdez Torres, Dr. Marcos Meneses, Dr. Sara Luz Nahuat; **Netherlands:** Dr. Douwe de Boer, Mr. Peter Hendrix, Dr. Ilona Kars, Mr. Kees Sahin, Rob van der Laan, Mr. Olaf van Dooren; **New Zealand:** Ms. Hilary Chisholm, Ms. Meredith Hullis, Mandy Matthews, Ms. Della Welch; **Nigeria:** Ms. Mary Adejoro; **Oman:** Dr. Fahad Al-Said; **Portugal:** Dr. Fernando Cardoso, Loic de Oliveira; **Singapore:** Mr. Lanus Quah; **South Africa:** Mr. Toby Mcdowall, Mr. Timothy Pentz, Mr. K.N. Pillay; **Spain:** Ricardo Blasco Ferrer, Mr. Ambrosio Hernandez Gonzalez, Ms. Ines Mataix, Xesús Moruja Martínez, Mr. Juan Pedro Perez Abellan; **Sweden:** Mr. Dejan Jovanovic; **Switzerland:** Mr. Christian Uebelhard; **Taiwan:** Ms. Linda Liao; **Thailand:** Ms. Komchai Thaiying; **Turkey:** Mehmet Sait Gokcek, Mr. Alper Us, Prof. Dr. Tevfik Yotas; **Ukraine:** Mr. Ioannis Tsiachristas; **United Arab Emirates:** Mr. Salem Al Shekaili; **United Kingdom:** Mr. Perrakis Antonio, Mr. Rupert Bannister, Mr. Mervyn Brown, Mr. Gerry Gorevan, Mr. Alistair Griffiths, Chris Jerram, Anne Livingston, Dr. Hazel Mactavish, Dr. Andy Marchant, Mr. Graham Moore, David Musker, Mr. Hamish Reid, Mr. David Stokes, Dr. Abbsali Yadollahi; **United States of America:** Dr. Dell K. Allen, Mr. Paul Bodenstine, Dr. Kamal Chowdhury, Mr. Kit Comby, Dr. Daniel DeBrouse, Mr. Ibrahima Dione, Harold Falber, Kevin Forney, Lauren Garner, Carrie Garra, Paul Gepts, Mr. Leonard Gianessi, Dr. Bob Guthrie, Mr. William Hall, Ron Johnson, Dr. Eileen Kabelka, Mr. Tim Loeffler, Prof. Jiang Lu, Richard Luftig, Mr. Howard Maltby, Mr. Andrew Mariani, Mr. Jonathan Moody, Dr. Robert Oakes, Dr. Ebenezer Ogundiwin, Steven Parker, Jeremy Pickens, Dr. Barbara Reed, Mr. Janet Robbins, Dr. Godfree Roberts, Mary Schiechl, Mr. Mark Schiesser, Paul Schulze, Mr. John Siddle, Mr. Justin Smith, Dr. Theodore Snazelle, Dr. Roy Stahlhut, Prof. Rommy Surjono, Mr. Larry Turley, Mr. Michael van Bavel, Dr. Petrus van Hest, Dr. Dawn Vander Linden, Mr. Pieter Vanderlaan, Robert Veidenheimer, Der I Wang, Sally Wedel, Jun Wen, Mr. Patrick Wood, Lisa Worthen; **Vietnam:** Hoang Phuong Thao

Calendar of ISHS Events

For updates and more logon to www.ishs.org/calendar. Do always mention your ISHS membership number or attach copy of your ISHS membership card when registering. A reduced ISHS members registration fee applies.

YEAR 2006

- February 5-10, 2006, Sun City, Johannesburg (South Africa): **VIII International Mango Symposium.** Info: Event Dynamics Africa, Jenny Dickerson, PO Box 98009, Sloane Park, 2152, South Africa. Phone: (27) 11 440 8027, Fax: (27)11 786 5683, email: jenny@edafrica.co.za web: www.mangosa2006.co.za
- February 6-11, 2006, Pune - Maharashtra (India): **International Symposium on Grape Production and Processing**. Info: Dr. Indu S. Sawant, Grape Grower's Federation of India, Draksha Bhavan E/4, Market Yard, Gultekdi, Pune 411 037, Maharashtra, India. Phone: (91)2024267910, Fax: (91)2024270491, email: isgpp2india@yahoo.co.in
- February 19-24, 2006, Agadir (Morocco): **International Symposium on Advances in Soil and Soilless Cultivation under Protected Environment.** Info: Conveners Dr. A Hanafi and Dr. W.H. Schnitzler, Institut Agronomique et Véterinaire Hassan II, Complexe Horticole, PO BOX 12042, Cité Balnéaire, Agadir 80.000, Morocco. Phone: (212)48248152 or 61177968, Fax: (212)48248152, email: hanafi@iavcha.ac.ma web: www.iavcha.ac.ma/ishs-morocco2006
- February 21-24, 2006, Rotorua (New Zealand): **VI International Kiwifruit Symposium.** Info: Dr. Bob Martin, Market Access and Technical Manager, Zespri International Ltd., 400 Maunganuit Rd., Mount Maunganui (PO Box 4043, Manganui South), New Zealand. Phone: (64)75751591 or 21595128, Fax: (64)75751340, email: bob.martin@zespri.com web: www.kiwi2006.com
- February 22-25, 2006, San Remo (Italy): **The Labiatae: Advances in Production, Biotechnology and Utilization.** Info: Dr. Barbara Ruffoni, CRA Experimental Institute of Floriculture, Corso Inglesi 508, 18038 San Remo, Italy. Phone: (39)0184667251, Fax: (39)0184695072, email: b.ruffoni@istflori.it web: www.istflori.it
- February 28 - March 2, 2006, Wolfville, Nova Scotia (Canada): **I International Organic Apple and Pear Symposium.** Info: Dr. Ralph Martin, Box 550, SNAC, Truro, NS, B2N 5E3, Canada. Phone: (1)9028936679, Fax: (1)9028967095, email: rmartin@nsac.ns.ca or Dr. Charlie Embree, AAFC, 32 Main Street, Kentville, NS, B4N 1J5, Canada. Phone: (1)9026795708, Fax: (1)9026792311, email: embreec@agr.gc.ca web: www.organicapple.ca
- March 28-31, 2006, Lorca - Murcia (Spain): **VI International Symposium on Artichoke, Cardoon and their Wild Relatives.** Info: Ir. Regino Aragón Pallarés, Dpto. Horticultura, IMIDA, C/ Mayor, S/N, 30150 La Alberca (Murcia), Spain. Phone: (34)968366773, Fax: (34)968366792, email: regino.aragon@carm.es or Dr. Juan A. Fernández, Departamento Producción Vegetal, Universidad Politécnica de Cartagena, Paseo Alfonso XIII, 52, 30203 Cartagena, Spain. Phone: (34)968325446, Fax: (34)968325435, email: juan.fernandez@upct.es Symposium Secretariat: Viajes CajaMurcia, Gran Via Escultor Salzillo 5. Entlo. Drcha., 30004 Murcia, Spain. Phone: (34)968225476, Fax: (34)968223101, email: congresos@viajescajamurcia.com web: www.viajescajamurcia.com/artichoke
- March 30 - April 5, 2006, San Diego, California (USA): **VII International Protea Research Symposium.** Info: Dennis Perry, Perry's Panorama, PO Box 540, Somis, CA 93066-0540, USA. Phone: (1)8056423267, Fax: (1)8056425967, email: perrypan@adelphia.net or Dr. Kenneth W. Leonhardt, Dept of Horticulture, University of Hawaii, 3190 Maile Way, Rm 102, Honolulu, HI 96822-2232, USA. email: leonhard@hawaii.edu web: www.ipa2006conference.org
- April 1-5, 2006, Guangzhou (China): **II International Symposium on Loquat.** Info: Dr. Shunquan Lin, College of Horticulture, South China Agricultural University, Guangzhou 510642, Wushan, China. Phone: (86)2085288262, Fax: (86)2085282107, email: cmliu@scau.edu.cn
- April 24-27, 2006, Almería (Spain): **Symposium on Greenhouse Cooling: Methods, Technologies and Plant Response.** Info: Dr. Jerónimo Pérez Parra, Estación Experimental de Cajamar, Autovía del Mediterráneo Km. 416,7, 04710 El Ejido, Almería, Spain. Phone: (34)950580569, Fax: (34)950580450, email: jpparra@cajamar.es web: www.coolingsympalmeria06.com

- May 7-11, 2006, Amman (Jordan): **I International Symposium on Fresh Food Quality Standards: Better Food by Quality and Assurance.** Info: Dr. A. Fardous, Director General, National Center for Agricultural Research and Technology Transfer, PO Box 639, Baq'a, 19381 Amman, Jordan. Phone: (962)64726680, Fax: (962)64726099 or (962)665356519, email: garyouti@ncartt.gov.jo or Prof. Dr. W.H. Schnitzler, Technical Univ. of Munchen, Inst. of Vegetable Crops Science, Weihenstephan, 85354 Freising, Germany. Phone: (49)8161713427, Fax:(49)8161714491, email: whs@wzw.tum.de web: www.ncartt.gov.jo
- May 22-26, 2006, Antalya (Turkey): **XX International Symposium on Virus and Virus-like Diseases of Temperate Fruit Crops and XI International Symposium of Small Fruit Virus Diseases.** Info: Prof. Dr. Kadriye Çaglayan, Mustafa Kemal University, Agriculture Faculty, Plant Protection Department, 31034 Antakya-Hatay, Turkey. Phone: (90)3262455836 Ext.1347, Fax: (90)3262455832, email: caglayan@mku.edu.tr and Prof. Dr. Filiz Ertunc, Ankara University, Faculty of Agriculture, Department of Plant Protection, 06110 Ankara, Turkey. Phone: (90)3123170550 ext.1120, Fax: (90)3123187029, email: ertunc@agri.ankara.edu.tr web: www.fv2006.gen.tr
- June 6-8, 2006, Tunis (Tunisia): **X International Symposium on the Processing Tomato.** Info: Abdellatif B'Chir, GICA, 77 avenue Taïeb M'Hiri, 1002 Tunis, Tunisia. Phone: (216)71782633 Fax: (216)71783206, email: secretariat@worldtomatocongress.com or Sophie Colvine, AMITOM, Phone: (44)1387820322, Fax: (44)1387820322, email: colvine@tomate.org web: www.worldtomatocongress.com
- June 7-10, 2006, Presov (Slovak Republic): **I International Symposium on Chamomile Research, Development and Production.** Info: Dr. Ivan Salamon, Department of Ecology, FHPV Presov University, 17th November Street #1, 071 16 Presov, Slovakia. Phone: (421)517725361 or (421)907186500, Fax: (421)517725547 or (421)517710803, email: salamon@fhpv.unipo.sk web: www.chamomile.szm.sk
- July 2-6, 2006, Udine (Italy): **IX International Conference on Grape Genetics and Breeding.** Info: Prof. Enrico Peterlunger, Università di Udine, Dip. di Scienze Agrarie e Ambientale, Via delle Scienze 208, 33100 Udine, Italy. Phone: (39)0432558629, Fax: (39)0432558603, email: peterlunger@uniud.it web: www.grapebreeding2006.com
- NEW August 7-10, 2006, Bangkok (Thailand): **International Conference on Managing Quality in Chains.** Info: Dr. Sirichai Kanlayanarat, Division of Postharvest Technology, King Mongkut's University of Technology, Thonburi, 83 Moo 8 Tientalay 25 Rd., Bhakham, Bangkhuntien, Bangkok 10150, Thailand. Phone: (66)24709796, Fax: (66)24523750, email: sirichai.kan@kmutt.ac.th web: www.kmutt.ac.th/mquic2006
- August 10, 2006, Seoul (Korea): **Meeting of the ISHS Executive Committee**
- August 11-12, 2006, Seoul (Korea): **Joint meeting of the ISHS Executive Committee and Council**
- August 13-18, 2006, Seoul (Korea): **XXVII International Horticultural Congress. web: www.ihc2006.org**
- August 15, 2006, Seoul (Korea): **ISHS General Assembly, 12:00 - 15:00h**
- August 18, 2006, Seoul (Korea): **Joint meeting of the ISHS Executive Committee and Council, 10:00 - 12:00h**

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The International Society for Horticultural Science (ISHS) in the tropical world

The Committee for Research Cooperation (CRC)

Presented by **Jacky Ganry**
DDR CIRAD
Member of the CRC
Contacts: **jacky.ganry@cirad.fr**
info@ishs.org

The CRC is a special entity within the ISHS.

The ISHS, with members in 128 countries, is the leading independent organization of horticultural scientists in the world.

Aim of the ISHS: "to promote and to encourage research in all branches of horticulture and to facilitate cooperation of scientific activities and knowledge transfer on a global scale by means of its publications, events and scientific structure".

Currently 5800 members; web site: www.ishs.org.

The CRC creation was decided by the World Conference on Horticulture Research (WCHR), Joint ISHS-ASHS conference, Rome, June 1998.

Members of the CRC and of the ISHS board (Arusha, Tanzania, 2005).

Terms of reference

The role of the CRC is to enhance, strengthen and widen the role of ISHS through the promotion of research cooperation particularly in developing countries.

Tropical fruit stall in Asia.

Peppers and fruits in an open market in Mayotte.

Goals

- To identify and engage agencies, organizations, foundations and corporate partners to enhance ISHS involvement in capacity building in the developing world;
- To maximize the reach of ISHS publications and services;
- To increase the number and broaden the scope of ISHS symposia held in developing countries;
- To promote ISHS membership and increase participation of horticultural scientists in developing countries in the activities of ISHS;
- To create a database of potential corporate, agency and foundation partners;
- To obtain the funding and engage the human capital needed to support these goals.

Sheltered vegetable cultivation in Vietnam.

Amaranthus spp. field test plots (Tanzania).

Members

- Dr. Uygun Aksoy, CRC Chair, Profr. Hortic., Ege Univ., Turkey.
- Dr. Alison Hodder, Agric. Off., Hortic. Crop. Group, FAO, Rome, Italy.
- Dr. Jacky Ganry, Deputy Dir. Res. Dep. FLHOR, CIRAD, Montpellier, France.
- Dr. Rodomiro Ortiz, Dir., Intensive Agroecosyst. Program-CIMMYT, Mexico.
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- Dr. Tomas Lumpkin, Dir. Gen., AVRDC, Taiwan.
- Dr. Hubert Zandstra, Former Dir. Gen., Int. Potatoe Res. Cent. (CIP), Lima, Peru.
- Dr. André de Jager, Manag. Int. Res. Program, North-South Cent., Wageningen Univ., the Netherlands.

Meetings

- 1st: October, 5, 2003, Providence, Rhode Island, USA.
- 2nd: April, 14, 2004, Chania, Crete, Greece.
- 3rd: February, 12–13, 2005, Arusha, Tanzania.

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