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Cover photograph: Indianapolis: Western end of the Canal Walk District - Washington. Picture by courtesy of Gert Groening, see p. ....

Errors and Corrections

Chronica 44(2):
Page 10: Reference to Figure 6 should read ‘Total financial support for organic agricultural research in 2002 (millions of Euros, columns) and surface of organic culture (millions of hectares, points) in 12 European countries.’
Page 31, Figure 4: Y-axis should be ‘Crop yield (t/ha)’
Page 31, Figure 5: Y-axis should be ‘WUE (kg m-3)’
Page 32, Figure 6: Y-axis should be ‘NUE (ton per kg)’
Page 33, Figure 8: Y-axis should be ‘Daily global radiation (MJ m-2)’
Page 36, 2nd column, line 5: ‘10x1’ instead of ‘10, 1’
Page 37, 1st column, Conclusions, line 12: ‘production in Morocco and the Canary Islands...’ instead of ‘production in Morocco...’
The Future of Horticultural Science within Academia

Norman E. Looney, ISHS President

Despite unprecedented growth in the size, diversity and commercial value of horticultural industry worldwide and ongoing enthusiasm for the contributions of horticulture to improving urban environments, horticultural science within academia is experiencing a crisis of confidence. Worse, and especially in the most industrialized nations, opportunities for obtaining a high quality undergraduate education in horticultural science are in serious decline. As a learned profession we are failing to compete for shared resources, for students, and for prestige within the university community. Too many of us accept the inevitability of this decline. Many others have begun to believe the elitist rhetoric that questions the academic worth of all science connected with food and agriculture.

It is not difficult to document this trend. For example, the number of “stand alone” departments of horticultural science (or departments serving horticultural science specializations like pomology or viticulture) at North American universities declined from 61 in 1970 to fewer than 40 in 2000 and is even fewer now. In most cases horticultural science did not disappear at these universities but was amalgamated with one or more other departments. Typically, this new department is called Plant Science. Inevitably, the number of courses addressing horticultural science topics and the number of professors championing horticulture is significantly reduced. In some cases horticultural science as an identified discipline has been eliminated altogether.

This trend is equally apparent across Western Europe (e.g., Germany and The Netherlands) and in countries like Australia and New Zealand. Clearly it is related to changing demographics where fewer families are engaged in production horticulture, but this is certainly not the only defining factor.

Can this trend be reversed? I believe it can, but we will have to start with some very serious discussions about who we are within academia and exactly whom we serve within society at large.

Your Board has discussed and debated this topic on numerous occasions. At the autumn 2003 Board meeting (Providence, Rhode Island) we met with the ASHS Board of Directors to explore the idea of a joint ISHS-ASHS Task Force that would address this issue. It was unanimously agreed that there is an urgent need for a Task Force to define the problem and develop a plan of action for strengthening horticultural science as an academic pursuit and I am pleased to report that enthusiasm for this initiative continues to run high. The members of this Joint Task Force are myself, Dr. Dan Cantliffe (Chair, ISHS Vegetable Section), Dr. Fred T. Davies (Professor of Horticultural Science at Texas A&M University), Dr. Rod Drew (Vice Chair of the ISHS Commission on Biotechnology and Molecular Biology), Dr. Gert Groening (Vice Chair of the ISHS Commission on Landscape and Urban Horticulture), Dr. Jules Janick (ISHS Board Member responsible for Publications), Dr. Julia Kornegay (Head of the Horticultural Science Department at North Carolina State University), Dr. Ian Warrington (ISHS Vice President), and Dr. George Wilson (ASHS Past President and ISHS Council Member for the USA).

At the recent (July 2004) ASHS Annual Conference, Dr. Wilson led an “ASHS/ISHS Open Forum to Discuss the Future of Horticulture.” This Forum attracted more than 50 interested scientists and was an excellent kick-off for this initiative. The views and suggestions put forward will be brought to the 2004 ISHS Executive Committee and Council meetings (August 25-29 in Coolum, Australia). All Joint Task Force members will be present in Australia except for Drs. Davies and Kornegay. We expect a lively and productive discussion.

My personal view is that we must find a way to position horticulture as an essential life science in modern society. It is only with that level of societal recognition and respect (and the political power that will follow) that we can expect to reverse the forces that are pushing horticultural science to the margins of academia. We can do this by becoming the recognized profession addressing the people-plant relationship, whether it be biological or environmental, within urban or rural society, and in rich or poor countries. That space within academia is available.

We can do this by using the mass media to explain how horticultural science serves societal expectations for fresh and nutritious foods in every season, for medicinal and aromatic plants, for beautiful flowers and woody ornaments, and for restful parks and gardens. Too few people understand our essential roles in plant improvement, crop production technology, environmental horticulture, and the discovery and protection of plant genetic resources.

We can do this by recognizing that many of our current university programs fail to address a host of horticultural science sub-disciplines and overall may be insufficiently rigorous to command the respect we desire. Higher admission standards and fewer but much better faculties of horticultural science may be the way to go - regional departments offering greater breadth and depth of horticultural science education.

Others will have different opinions and suggestions and the outcomes of this Task Force are hard to predict. The important point is that we have started a process that confronts a concerning issue, will certainly strengthen our self-awareness, and hopefully change our profession for the better.
Feast of Horticultural Science at Coolum

Tony Biggs, Australian Society of Horticultural Science

A major horticultural science conference held on Queensland’s Sunshine Coast September 1st - 3rd provided a wide and varied program of meetings, oral presentations and posters. Organised jointly by the Australian Society of Horticultural Science (AuSHS), the New Zealand Society for Horticultural Science (NZSHS) and the New Zealand Society of Plant Physiologists, Inc (NZSPP), it was the first time that the three Societies have met jointly. The Queensland Department of Primary Industries and Fisheries (DPI&F) and Horticulture Australia Limited (HAL) were major sponsors of the conference.

The joint conference followed immediately on the Board, Executive and Council meetings of the International Society for Horticultural Science (ISHS).

Keynote speakers addressed the topic of Current Developments and Future Prospects in Horticulture. Tony Biggs, President of AuSHS, Dr. Ahmad Dimyati, Secretary of the Indonesian Agency for Agricultural Research and Development (IAARD), and Dr. Norm Looney, President of the ISHS spoke respectively on the Australian/New Zealand, Asian and International perspectives.

The joint conference theme of Harnessing the Potential of Horticulture in the Asia Pacific had attracted speakers from many Asian countries, the United States, the United Kingdom and Spain as well as Australia and New Zealand. Plenary and concurrent conference sessions allowed oral presentations on more than 70 topics and included 50 posters.

Two highlights in the segment on Harvesting the Genetic Potential were keynote addresses Jules Janick, Professor of Horticulture from Purdue University in the United States, on the future of horticultural crop breeding and the presentation by Dr. Violeta Villegas on the public acceptance of genetically modified crops in southeast Asia. Dr. Villegas is Head of Regulatory Affairs (Asia Pacific) with Syngenta Seeds.

Professor Ronnie Harding, of the University of New South Wales, was the keynote speaker in the segment on Reaching the Potential for Sustainable Horticulture. A paper from researchers with Queensland Department of Primary Industries and Fisheries - Horticulture and Forestry Science was entitled ‘Where Science Meets Sustainable Production: A banana Case Study from Tropical Queensland’.

A major feature of the whole conference occurred on Friday, September 3rd when the Annals of Botany Address was delivered by Dr. John Finlay, this year’s NZSPP Outstanding Physiologist. Dr. Finlay is from the Grand Forks Human Nutrition Research Center of USDA and has carried out research on bioactive compounds in broccoli.

This conference was considered by many participants one of the most important gatherings of horticultural scientists in this part of the world.
Plants are critical to the quality of our lives and there can be no doubt that our physical and emotional well being is dependent on our connections to the natural environment around us. These are not new messages for those of us in the field, nor are they novel messages for all those who garden or who love gardens and the beauty of the natural environment. However, in a surprisingly powerful research paper (Wandersee and Schussler, 2001), we are alerted to a serious affliction, particularly affecting the population of the United States though not exclusive to our boundaries. It is a condition known as plant blindness. This condition has the following specific symptoms:

- the inability to see or notice plants in one’s environment;
- the inability to recognize the importance of plants in the biosphere and in human affairs;
- the inability to appreciate the aesthetic and unique biological features of the life forms belonging to the plant kingdom; and
- the misguided anthropocentric ranking of plants as inferior to animals, leaving the conclusion that plants are not worthy of human consideration.

In short, the symptom of plant blindness is that afflicted persons are unable to recognize and appreciate the esthetic value of plants or believe that plants are worthy of consideration!

We in the plant sciences, in the green industry and in the green professions have our work cut out to counter the effects of plant blindness in our world. How can we even consider placing sufficient focus on growing enough food if as a society we fail to see plants as being important? Where are our botany classes in high school and university? What is happening to horticultural instruction? Where is the money for plant research? Are we collectively addressing this as a serious affliction? As a culture, is the relationship of plants to people even on our radar screen?

Let me suggest that public gardens and public green spaces can provide an antidote to this indifference. They can provide the vehicle for connecting plants to people everywhere. At the outset, however, let me point out that gardens and green spaces need not be the sole antidote to the condition of plant blindness. If we had stories about plants on the front page of every newspaper along with stories about war and other things that are important in the world, that would be a good thing. If we had important books that hit the best-seller list, as did The Botany of Desire by Michael Pollan, that would be a good thing. So we need to trudge forward on lots of fronts, but let me focus here on what can be achieved with public gardens and public green spaces.

I have had a special opportunity over the last 24 years to observe what a public garden can do to connect people to plants. This connection was my focus as a professional. The Walt Disney World Resort in Florida receives 40 million visitors a year; 40 million people we could influence with respect to valuing plants and gardens. What an opportunity for a plant person to do something meaningful! Outdoor public places are where we come together in communities - young and old, rich and poor, the totally fit and those struggling to move around, and all cultures whether we speak the native tongue or not. It is here that we meet our neighbors and chat; it is here that we walk our dogs, grow and share our vegetables in community gardens, picnic with the family, stroll together in the waning light of day, and watch the children play. There has been great enthusiasm for outdoor public places in America, the belief being that they improve our urban environment. In New York City there was an outcry to “save the commu-

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1 An extract from an address presented August 12, 2002 at the XXVth International Horticultural Congress.
Community gardens” and we did. Building public plazas has again become a major focus and was successful recently in West Palm Beach, Florida. Recapturing industrial areas back for public use - there are great examples in San Francisco and Greenville, South Carolina. Revitalizing waterfronts; reconnecting the fabric of cities with public space that goes over or under highways; Seattle and Boston have good examples. Preserving scenic parkways - the George Washington Parkway in Alexandria, Virginia is a stellar example of one of America’s great scenic parkways. Greening up school yards - Chicago, and the State of California are both making huge efforts there. Where these spaces are well designed, well maintained and safe, and where they are connected by mass transit or by sidewalks, everyone has access and the city is considered livable.

Perhaps the public consciously knows why it feels good in these spaces, but I dare say it is often a subliminal reality. People feel good but they have no idea that it is our research, our understanding of how and where plants grow, and our collective commitment to making plants be part of the world we live in that are behind every successful green space. We believe that important values are communicated in public spaces, particularly public green spaces, but do we really know, beyond anecdotal accounts, what works and why? By celebrating the art and science of horticulture, by using experiential knowledge, by observing carefully, and by being as innovative and creative as possible, I believe we can communicate the magic, beauty, and the importance of plants to every single person who enters a public landscape.

So what are the values that we communicate directly through our public open green spaces, whether it be a public park, botanic garden, theme park, city square or even planters lining a very busy boulevard; whether it be a series of front yards or a community garden where ethnic communities come together to grow their vegetables, a pocket park or a flower market? Whether large or small, native or cultivated, these public outdoor places offer opportunities to make connections, plants to people and people to plants. These outdoor places clearly demonstrate the values that we set forth as important in society.

REFERENCES


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About the Author

Dr. Katy Moss Warner is President of the American Horticultural Society. She was formerly Director of Horticulture and Environmental Initiatives, Disney World, Lake Buena Vista, Florida, USA.
Production and Breeding of Cacti for Grafting in Korea

Myeong Il Jeong, Chang-Hui Cho and Jung-Myung Lee

Grafted cacti are now regarded as one of the most admired ornamental indoor plants worldwide. Approximately 15 million grafted cacti are being traded in the international market, and 10 million of these have been developed and produced in Korea. Ninety new cultivars many with brilliant colors and unusual forms have been developed by the National Horticultural Research Institute (NHRI), Rural Development Administration (RDA), and Goyang Cactus Experiment Station, Gyeongggi Province. The grafted cactus industry in Korea has been stabilized but is expected to expand with the introduction of new cultivars and advanced grafting technology (Lee and Oda, 2003).

PRESENT STATE OF PRODUCTION

Approximately 2,500 species of cacti are distributed in the subtropical zone of the arid regions in North and South America. Grafted cacti were introduced in Korea by private collectors in the mid 1940s and commercial cultivation was launched in the late 1970s. The cultivation area was 3.5 ha in 1985, increased to 61.6 ha in 1995, and reached 64.2 ha in 2002, with a production of 48 million plants in that year (Table 1). Rapid increase in cacti production was due to grafting, which now accounts for 60% of the total cactus cultivated area and 64% of total production in 2002.

In Korea, grafted cacti are commonly cultivated in greenhouses using soil beds or benches (Fig. 1 and 2). Cutting down the grafting labor cost for mass production has been the major concern for profitable growing because grafted cacti are a labor-intensive crop. They require 17,000 hours of labor per hectare and the grafting operation accounts for 30 to 40% of all labor required. Recently, new implements for grafting have been developed to reduce grafting labor by more than 40% in comparison with the traditional method that uses thread (Fig. 3) (Lee and Oda, 2003). Optimized curing of the grafted cacti is critical for the production of uniform, high-quality cacti (Fig. 4).

Table 1. Cultivation area and production of total cacti in Korea.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cultivation area (ha)</th>
<th>Production (1,000 plants)</th>
<th>Value (US $1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>3.5</td>
<td>368</td>
<td>235</td>
</tr>
<tr>
<td>1990</td>
<td>38.3</td>
<td>10,819</td>
<td>2,799</td>
</tr>
<tr>
<td>1995</td>
<td>61.6</td>
<td>28,747</td>
<td>8,621</td>
</tr>
<tr>
<td>2000</td>
<td>50.2</td>
<td>29,160</td>
<td>7,935</td>
</tr>
<tr>
<td>2001</td>
<td>58.4</td>
<td>36,267</td>
<td>8,851</td>
</tr>
<tr>
<td>2002</td>
<td>64.2</td>
<td>48,970</td>
<td>8,837</td>
</tr>
</tbody>
</table>

New technological improvements have been developed for producing high quality cactus; clarification of the quality and quantity of light,
establishment of the irrigation practices, nutrient solution culture technique, and off-season growing technology through controlling root-zone temperature. Advances in these techniques have resulted in more stabilized production of grafted cacti year-round.

The sizes of grafted cacti are determined by the size of the stock used for grafting. The cacti for grafting are classified into three categories; large, medium, and small. The days required for production depends on the size of stock and the kind of plant (Table 2).

<table>
<thead>
<tr>
<th>Species</th>
<th>Product size</th>
<th>Stock length (cm)</th>
<th>Desirable size for sale (cm)</th>
<th>Periods required for production (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnocalycium mihanovichii</td>
<td>Large</td>
<td>12~14</td>
<td>Globe diam. 4.5</td>
<td>8~9</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>9</td>
<td>3.0</td>
<td>5~6</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>6</td>
<td>2.5</td>
<td>2~3</td>
</tr>
<tr>
<td>Chamaecereus silvestrii</td>
<td>Large</td>
<td>12~14</td>
<td>Length 5~6</td>
<td>5~6</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>9</td>
<td>3~4</td>
<td>4~5</td>
</tr>
<tr>
<td>Gymnocalycium denudatum</td>
<td>Medium</td>
<td>9</td>
<td>Globe diam. 3~4</td>
<td>4~5</td>
</tr>
<tr>
<td>Notocactus scopa</td>
<td>Medium</td>
<td>9</td>
<td>Globe diam. 3~4</td>
<td>4~5</td>
</tr>
<tr>
<td>G. badianum</td>
<td>Medium</td>
<td>9</td>
<td>Globe diam. 3~4</td>
<td>4~5</td>
</tr>
<tr>
<td>Eriocactus leninghausii</td>
<td>Medium</td>
<td>9</td>
<td>Globe diam. 3~4</td>
<td>4~5</td>
</tr>
</tbody>
</table>

Table 2. Cacti size and duration required for the production of different cactus species.

The standarized grafted cacti are sent to export companies with the roots removed. Export company groups classify the cacti according to their size and quality upon arrival and then brush away the soil and dust attached to the body before exporting them. Cacti are packaged in boxes and exported by air or ship (Fig. 5).

**PRESENT STATUS OF EXPORT**

Grafted cacti have been cultivated since the 1940s in Japan. Thus, Japan had been the major exporting country until the early 1980s. Korea began to export cacti for the first time in 1978 and bulk export was begun in 1984. Exports were valued at 2.47 million cacti worth US $2.47 million in 1993 and US $2.26 million in 2002, averaging in excess of US $2 million annually over the last 10 years (Table 3). Korea now exports grafted cacti to more than 20 countries including the Netherlands, USA, China, and Canada; the Netherlands and USA are the major importing countries. Among the various cacti, G. mihanovichii accounts for 70%, C. silvestrii for 20%, and N. copa,

<table>
<thead>
<tr>
<th>Country</th>
<th>1998 Quantity (ton)</th>
<th>1998 Value (US$ 1,000)</th>
<th>2000 Quantity (ton)</th>
<th>2000 Value (US$ 1,000)</th>
<th>2002 Quantity (ton)</th>
<th>2002 Value (US$ 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Netherlands</td>
<td>272</td>
<td>707</td>
<td>187</td>
<td>686</td>
<td>223</td>
<td>921</td>
</tr>
<tr>
<td>USA</td>
<td>56</td>
<td>451</td>
<td>54</td>
<td>588</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>China</td>
<td>23</td>
<td>80</td>
<td>223</td>
<td>466</td>
<td>16</td>
<td>204</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>91</td>
<td>321</td>
<td>329</td>
<td>391</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>36</td>
<td>281</td>
<td>35</td>
<td>304</td>
<td>54</td>
<td>381</td>
</tr>
<tr>
<td>Others</td>
<td>50</td>
<td>424</td>
<td>38</td>
<td>302</td>
<td>55</td>
<td>458</td>
</tr>
<tr>
<td>Total</td>
<td>528</td>
<td>2,266</td>
<td>866</td>
<td>2,737</td>
<td>402</td>
<td>2,419</td>
</tr>
</tbody>
</table>

Table 3. Changes in the quantity and amount of grafted cacti trade according to countries and year.

**Table 4. Cacti cultivars bred and released by NHRI (also see Fig. 7).**

<table>
<thead>
<tr>
<th>Species</th>
<th>Years</th>
<th>No.</th>
<th>Cultivar</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. mihanovichii</td>
<td>1994</td>
<td>4</td>
<td>Hongil, Hongwoo, Honghwa, Hongio</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>3</td>
<td>Myeongweol, Seonhong, Hongkwang</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>5</td>
<td>Hongsil, Cheongsil, Yeongji, Konji, Hongweol</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>10</td>
<td>Seolhong, Jinhong, Manhong, Hongsu, Yeonmin</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>9</td>
<td>Baeeya, Mihong, Hongsung, Yeonhwa, Keumhong</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>5</td>
<td>Damdam, Yeonhong, Yeonhwa, Hwangweol, Danhong, Bihong</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>6</td>
<td>Heukhong, Suhwang, Gamhong, Seohong, Seohwang, Noksim</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>5</td>
<td>Hwihwang, Hwisung, Heukseong, Suhong, Geoseong</td>
</tr>
<tr>
<td>C. silvestrii</td>
<td>1999</td>
<td>5</td>
<td>Mangwool, Sunji, Bosong, Doran, Somsom</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>3</td>
<td>Duri, Mongsil, Woori</td>
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<tr>
<td></td>
<td>2001</td>
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<td>Total</td>
<td>-</td>
<td>60</td>
<td>-</td>
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</table>
E. leninghausii and G. baldianum for 10% of the export (see Table 2). G. mihanovichii consisted of 50% red color, 15% yellow, 15% orange, 15% pink and 5% other colors (Fig. 6). Recently, attractive cultivars having various colors have been developed and color availability is now extensive. Grafted plants are replanted in a small pot or planted in a medium to large pot with other succulents for distribution or local sale.

**BREEDING OF NEW CULTIVARS**

Korea now ranks first in the production and export of grafted cacti in the world. In the past, however, the rating of cacti grown in Korea was low in the international market due to low quality with color limited to red until the early 1990s. To promote the breeding and development of cacti cultivars and produces, the NHRI-RDA made an assessment of the international markets of main importing countries like the Netherlands, USA, and Japan. This assessment led to the resolution of breeding cacti for international standards. NHRI was then able to collect more than 400 species of *Gymnocalycium* and *Lobivia*. Researchers evaluated the characters and used these as basic germplasm. In addition, Random Amplified Polymorphic DNA (RAPD) technique was applied to elucidate relationships between major cacti species. Other technologies such as controlling flowering period, pollen storage, in vitro culture and selection methods, cross-compatibility between species, and inheritance analysis of color and quality were thoroughly investigated.

By utilizing elaborate in vitro culture techniques, we have been able to increase the percentage of successful selection of new pigmented, chlorophyll-deficient cultivars. Korean cactus breeding has been based on inbreeding, maintenance of germplasm for cross breeding, and well-executed selection techniques. These breeding efforts have raised about 10 outstanding cultivars each year and total of 90 cultivars have been released since 1994, including 42 of *G. mihanovichii* cultivars, 11 of *C. silvestrii*, and 1 of *G. denudatum* (Table 4, Fig. 7). This year, NHRI plans to release 5 new cultivars of *G. mihanovichii* and 2 of *C. silvestrii*. The diversified color of the new cultivars extends the marketability of the grafted cacti and provides for the preference of different importing countries. The 10 different colors released include yellow, red-yellow, scarlet, pink, black-pink, greenish-yellow, and deep red. Separate breeding work at the Cactus Experiment Station of the Gyeonggi Agricultural Research and Extension Services (GARES) (http://nongup.gyeonggi.go.kr) of Gyeonggi Province also made significant contribution to various areas of cactus production, marketing, export, and breeding. Thirty outstanding cultivars were developed from this station (Table 5, Fig. 8).

**FUTURE PROSPECTS**

The majority of potted cacti traded in the international market are green. The colorful, but chlorophyll deficient, cacti are mainly produced in Asia and South America. Grafted cacti account for less than 10% of all potted cacti and are considered to have limited availability and marketability. The NHRI plans to improve the marketability of grafted cacti by promoting the development of new cultivars with a variety of colors suitable for international trade. The NHRI will continue to invest in research and development to enhance the quality and marketability of grafted cacti in order to maintain its competitive edge in the international market.
REFERENCES


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INTRODUCTION
The North American pawpaw, Asimina triloba (L.) Dunal, grows wild as an understory tree or thicket-shrub in mesic hardwood forests ranging from northern Florida to southern Ontario (Canada) and as far west as eastern Nebraska. Fruit (100-1000 g) may be borne singly or in clusters, are highly nutritious, have a strong aroma, and have a unique flavor that resembles a combination of banana, mango, and pineapple. This oblong shaped fruit has both fresh market and processing potential.

Historical and Origins
Pawpaws have a well-established place in folklore and American history. The traditional American folk song, “Way down, yonder in the pawpaw patch” was quite popular at one time and fall hunting for pawpaw in the woods is a cherished tradition for many rural families in the eastern United States. The first report of pawpaw dates back to 1541 when followers of the Spanish explorer Hernando de Soto found Native Americans growing and eating pawpaws in the valley of the Mississippi. The Native Americans used the bark of pawpaw trees to make fishing nets. Daniel Boone and Mark Twain were reported to have been pawpaw fans. Lewis and Clark recorded in their journal (18 Sept. 1806) how pawpaws helped save them from starvation. Several American towns, townships, creeks and rivers were named after the pawpaw during the 19th century. Interest in pawpaw as a fruit crop was evident in the early 1900s; however, the rapid perishability of fruit likely decreased interest in pawpaw. Interest in pawpaw did grow in the years between 1950 and 1985. Recently, there has been developing interest in pawpaw as a gourmet food.

World Production
Although pawpaw has great potential for commercial production, orchard plantings remain limited. Currently, most pawpaw fruit for sale are collected from wild stands in the forest. However, in a number of states in the United States, small private orchards, usually less than 1 ha in size, have been planted. There are also pawpaw plantings in Italy, China, Israel, Japan, Romania, Belgium, and Portugal.

Table 1. Nutritional comparison of pawpaw with other fruits. 1

<table>
<thead>
<tr>
<th>Composition</th>
<th>Units</th>
<th>Pawpaw</th>
<th>Banana</th>
<th>Apple</th>
<th>Orange</th>
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<td>Total Fat</td>
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<td>Mg</td>
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<td>Thiamin</td>
<td>Mg</td>
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<td>Mg</td>
<td>58</td>
<td>47</td>
<td>9</td>
<td>40</td>
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</table>

1 Derived from Jones and Layne (1997). Mean value per 100 grams edible portion. Pawpaw analysis was done on pulp with skin, although the skin is not considered edible. Probably much of the dietary fiber, and possibly some of the fat, would be thrown away with the skin.

2 Retinol Equivalents - these units are used in National Research Council Recommended Dietary Allowances table.

3 International Units.
Annona reticulata is the only temperate-zone genus. Pawpaw is *Carica papaya* (L.), sweetsop or sugar apple (*A. cherryola* L.), atemoya (*A. cherimola* L.), and soupsop (*A. muricata* L.). The genus *Asimina* is the only temperate-zone representative of the tropical Annonaceae, and includes nine species, most of which are native to the extreme southeastern regions of Florida and Georgia. The North American native pawpaw (*Asimina triloba*) produces the largest fruit, has the most northerly and largest native range and the greatest commercial potential of the *Asimina* genus. Pawpaw is also a common name for papaya (*Carica papaya*), a tropical fruit in the family Caricaceae. The two fruits are genetically unrelated, but some pawpaws do have a papaya-like flavor.

**Description**

Pawpaw is a moderately small, deciduous tree or shrub that flourishes in the deep, rich fertile soils of river-bottom lands of the forest understorey. Trees may attain 5 to 10 m in height and are usually found in patches, due to root suckering. In sunny locations, trees typically assume a pyramidal habit, with a straight trunk and lush, dark green, long, drooping leaves (Fig. 1E). Leaves occur alternately, are obovate-oblong in shape, glabrous, with a cuneate base, acute midrib, and may be 15 to 30 cm long and 10 to 15 cm wide. Vegetative and flower buds occur at different nodes on the stem, the flower buds being basipetal. Vegetative buds are narrow and pointed, and the flower buds are round and covered with a dark-brown pubescence.

The dark maroon-colored flowers of the pawpaw are hypogynous and strongly protogynous. Flowers are pendant or nodding, with sturdy pubescent pedicules up to 4 cm long. The mature flowers have an outer and inner whorl of three, maroon-colored, three-lobed petals reaching up to 5 cm in diameter (Fig. 1A,B). The inner petals are smaller and fleshy, with a nectary band at the base. The flower has a fucoid aroma. Flowers have a globular androecium and a gynoecium usually composed of three to seven carpels resulting in three to seven fruited clusters; up to nine-fruited clusters have been noted (Fig. 1C). Flowers emerge before leaves in spring (about April in Kentucky). Pawpaw blossoms occur singly on the previous year’s wood.

Pawpaw’s custard-like fruits are berries. The fruit have an oblong shape, green skin, a pleasant but strong aroma when ripe, and intense flavor (Fig. 1C,D). However, flavor varies among cultivars, with some fruit displaying complex flavor profiles. Fruit from poor quality pawpaw genotypes can have a mushy texture, lack sweetness, and have an overly rich flavor with turpentine or bitter-sweet aftertaste; many wild pawpaws have poor eating quality. Fruit from superior genotypes have a firm texture, a delicate blend of flavors, are rich but not cloying, and have no bitter aftertaste. The flavor of a pawpaw fruit can intensify when it over-ripens, as with banana, resulting in pulp that is excellent for use in cooking. The fruit are oblong-cylindrical, typically 3 to 15 cm long, 3 to 10 cm wide and weigh from 100 to 1000 g. They may be borne singly or in clusters which resemble the “hands” of a banana plant. In the fruit, there are two rows of seeds (12 to 20 seeds) that are brown and bean shaped and that may be up to 3 cm long. The seed and skin of the fruit are generally not eaten. The endosperm of the seeds contain alkaloids that are emetic and if chewed may impair mammalian digestion.

Pawpaw fruit allergies have been reported in some people.

**Reproductive Biology**

Flowers are strongly protogynous and are predominantly self-incompatible, although the pawpaw cultivar Sunflower may be self-fruitful. Pollination is by flies (Diptera) and beetles (Nitidulidae), and possibly other nocturnal insects. Seedlings normally begin to flower upon reaching about 1.8 m in height, but may not set fruit; cropping is achieved at five to eight years of age. Grafted pawpaw trees often flower within 3 years of planting, but often fail to set fruit at that time. This may be due to inadequate pollination or inadequate canopy to support fruit development. Grafted trees usually begin reliable fruit production at 5 to 6 years of age.

For an individual tree, the bloom and pollination period may last from 3 to 4 weeks. There is also cultivar variation for bloom date that may be related to chilling hour requirement. As a result, harvest for an individual tree may be extended over a 3-4 week period. Thus, multiple harvests are necessary depending on fruit ripeness. Each fruit cluster develops from an individual flower, and fruit within a cluster develop and often ripen at different times (Fig. 1B). In cultivation, pawpaw yields per tree are often low. Yields for mature grafted trees in
the 7th year can average between 2.0 to 6.5 kg per tree, depending on the cultivar. The tropical Annonaceae relatives of the pawpaw, such as cherimoya, sweetsop (sugar apple), soursop, and atemoya also have low yields, due to low rates of natural pollination. Pawpaws in the wild often have poor fruit set due to low light levels in the understory and pollinator limitation. Pawpaws in the wild often produce many root suckers that could potentially result in large clonal patches contributing to poor fruit set because of self-incompatibility. Fruit set can be improved by hand cross-pollination and can likely be used to improve yields.

**Fruit Growth and Development**

Fruit increase in size during the course of spring and summer, ripening in late summer or early fall. Pawpaw fruit ripening is characterized by an increase in soluble solids concentration (up to 20%), flesh softening, increased volatile production, and, in some genotypes, a decline in green color intensity of the skin. Within 3 days after harvest, ethylene and respiratory climacteric peaks are clearly evident as pawpaw fruit rapidly softens. A common practice to determine maturity is to touch each fruit to determine if it is ready to harvest; ripe softening pawpaw fruit yield to slight pressure, as ripe peaches do, and can be picked easily with a gentle tug. Thus, fruit are harvested when they have already begun ripening and have lost some firmness.

**HORTICULTURE**

**Propagation**

The pawpaw produces a relatively large, flat seed with a dark brown fibrous seed coat. Seed can be collected from fruit when the flesh is soft or over-ripe. Pawpaw has moderately recalcitrant seed that does not tolerate desiccation, and it only has a relatively short period of viability at room temperature. As little as 5 days under open air conditions can reduce the moisture content of pawpaw seeds to 5% and result in total loss of viability. Pawpaw seed requires stratification for optimal germination. Pawpaw seeds must be stored moist at chilling (5°C) temperature to overcome embryo dormancy. Seed can be stored in moist peat moss in ziplock bags for 2 to 3 years at 5°C and maintain a high germination percentage. Storing pawpaw seed in a freezer (-15°C) will kill the embryo and make the seed not viable. Stratified seed can be sown in a well-aerated potting substrate with a high sphagnum peat moss component (>75% by volume), cation exchange capacity, and water holding capacity. Tall containers should be used to accommodate the developing taproot of seedlings. Because pawpaw has a coarse fibrous root system that is quite fragile, most commercial nurseries propagate pawpaw in containers rather than in a nursery bed. Although some commercial nurseries sell bare-root trees grown in nursery beds, we do not recommend this practice. Transplant shock is common with bare-root trees and field establishment is usually poor. Young pawpaw seedlings are sensitive to excessive ultraviolet (UV) light and can be damaged under full sun conditions. If you are growing seedlings outside, keep the plants in moderate shade their first year (we use 55% shade cloth) for maximum growth of the plant. Seedlings will grow well in whitewashed or even unshaded greenhouses. Plants in their second year of growth outside do not require shading and will grow nicely in full sun provided water is not limiting.

Chip-budding and whip-and-tongue grafting are the two most reliable methods to clonally propagate pawpaw. Winter collected, dormant budwood should have its chilling requirement fulfilled. Bud budding and grafting are most successful when the seedling rootstock is at least 0.5 cm diameter and actively growing. Bud take exceeding 90% can be obtained. Clonal propagation of pawpaw by other methods such as root cuttings or softwood cuttings has been unsuccessful. Clonal propagation of pawpaw by tissue culture has been attempted using various explant sources of different physiological ages. The primary limitation in tissue culture is the inability of explants to form roots.

**Rootstocks**

Currently, pawpaw cultivars with superior fruit characteristics are propagated by grafting and budding onto seedling rootstocks. No clonal rootstocks are available for pawpaw.

**Training and Pruning**

Present recommendations for pawpaw plantings are 2.4 m within rows and 3.7 to 4.6 m between rows. Row orientation should be north-south if possible. Shading of pawpaw in the field the first year is recommended and can be accomplished by installing translucent double-walled polyethylene “tree-tubes” around each tree, securing them with bamboo stakes. However, trees taller than 45 cm at planting do not require shading. During warm summer temperatures (>35°C), the tubes should be removed from the trees, otherwise foliage within tubes can become heat-stressed and desiccated. Weed control is important to limit competition and improve establishment, but there are no herbicides currently labeled for use on pawpaw. Mulching with straw or other organic material can be used to limit weed growth in the tree row. When natural rainfall is inadequate, supplemental irrigation can substantially improve tree survival rates.

Most pawpaw genotypes naturally develop a strong central leader. The growth habit is similar to that of ‘Bradford’ pear, a popular ornamental tree in the U.S. Trees should not be headed at planting and no pruning is required the first year. Branches can often develop narrow crotch angles in relation to the trunk. Training to more horizontal scaffold limbs increases scaffold strength and reduces limb breakage, which may occur under heavy crops or during ice storms. Pruning is conducted in late winter-early spring and consists of removing low branches to a height 60 to 90 cm on the trunk.

**Thinning**

Pawpaw fruit set can often be low, but some growers do practice hand thinning of fruit to increase fruit size.

**Fertilization**

Fertilization requirements have not been determined for bearing pawpaw trees. However, trees fertigated with water-soluble fertilizer (20N-8.6P-16.6K) plus soluble trace elements once in May, June, and July during active growth have achieved 30 to 45 cm of shoot extension each year in Kentucky. Excellent growth has been achieved with granular ammonium nitrate fertilizer (34-0-0) broadcast under pawpaw trees in early spring at 30-60 g N/tree applied before budbreak.

**Diseases and Pests**

Pawpaws have few disease problems; however, leaves can exhibit leaf spot, principally a complex of Mycocentrospora asiminae, Rhopalocinidium asiminae Ellis & Morse, and Phyllosticta asiminae Ellis & Kellerm. At orchards in Oregon (outside pawpaw’s native range), vascular wilt-like symptoms have been observed in the spring after pawpaw trees have leafed out. The pawpaw peduncle borer (Talponia plummeriana Busch) is a small moth whose 5 mm long larva burrows into the fleshy tissues of the flower causing the flower to wither and drop. The zebra swallowtail butterfly (Eurytides marcellus), whose larvae feed exclusively on young pawpaw foliage, will damage leaves, but this damage has been negligible in plantings. The larvae of a leaf-linter (Chorisotoma pararellata Robinson) may also damage flowers and leaves. Deer will not generally eat the leaves or twigs, but they will eat fruit that has dropped on the ground. Occasionally, male deer will rub their antlers on young trees scraping off bark and occasionally breaking off branches. Japanese beetles (Popillia japonica Newman) occasionally feed on young foliage and can damage pawpaw trees.

Biologically active compounds known as annonaceous acetogenins have been extracted from pawpaw twigs and have potential as human medications and botanical pesticides. About 250 of these compounds have been isolated and characterized. Three of these compounds, bullatline, bullettin, and bullanin have high potencies against human cancer cells in vitro. Dr. Jerry McLaughlin of Nature’s Sunshine Products (Spanish Fork, Utah) has developed a commercial head lice removal shampoo from pawpaw. Botanically derived pesticides that are environmentally compatible...
and biologically degradable may also be obtained from pawpaw because the annonaceous acetogenins are toxic to several economically important insect species.

**Handling and Postharvest Storage**

Pawpaw fruit soften rapidly at room temperature after harvest. At room temperature, very soft ripe fruit have a 2-to-3-day shelf life while those fruit that are just beginning to soften have a 5-to-7-day shelf life. Fruit that have just begun to soften can be stored for 1 month at 4°C with little change in fruit firmness and they will ripen normally when returned to room temperature. Hard immature fruit will not ripen, even if treated with ethephon. Because fruit are non-uniform in size and shape, packaging that minimizes bruising during shipping needs to be developed.

**Main Cultivars and Breeding**

Efforts to domesticate the pawpaw began early in the 20th century. In 1916, a contest to find the best pawpaw was sponsored by the American Genetics Association. This contest generated much interest and the sponsors thought that with time and “intelligent breeding” commercial quality varieties could be developed and an industry begun. However, an industry did not develop. Pawpaw enthusiasts noted that the rapid perishability of pawpaw fruit was the major factor inhibiting commercialization.

Beginning in the 20th century, elite pawpaw selections from the wild were assembled in extensive collections by various enthusiasts and scientists, including Benjamin Buckman (Farmington Illinois, circa 1900 to 1920), George Zimmerman (Linglestown, Pennsylvania, 1918 to 1941), and Orland White (Blandy Experimental Farm, Boyce, Virginia, 1916 to 1938).

### Table 2. Promising commercially available pawpaw cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convis</td>
<td>Selected from Corwin Davis orchard. Large fruit size¹, yellow flesh; ripens 1st week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Davis</td>
<td>Selected from the wild in Michigan by Corwin Davis in 1959. Introduced in 1961 from Bellevue, Michigan. Medium size fruit, up to 12 cm long; green skin; yellow flesh; large seed; ripens 1st week of Oct. in Michigan.</td>
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<tr>
<td>Duckworth A</td>
<td>Low-chill cultivar selected in San Mateo, Florida by Eric Duckworth, seedling of Louisiana native parent; tree with pyramidal shape.</td>
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<tr>
<td>Duckworth B</td>
<td>Low-chill cultivar selected in San Mateo, Florida by Eric Duckworth, seedling of Louisiana native parent; grows no larger than a shrub.</td>
</tr>
<tr>
<td>Ford Amend</td>
<td>Selected from wild seedling of unknown parentage by Ford Amend around 1950. Introduced from Portland, Oregon. Medium size fruit and earlier than Sunflower; ripens late September in Oregon; greenish-yellow skin; orange flesh.</td>
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<tr>
<td>IXL</td>
<td>Hybrid of Overleese and Davis; large fruit, yellow flesh; ripens 2nd week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Jack's Jumbo</td>
<td>Selected in California from Corwin Davis seed; large fruit.</td>
</tr>
<tr>
<td>Kirsten</td>
<td>Hybrid seedling of Taytwo x Overleese; selected by Tom Mansell, Aliquippa, Pennsylvania.</td>
</tr>
<tr>
<td>Lynn's Favorite</td>
<td>Selected from Corwin Davis orchard. Yellow fleshed, large fruit; ripens 2nd week of Oct. in Michigan.</td>
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<tr>
<td>Mango</td>
<td>Selected from the wild in Tifton, Georgia, by Major C. Collins in 1970. Vigorous growth.</td>
</tr>
<tr>
<td>Mary Foos Johnson</td>
<td>Selected from the wild in Kansas by Milo Gibson. Seedling donated to North Willamette Expt. Sta., Aurora, Oregon, by Mary Foos Johnson. Large fruit; yellow skin; butter-color flesh; few seeds; ripens first week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Middletown</td>
<td>Selected from the wild in Middletown, Ohio, by Ernest J. Downing in 1915. Small fruit size.</td>
</tr>
<tr>
<td>NC-1</td>
<td>Hybrid seedling of Davis Overleese; selected by R. Douglas Campbell, Ontario, Canada, in 1976. Large fruit; few seeds; yellow skin and flesh; thin skin; early ripening, 15 Sept. in Ontario and early Sept. in Kentucky.</td>
</tr>
<tr>
<td>Overleese</td>
<td>Selected from the wild in Rushville, Indiana, by W.B. Ward in 1950. Large fruit; few seeds; bears in clusters of three to five; ripens 1st week of Oct. in Michigan and early Sept. in Kentucky.</td>
</tr>
<tr>
<td>PA-Golden 1</td>
<td>Selected as seedling from seed originating from George Slate collection by John Gordon, Amherst, New York. Early cropping. Medium size fruit, yellow skin, golden flesh; matures late August in Kentucky and mid-Sept. in New York.</td>
</tr>
<tr>
<td>Prolific</td>
<td>Selected by Corwin Davis, Bellevue, Michigan, in mid-1980s. Large fruit; yellow flesh; ripens first week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Rebecca's Gold</td>
<td>Selected from Corwin Davis seed, Bellevue, Michigan, by J.M. Riley in 1974. Medium size fruit; kidney-shaped; yellow flesh.</td>
</tr>
<tr>
<td>SAA-Overleese</td>
<td>Selected from Overleese seed by John Gordon, Amherst, New York, in 1982. Large fruit; rounded shape; green skin; yellow flesh; few seeds; matures in mid-Oct.-in New York.</td>
</tr>
<tr>
<td>SAA-Zimmerman</td>
<td>Selected as seedling from seed originating from G.A. Zimmerman collection by John Gordon, Amherst, New York, in 1982. Large fruit; yellow skin and flesh; few seeds.</td>
</tr>
<tr>
<td>Sue</td>
<td>Selected in southern Indiana. Medium size fruit, yellow flesh, skin yellow when ripe.</td>
</tr>
<tr>
<td>Sunflower</td>
<td>Selected from the wild in Chanute, Kansas, by Milo Gibson in 1970. Tree reported to be self-fertile. Large fruit; yellow skin; butter-color flesh; few seeds; ripens early to mid-Sept. in Kentucky and the first week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Sweet Alice</td>
<td>Selected from the wild in West Virginia by Homer Jacobs of the Holden Arboretum, Mentor, Ohio, in 1934.</td>
</tr>
<tr>
<td>Taylor</td>
<td>Selected from the wild in Eaton Rapids, Michigan, by Corwin Davis in 1968. Small fruit; bears up to seven fruit in a cluster; green skin; yellow flesh; ripens 1st week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Taytwo</td>
<td>Selected from the wild in Eaton Rapids, Michigan, by Corwin Davis in 1968. Sometimes spelled Taytoo. Small fruit; light-green skin; yellow flesh; ripens 1st week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Tollgate</td>
<td>Yellow fleshed, large fruit, fruit, ripens 1st week of Oct. in Michigan.</td>
</tr>
<tr>
<td>Wells</td>
<td>Selected from the wild in Salem, Indiana, by David Wells in 1990. Small to medium size fruit; green skin; orange flesh. Ripens mid to late Sept. in Kentucky.</td>
</tr>
<tr>
<td>Wilson</td>
<td>Selected from the wild on Black Mountain, Harlan Co., Kentucky, by John V. Creech in 1985. Small fruit; yellow skin; golden flesh.</td>
</tr>
<tr>
<td>Zimmerman</td>
<td>Selected in New York from G.A. Zimmerman seed by George Slate.</td>
</tr>
</tbody>
</table>

¹ Descriptions derived from Jones et al. (1998), and unpublished data of K. Pomper. Descriptions come from a wide variety of sources, and most of the cultivars have not been compared for performance side by side at one geographic site.

² Fruit size categories of small, medium, and large are <100 g, 100 to 150 g, and >150 g, respectively.
1926 to 1955). From about 1900 to 1960, at least 56 clones of pawpaw were selected and named. Fewer than 20 of these selections remain, with many being lost from cultivation through neglect, abandonment of collections, and loss of records necessary for identification. Since 1960, additional pawpaw cultivars have been selected from the wild or developed as a result of breeding efforts of hobbyists. More than 40 clones are currently available (Table 2). From 1995 to 1999, KSU and the PawPaw Foundation (PPF) established a Pawpaw Regional Variety Trial (PRVT) with 28 clones at 13 sites across the U.S. Cultivars being tested include Middletown, Mitchell, NC-1, Overleese, PA-Golden (#1), Rappahannock, Shenandoah, Sunflower, Susquehanna, Taylor, Taytwo, Wells, and Wilson. The other 15 clones were selections from the PPF breeding effort. Tree survival, trunk cross-sectional area, fruit size and taste, flesh-to-seed ratio, resistance to pests and diseases, and overall productivity on a year-to-year basis are among the attributes being evaluated. The pawpaw cultivars PA-Golden (#1), Overleese, NC-1, Sunflower, Shenandoah, and Susquehanna have performed well in Kentucky, have excellent fruit size and flavor, and are recommended for planting in the southeastern United States. Complete results from the PRVT and additional regional recommendations will be available in a few years.

### References


### About the Authors

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length poly(A) tract immediately following the termination codon of the coat protein (CP) gene. Another new subgroup II tobamovirus affecting grafted cacti was reported from Korea.

Other papers described detection, identification and sequencing of potexviruses in phlox, portulaca, hosta, and Allium. Alternanthera mosaic virus from phlox and portulaca may be confused with Papaya mosaic virus, to which it is closely related; Hosta virus X was shown to be seed-transmitted, with >90% seed infection in highly susceptible types. This virus could be detected in the embryo of some cultivars.

Several papers addressed tospovirus infection in various crops, including analysis of thrips transmission of Watermelon silver mottle virus and expression of the N gene of various tospoviruses from an infectious potyviral cDNA clone. New tospoviruses were reported affecting Calla lily, Phalaenopsis, and chrysanthemum and previously known tospoviruses were reported to infect new hosts. The invited talk by Yeh summarized tospovirus taxonomy, the specificity of thrips transmission as well as PCR and serology for detection and identification. Also covered were the use of insecticides, resistance genes and engineered resistance for control of tospovirus diseases.

Reports of new viruses reflect interest in crops being grown in larger volume. For example, five potyviruses and a tospovirus were reported in Calla lily, and two new potyviruses in Spiranthes orchids. Two closteroviruses, a carlavirus, and a potyvirus were reported in Hippeastrum. The movement of viruses was reported between crops that are grown together or irrigated with contaminated water (four tombusviruses in Limonium; and multiple viruses in Verbena, Diascia, and Lobelia).

Phytoplasma-induced diseases of rose, Asclepias, magnolia and rhododendron were described. A report was made on the distribution within poinsettia plants of the branching-inducing phytoplasma. A review of phytoplasma-induced diseases in floral crops covered the detection since 1980 of phytoplasmas in anemone, Ranunculus, Celosia, Matthiola and other ornamental plants. Almost the complete spectrum of phytoplasma types detected in other crops have now been discovered affecting ornamentals. Vertical physical barriers were reported to minimize transmission between screen houses, due to the tendency of the leafhopper vectors to stay close to the ground.

The coat protein genes of isolates of Odontoglossum ringspot virus (ORSV; tobamovirus) and Cymbidium mosaic virus (CymMV; potexvirus) from Phalaenopsis and Cymbidium orchids in Korea were compared. Very high homology between ORSV isolates and high homology between CymMV isolates suggest that these genes are suitable for genetic engineering to obtain virus resistance in orchids. Another paper described transformation of Nicotiana benthamiana and Dendrobium orchids with the CymMV coat protein or mutated movement protein gene for potential resistance. All plants became infected following mechanical inoculation (although in some cases with reduced replication of the virus). Additional gene constructs that may induce more effective gene silencing, are under examination.

Expression of antiviral single chain antibodies was reported to confer effective resistance to Cucumber mosaic virus in N. benthamiana, and to Tomato spotted wilt virus in N. tabacum. Production of chrysanthemum expressing Chrysanthemum virus B constructs and poinsettia transformed by electrophoresis were also reported. The current state of knowledge in transforming ornamentals for various traits and work related to production of virus-resistant ornamentals was reviewed. Only color-modified carnations appear to be commercially available, although several other types of genetically modified ornamentals have been field tested.

The next Symposium on Virus Diseases of Ornamental Plants will be held in the Netherlands in 2008.

John Hammond

Participants of the Symposium.
Geen elektronische versie beschikbaar.

Bijschrift volgt
Beijing, China, was the venue of the 4th International Symposium on Edible Alliaceae (ISEA) held from April 21 to 26, 2004. The symposium was hosted by the Chinese Society for Horticultural Science and the Institute of Vegetables and Flowers (IVF) of the Chinese Academy of Agricultural Sciences (CAAS).

The opening ceremony was presided by Dr. Du Yongchen, Director of IVF, and Deputy Secretary General of Chinese Society for Horticultural Science (CSHS). At the opening ceremony Prof. Zhu Dewei welcomed the participants on behalf of the Chinese Society for Horticultural Science and the Organizing Committee of the Symposium. After that Professor Xiang Chongyang, honorary president of CSHS and former Vice Minister of Ministry of Agriculture, People Republic of China, presented some introductory remarks to the 108 participating scientists, growers and merchants from 20 countries in five continents. Mr. Johan Haarhuis, Chairman of the World Allium Association and Dr. Qu Dongyu, Vice President of the CAAS and Secretary General of CSHS, delivered a speech. Dr. Claudio Galmarini, Chairman of the ISHS Working Group on Edible Alliaceae, presented an excellent review of Allium research in the last ten years.

The main objective of the organizers was to have attention paid to subjects such as: - Alliums and health, - recent advances in Allium genetics and breeding, for instances as to dry matter content and transformation, - management of genetic resources, - advances in disease and pest resistance, - cultural practices, - organic production, - post-harvest technology, - marketing and others. On these a total of 47 oral presentations and 37 posters.
were presented. In the last few years in particular there was a rapid development in biotechnology. At the symposium a good balance was reached between papers dealing with new methodologies (genetic transformation, genomic approaches) and conventional breeding. Oral and poster sessions alternated to allow scientists working in different fields of research to meet and hold discussions.

Recent developments and future prospects of gene transfer in *Allium* were introduced in a keynote lecture by Dr. S.-J. Zheng (Wageningen-UR, Plant Research International, Wageningen, the Netherlands). Gene transfer can be realized through sexual hybridisation, somatic hybridisation and genetic transformation. Sexual hybridisation has always been an important tool for the introduction of genetic variation needed for plant improvement. Some of the latest developments in this area are the genepool approach to introgress agronomically important traits from wild relatives in onion and the possibilities for sexual hybridisation in garlic.

“Genomic resources” was one of the most interesting topics of the symposium exploring the possibilities of developing methods for model plants such as *Arabidopsis thaliana* and rice that can also be applied to the genetic improvement of related crops. Economically onion (*Allium cepa*) is the most important vegetable of the monocot order Asparagales, followed by garlic (*A. sativum*) and asparagus (*Asparagus officinalis*). The orders Asparagales and Poales (containing the grass family) represent two distinct monophyletic groups in the monocots. Prof. M.J. Havey (USDA-ARS, Department of Horticulture, University of Wisconsin, Madison, USA) and others synthesized a normalized cDNA library of onion from equal molar amounts of mRNA from callus, immature bulbs, and roots. The frequency of beta-tubulin cDNAs was reduced from 0.28% to 0.004% by the normalization process, a 70-fold reduction. To date, 14,102 single pass sequencing reactions have yielded 12,308 good sequences that assembled 2,296 clusters and 6,015 singletons to a total of 8,311 distinct sequences, at least twice the number expected from a non-normalized library. Over 5,000 onion expressed sequence tags (ESTs) showed highly significant homologies to rice ESTs. Onion ESTs showing highly significant homologies to rice ESTs not repeated in rice genome will be used for comparative mapping of asparagus, garlic, and onion with the Poales.

A large part of the symposium was dedicated to *Allium* flavour. The positive effects of calcium to onion are well known. However, it is not widely known that onions require high levels of chloride. The effects of calcium chloride on onion growth, sulphur uptake and metabolism were also tested. Calcium chloride was found to decrease sulphur accumulation in the bulb, lower bulb pungency and affect the cysteine sulfoxide flavour precursors. Additionally, calcium improved post-harvest shelf life and bulb weight. Calcium chloride may be a new and exciting tool to assist growers of mild onions in mitigating the effects of high sulphur environments.

Social events were as rich as the scientific programme. Lunches and dinners allowed exhibiting various facets of “Chinese Cuisine”. The Saturday was dedicated to visits, which included the Institute of Vegetables and Flowers, the Beijing Vegetable Research Centre, the Beijing Municipal Academy of Agricultural and Forestry Sciences, and the Xinfadi Vegetable Auction Market, which is the biggest one in Beijing area. On Monday April 26, most participants visited garlic packing and processing enterprises and production fields in Jinxiang County, Shandong Province, the major garlic and onion growing area (330,00 hectares in total) in China. The tours also offered an opportunity to enjoy tourist attractions including “the Great Wall and Ming Tomb”, “the Forbidden City” and “the Birth Place of Confucius”.

The conference decided to host the 5th International Symposium on Edible Alliaceae in 2007 in The Netherlands. The proceedings of the symposium will be published as an issue of *Acta Horticulturae*.

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Liu Guangshu
Toward Ecologically Sound Fertilisation Strategies for Field Vegetable Production

The Symposium “Toward Ecologically Sound Fertilisation Strategies for Field Vegetable Production” was held at the Faculty of Agriculture, in Perugia, Italy, from 7 to 10 June 2004.

The Symposium was organised by the Department of Agroenvironmental and Crop Sciences, University of Perugia under the flag of the International Society for Horticultural Sciences (ISHS), Working Group on Vegetable Nutrition and Fertilization, and with the patronage of the Italian Horticultural Society (SOI). Prof. Dr. Francesco Tei (University of Perugia) was the convener.

The Symposium was dedicated to the memory of our colleague and friend Dr. Remmie Booij who died last December 2003. About 100 participants from 26 countries in Europe (Austria, Belgium, Channel Islands, Croatia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Poland, Portugal, Serbia and Montenegro, Spain, Sweden, The Netherlands, United Kingdom), Africa (Republic of South Africa), Asia (Israel, Japan, Taiwan), Latin America (Argentina) and North America (Canada, USA) attended.

After the opening welcome by the convener, by Prof. F. Mannocchi, on behalf of the Rector of the University of Perugia and the Dean of the Faculty, and by Prof. C. Marucchini, Head of the Department of Agroenvironmental and Crop Sciences, the Symposium passed directly on to the scientific subjects with two keynote lectures (Chair: Prof. M. Guiducci, University of Perugia, Italy).

The first invited speaker, Prof. Dr. Manfred K. Schenk (University of Hannover, Germany), gave an overview on genotypic variation in N- and P-efficiency of vegetable crops and suggested that one strategy to ecologically sound production of field vegetables could be the development of nutrient efficient varieties to produce at lower fertility level of the soil.

The second invited speaker, Prof. Dr. Ian Burns (Warwick HRI, United Kingdom), examined the scientific basis for some of the most widely used N fertiliser recommendation methods and evaluated their accuracy and robustness. Moreover he proposed a novel integrated decision support system, which combines the best predictions of the different N fertiliser recommendation methods in a single package.

Sixteen oral presentations and 53 poster presentations covered four main topics according to the following sessions: 1) Base processes (9 contributions); 2) Crop nutrient requirements and yield quality (21); 3) Methodologies and strategies for a sound fertilisation (25) and 4) Non-conventional nutrient sources (12).

The visit of posters in each session was preceded by a poster summary that is a brief presentation of the main aspects covered and of the main findings and implications to be taken into account.

The contributions of the first session “Base Processes” were on different aspects related to plant nutrient uptake (ambient air humidity, temporary N limitation, source-sink relationship, light interception, mycorrhization, partial root drying) and mineralization of crop residues. This session was chaired by Prof. M. Schenk, University of Hannover, Germany and the corresponding poster summary by Dr. D. Savic, University of Belgrade, Serbia and Montenegro.

The second session “Crop nutrient requirements and yield quality” was chaired by Dr. Jacques Neeteson, PRI Wageningen, The Netherlands and the poster summary by Dr. P. Benincasa, University of Perugia, Italy. The presentations clearly showed that fertilisation in vegetable crops plays a key role to obtain high yield and quality, but it may cause negative side-effects on environment and human health. Experimental maximum nutrient rates are not necessary to get maximum yield (sometimes experimental maximum rates are similar to the recommended rates). Forcing
fertilisation does not increase yield, does not affect or even reduces quality, reduces nutrient recovery, increases residual nutrient content and environmental risks. Delayed/split application and fertigation slightly affect yield and quality, but increase nutrient recovery.

The third session “Methodologies and strategies for a sound fertilisation” was the core of the symposium. This session was presided by Prof. I. Burns, Warwick HRI, UK and the poster summary by Dr. A. Baumgarten, AGES Vienna, Austria. Knowledge about the dynamics of nutrients in the soil-plant system is crucial to develop rational fertilisation strategies from crop level to the level of farming systems. A modern N-fertilisation strategy should maintain a proper yield, but reduce the potential risks (nitrate leaching, nitrate accumulation, susceptibility for diseases, loss of uniformity) related to high nitrogen supply, sandy soils and improper common practices (e.g. irrigation). The suggested strategies are: an adequate reduction of nitrogen fertilisation, the fertilizer placement, the fertigation, the modelling of plant growth, nitrogen uptake and time dependent demand. To develop sound fertilisation programmes it is necessary to monitor the soil and crop nutrient status. This can be done by means of a reliable soil analysis, non-destructive plant analysis (e.g. gamma absorption technique, crop scan in combination with growth model, SPAD) and destructive plant analysis (e.g. plant sap analysis). As to soil analysis, Nmin is still the reference method, reflectometric measurement is promising, conductivity of soil solution seems not suitable and soil suction devices are too complex. Alternative strategies could be represented by the use of nitrification inhibitors and the improvement of plant nutrient uptake by inoculation with mycorrhiza fungi or active ingredients. The collection of reliable databases and the development of models and decision support systems for realising site- and/or species-specific fertilizer recommendations should be taken into consideration as future strategies.

The fourth session was chaired by Dr. N. Tremblay, Agriculture and Agri-Food Canada and poster summary by Dr. D. Studstill, University of Florida, Gainsville. It dealt with the use and management of “non-conventional nutrient sources” such as compost, crop residue, poultry manure, chicken litter and sludge, that are more and more popular in integrated and organic cropping systems. The organic fertilisers show in general low efficacy due to slow nutrient release, can lead to high residual soil nutrient content, and often give variable or even contradictory results depending on the seasonal climate.

A one-day technical tour took place in a beautiful piece of land close to Perugia, in the surroundings of the Trasimeno Lake. Thanks to its rather mild climate and its soil characteristics, this part of Umbria is particularly suitable for vegetable cropping. Delegates visited some farms that have long grown tomato, melon and sweet pepper and have so far built up a strong experience in that field, gaining a solid reputation all over Italy.

In conclusion, a sound fertilisation should be developed in order to obtain a proper yield and profitability together with a high quality of vegetable production and environment. The development of sound fertilisation strategies has to take into account the needs and suggestions of both researchers, policy makers, farmers, and consumers, who have to interact with each other.

Research has to collect data, improve knowledge of basic processes, obtain general relationships and study and model the whole soil-plant system. It should also deepen knowledge on relationships between nutrition/fertilisation and other agronomic practices, study the effects on environment from cropping system scale to the scale of territories, improve and apply precision agriculture techniques and breed nutrient efficient varieties.

Farmers need simple, cheap and reliable and tuned methods for the analysis of the nutritional status of soil and plant, knowing the actual possibilities of application and the usefulness of non-conventional nutrient sources and alternative strategies. Also an extension service for small size farms, which are the most frequent in many countries, as well as systems of funding and penalties to support profitability and the environment are necessary.

The Symposium Organization wishes to thank all participants for their contributions to scientific success and to the friendly atmosphere of the meeting. Further information on the Symposium can be found at www.unipg.it/ishs2004. Reviewed oral and poster presentations will be published in Acta Horticulturae.

The next Symposium on the same subject is tentatively scheduled for 2007 at Alnarp, Sweden.
Seventh Int’l Symposium on Protected Cultivation in Mild-Winter Climates

The International Symposium on Protected Cultivation in Mild Winter Climates was held in Kissimmee, Florida, USA, just outside the gates to Walt Disney World from March 23 till 27, 2004. This was the first time this Working Group meeting was held outside of the Mediterranean area. Over 140 participants from 30 countries and 11 U.S. states attended and presented 51 oral presentations and 70 poster papers.

Symposium participants were treated upon arrival by the Organizing Committee to a commemorative print painted and printed especially for this Symposium. The print was done by Ms. Lynda Chandler and was based on direct observation of various crops discussed during the Symposium. Entitled ‘Protected Culture’, participants were given a vivid, colorful remembrance of their attendance at this meeting.

The opening session related to “Greenhouse Production in the Global Marketplace” and a keynote paper presented by Mario Steta from Queretaro, Mexico, provided an excellent overview of the rapid rise of the vegetable greenhouse industry in Mexico. Mario’s talk was followed by a series of talks that vividly laid out the dramatic increase in production of various horticultural crops under protected cultivation throughout the world. Emphasis was placed on methodologies to stay competitive in a global market and how new products can generate new markets.

In a second session, related to “Crop Engineering and Technology”, various papers and posters discussed new technologies to improve efficiencies of structures under protected culture. Orientation of the greenhouse, retractable-roof greenhouses, as well as greenhouse designs for Mars, for instance a dome design, presented new viewpoints on the current subject matter.

A third session focused on the “Methodologies for Improved Seedlings for Protected Cultivation” as well as the potential for grafting to improve vegetable production in greenhouses carried out in soils. Menahem Edelstein, for instance, spoke of how grafting has increased in Asia from the 1950’s to the present level of nearly 700 million plants annually through the various grafting methods and machines.

A fourth session focused on “Pest Management and Methodologies” related especially to Integrated Pest Management and the use of beneficial insects for biological control. Other papers related to the potential for improving the control of both root-based pathogens as well as leaf pathogens through the use of various protection agents and bio-friendly bacteria, such as olive mill waste water, which suppresses bacteria and promotes beneficial microorganisms.

In a session related to “Cropping Systems”, various new crops were introduced, such as baby squash and corn salad, as well as effective strategies for growth yield and fruit quality improvement of many greenhouse-grown vegetables, like disease resistant cultivars, antivirus screens and plastic coverings.

Participants of the Symposium.
One of our final sessions related to a new, but very popular area of great interest to many producers around the world, i.e. the organic production of various crops under protected cultivation. Talks dealt with the use of soluble organic fertilizers, effluent from poultry waste, bioremediation, and other fertility sources to be able to produce several different crops under greenhouse conditions organically.

One of the highlights of the symposium was the tours taken in the middle and at the end. On the second day of the symposium an all-day tour was held with the participants broken into three separate groups, wherein they visited various greenhouse production facilities in the Central Florida area. Participants had the choice to end their day at either the Monterey Mushroom facility or the Kennedy Space Center. On the last day, participants were able to enroll in a behind-the-scenes tour at The Land, Walt Disney World Epcot. The tour was especially arranged by Disney personnel for this Symposium and participants were treated to an in-depth exposure of how Disney arranges its show in The Land Pavilion to educate millions of people from all over the world annually about the wonders of agriculture, especially those crops produced under protected cultivation.

In a brief business meeting it was agreed that the next symposium will be organized in Morocco in 2005 by Abdelhaq Hanafi and co-chaired by Wilfred Schnitzler from Germany. Thereafter the Working Group will meet in Turkey, potentially in 2006 or 2007 for which Y. Tüzel will act as Convener.
The symposium was opened by Pietro Tonutti (University of Padova, Italy, convener), representatives of the three public institutions that co-organized the event (Verona Chamber of Commerce, Italian Ministry for Agricultural and Forestry Policy and the Veneto Region), and by Errol Hewett (New Zealand, chairperson of the ISHS Quality and Post Harvest Horticulture Commission). A total of 425 papers (173 oral and 252 poster) were presented during the 13 sessions and 2 workshops.

The opening plenary lecture by Jim Giovannoni (USA) focused on genomics as a tool to understand ripening control of fruit quality in tomato and reported the results obtained by laboratories of different countries in the shared effort to develop tomato genomic resources. Following the opening lecture, papers dealing with basic aspects of ripening physiology in climacteric and non-climacteric fruits and with senescence and abscission of different plant organs were presented. The sessions on ‘Fresh Cut Produce’ and ‘Handling, Packaging and Shipping Technology’ completed the programme of the first day.

On Tuesday, the Auditorium was reserved for the crowded session on ‘Postharvest Quality Management’ where the effects of traditional and innovative methods (including the use of 1-MCP) to extend shelf-life, reduce postharvest injuries and maintain organoleptic quality have been illustrated. Considering their tremendous innovative impact in plant science, a workshop on ‘Genomics and Proteomics of Fruit Quality’ was organized within the symposium. Leading scientists in these fields reported the advances in the setting up and characterization of EST (Expressed Sequence Tags) collections in tomato and citrus to order gain insight into molecular mechanisms of ripening processes, to get a more defined picture of the effects of storage conditions on fruit quality and to discover new metabolic pathways activated during ripening and related to quality traits. In addition to tomato and citrus, preliminary but promising results in setting up and using EST collections in peach and strawberry were reported.

The session on ‘Hormonal Regulation’ was opened by Harry Klee (USA) who provided an overview of ethylene receptors and the mechanisms controlling their expression and action. Genetic and molecular evidence supports a model in which the ethylene receptors act as negative regulators of downstream responses. A second workshop was dedicated to the ‘New strategies for Transport of Ornamentals and other Horticultural products’. Speakers pointed out that, in particular for cut flowers, not all post-harvest treatments result in better quality and that innovative packaging concepts will be essential for success in the field of flower transportation.

On Wednesday afternoon, participants had the opportunity to visit some storage facilities for pome and small fruits, packing houses and greenhouses for the production of ornamentals and cut flowers and to meet producers of minimally-processed fruit and vegetables and olive oil and wine makers in different areas of North Italy.

The session on ‘Postharvest Pathology’ on Thursday was introduced by Dov Prusky (Israel) who highlighted the host-pathogen interaction, characterized by multiple host factors affecting resistance and specific fungal factors modulating pathogenicity. Mario Schirra (Italy) opened the ‘Postharvest Pest Management’ session presenting research advances in heat therapy of horticultural crops including organic produce.

In the ‘Quality Aspects’ session, quality maintenance and its evolution during the post-harvest phase were addressed considering several parameters including the incidence of physiological disorders, biochemical and molecular processes directly or indirectly related to organoleptic traits, antioxidant activity and the content of nutraceuticals and health-promoting biomolecules.

During the fourth plenary lecture, Bart Nicolai (Belgium) presented an overview of non-destructive techniques for measuring quality: potential and limitations of spectroscopy (NIR in particular), vibration-based techniques, electronic noses and tomographic approaches were illustrated and discussed also during the course of the session.

The last day of the symposium was dedicated amongst others to postharvest problems in developing countries and a round table on “Fruit and vegetables quality enhancement in developing countries: how can this be achieved?” was co-ordinated by Errol Hewett and Fabio Mencarelli (Italy). Of particular scientific and social interest appeared some contributions coming from Asiatic countries that underlined the importance of setting up and introducing low-cost technologies and the technical specific training of farmers and dealers.

The social programme of the Symposium included a concert by the Padova University Orchestra Concentus Musicus Patavinus performing music by several European composers of the XVIII and XIX centuries. At the gala dinner, served in a magnificent old villa downtown Verona, Ruth Ben-Arie (Israel) and Adel Kader (USA) were awarded by the Organizing Committee for their careers and their contributions to postharvest science and education.

At the business meeting it was agreed that the next ISHS Postharvest Symposium will be organized in 2008 in Thailand. During the closing ceremony the fruitful and friendly atmosphere of the Verona meeting was illustrated by the display of a photo gallery that is now available at the official web site of the Symposium (www.soihs.it/postharvest2004).
Horticulture in Turkey

Semiha Güler

Turkey is a peninsula located in the northern hemisphere between 36-42° north latitude and 26-45° east longitude surrounded by the Mediterranean Sea in the south, by the Aegean Sea in the west, and by the Black Sea in the north. Although situated in the Mediterranean Basin where climatic conditions are quite temperate, the diverse nature of the landscape, and the existence in particular of mountains that run parallel to the coasts, results in significant differences in climatic conditions from one region to another.

While the coastal areas enjoy milder climates, the inland Anatolian plateau experiences extremes of hot summer and cold winter with limited rainfall. The Aegean and Mediterranean coasts have cool rainy winters, and hot, moderately dry summers. Annual precipitation in those areas varies from 580 to 1300 mm depending on location. The Black Sea coast receives the greatest amount of rainfall. The eastern part of that receives 2200 mm annually and is the only region of Turkey that receives rainfall throughout the year. Turkey’s diverse regions have different climates because of irregular topography. The Taurus Mountains close to the coast prevents rain clouds from penetrating to the interior part of the country. In the Eastern region of Anatolia, the elevation of mountains exceeds 2500 m. The Northern Black Sea Mountains and Caucasian Mountains hold the rain clouds, and therefore the area is affected by continental climate with a long and very cold winter. Because of its position forming a bridge between Asia and Europe, its climate and topography, Turkey is endowed with a rich diversity of flora (163 families, 1225 genera, 9000 species). Three thousand plant taxa out of 9000 species are endemic to Turkey.

In 2001 the area under cultivation of food crops was 26 million hectares showing a slight decrease when compared to 2000. Cultivated field area was 87% of the total agricultural land of which 19% (4.9 million ha) was fallow. Vegetables accounted for 3% of total agricultural land (0.8 million ha), vineyards 2% (0.5 million ha), fruit 5% (1.4 million ha), and olive trees 2% (0.6 million ha) (Fig. 1).

Total agricultural export revenue in 2001 was approximately 2 billion (10$^9$) US$, of which 1.15 billion (10$^9$) was horticultural crops. Of the total vegetable crops produced, 89% was fruit bearing (melons and watermelons). Leguminous, leafy or stem vegetables plus root, bulb and tuberous vegetables and others accounted for 11% of total production. The leading crop in vegetables was tomato with 8.4 million t followed by watermelons (4 million t), melons (1.8 million t), and cucumbers (1.7 million t). The main vegetable crops produced are summarized in Table 1. The tomato is grown throughout the year in the open field and under cover. Tomato grown under cover represents 17% of total production. In 2001, 190,767 t of tomato

![Figure 1. Distribution of cultivated area in Turkey, 2001.](image1.png)

![Figure 2. Main horticultural exports in 2001 (in million US$).](image2.png)
were exported, especially to EU countries; 100,000 t of paste were exported in 2002 with a value of 70.5 million US$.

Protected cultivation is of great importance in vegetable production. In 2001 the area under cover was 43,138 ha of which 17,123 ha was low tunnel, 14,978 ha plastic greenhouses, 6,015 ha glasshouses, and 5,022 ha high tunnel. Antalya province ranks first in protected cultivation with 14,745 ha area under cover, followed by Adana, Icel, and Mugla. In 2001, tomato production under cover was 1.4 million t of which 95% was produced by three provinces: Antalya, Icel, and Mugla. Antalya's production accounted for 70% of the country total. Some other important crops grown under cover are cucumber, green pepper, eggplant, watermelon, melon, bean (fresh), head lettuce, strawberry and banana. Adana takes first place in low tunnel; the main products are watermelon (84% of total production), and melon (43% of total production). Head lettuce comes from Izmir (74%), cucumber from Antalya, Icel, and Samsun.

Table 1. Some important vegetable crops grown in Turkey, 2001.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production (tonnes)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>8,425,000</td>
<td>1,268,897,381</td>
</tr>
<tr>
<td>Potato</td>
<td>5,000,000</td>
<td>561,525,944</td>
</tr>
<tr>
<td>Watermelon</td>
<td>4,020,000</td>
<td>494,750,373</td>
</tr>
<tr>
<td>Cucumber</td>
<td>1,740,000</td>
<td>313,747,927</td>
</tr>
<tr>
<td>Dry Onions</td>
<td>2,150,000</td>
<td>255,496,016</td>
</tr>
<tr>
<td>Green Pepper</td>
<td>1,150,000</td>
<td>253,294,253</td>
</tr>
<tr>
<td>Melon</td>
<td>1,775,000</td>
<td>252,946,291</td>
</tr>
<tr>
<td>Eggplant</td>
<td>945,000</td>
<td>168,597,873</td>
</tr>
<tr>
<td>Bean, fresh</td>
<td>490,000</td>
<td>161,128,115</td>
</tr>
<tr>
<td>Cabbages</td>
<td>610,000</td>
<td>86,946,396</td>
</tr>
<tr>
<td>Sweet pepper</td>
<td>410,000</td>
<td>84,862,882</td>
</tr>
<tr>
<td>Leeks</td>
<td>300,000</td>
<td>50,292,223</td>
</tr>
<tr>
<td>Head lettuce</td>
<td>220,000</td>
<td>47,637,036</td>
</tr>
<tr>
<td>Squash</td>
<td>305,000</td>
<td>42,042,481</td>
</tr>
<tr>
<td>Spinach</td>
<td>210,000</td>
<td>41,651,050</td>
</tr>
<tr>
<td>Carrot</td>
<td>230,000</td>
<td>41,432,882</td>
</tr>
<tr>
<td>Dry garlic</td>
<td>83,000</td>
<td>40,039,261</td>
</tr>
<tr>
<td>Leaf lettuce</td>
<td>130,000</td>
<td>37,077,288</td>
</tr>
<tr>
<td>Red radish</td>
<td>145,000</td>
<td>25,458,822</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>88,000</td>
<td>24,374,486</td>
</tr>
<tr>
<td>Calavence, fresh*</td>
<td>41,000</td>
<td>22,113,950</td>
</tr>
<tr>
<td>Okra</td>
<td>30,000</td>
<td>18,303,435</td>
</tr>
<tr>
<td>Peas, fresh</td>
<td>60,000</td>
<td>15,808,782</td>
</tr>
<tr>
<td>Broad beans, fresh</td>
<td>45,000</td>
<td>13,335,123</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>80,000</td>
<td>10,461,574</td>
</tr>
<tr>
<td>Artichokes</td>
<td>26,500</td>
<td>7,597,709</td>
</tr>
<tr>
<td>Black cabbages</td>
<td>100,000</td>
<td>5,899,029</td>
</tr>
<tr>
<td>Celery</td>
<td>16,000</td>
<td>3,643,418</td>
</tr>
</tbody>
</table>

Source: State Institute of Statistics
* coloured spotted or zebrus bean (Turkish named as ‘barbun’)
duction of hazelnuts was 625,000 t, of which 70% came from four provinces: Ordu, Giresun, Trabzon, and Samsun, in descending order. Ordu ranks first in production accounting for 28% of the country total.

**Olive**

There is an increasing interest in olive and olive products due to its positive effects on human health. Turkey possesses 99 million olive trees representing 600,000 ha. This sector is of great importance in the national economy with production of 600,000 t amounting to 297 million US$. Most of the production is destined for domestic market as oil and table olives. In 2002, 33.6 thousand t table olives were exported (approximately 30 million US$). In Turkey, olives are cultivated along the coast of the three seas, Mediterranean, Aegean, and Marmara. Aydin province in the Aegean Region is the top producer of olives with 21.6 million trees, followed by Izmir (12.7 million trees), and Mugla (12.5 million trees) in the same region. In the Marmara Region, Balıkesir and Bursa provinces are of great importance in olive production with over 9 million trees each.

**Citrus**

In Turkey, citrus ranks third in total fruit production after vine fruits and pome fruits with over 29 million trees and production of 2.5 million t. Citrus is the main fruit crop grown in Turkey's Mediterranean Region where more than four-fifths of the Turkish citrus crop is grown. Approximately half of all citrus is produced in large orchards. The major citrus producing areas are located along Turkey's Southern Mediterranean and Aegean Coastal plains, between the sea and the Taurus Mountains. Very little citrus comes from inland areas that are susceptible to freezing weather.

In Turkey, citrus is the main export. In 2002, export of dried apricots was 66,763 t, more than 11 times that of Europe (5,851 t). This exportation accounted for 76% of the world total (87,935 t). Early apricot production from the Icel-Mut district in the Mediterranean Region accounts for 10% of total production.

*Fig*

Fig is a major fig producer in the world with over 10 million trees and production of 235,000 t in 2001 accounting for 30% of the world total. The Aegean Region ranks first in fig production, followed by the Mediterranean Region. Fig plantations in the Aegean Region are mainly composed (99%) of ‘Sarilop’ (also known as ‘Calimyrna’), which has high dried fruit quality. In 2002, Turkey accounted for 55% of world total with 35,052 t of dried fig exports valued at 70 million US$. 2.7 times more than Europe. EC countries are the major importers of dried figs.

**Tea**

Tea production of the two provinces (Rize and Trabzon) accounts for 91% of country total (824,946 t). One province, Rize, located in north-eastern Turkey, which receives more than 2200 mm precipitation, produces 74% of Turkey's tea (607,000 t). This sector, covering 653 ha and involving 204,112 growers, is of vital importance in the country's economy.

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Table 2. Temperate fruit and nut crops grown in Turkey, 2001.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production (tonnes)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapes</td>
<td>3,250,000</td>
<td>773,982,16</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td>625,000</td>
<td>665,737,725</td>
</tr>
<tr>
<td>Apple</td>
<td>2,450,000</td>
<td>471,176,368</td>
</tr>
<tr>
<td>Olive</td>
<td>600,000</td>
<td>296,623,945</td>
</tr>
<tr>
<td>Green tea</td>
<td>824,946</td>
<td>168,600,870</td>
</tr>
<tr>
<td>Orange</td>
<td>1,250,000</td>
<td>180,085,752</td>
</tr>
<tr>
<td>Lemon</td>
<td>510,000</td>
<td>149,215,810</td>
</tr>
<tr>
<td>Peach</td>
<td>460,000</td>
<td>139,583,432</td>
</tr>
<tr>
<td>Apricot</td>
<td>470,000</td>
<td>110,255,990</td>
</tr>
<tr>
<td>Mandarin</td>
<td>580,000</td>
<td>103,809,500</td>
</tr>
<tr>
<td>Walnut</td>
<td>116,000</td>
<td>103,115,667</td>
</tr>
<tr>
<td>Cherries</td>
<td>250,000</td>
<td>102,209,136</td>
</tr>
<tr>
<td>Fig</td>
<td>235,000</td>
<td>97,748,732</td>
</tr>
<tr>
<td>Pear</td>
<td>360,000</td>
<td>95,684,630</td>
</tr>
<tr>
<td>Pistachio</td>
<td>30,000</td>
<td>65,032,755</td>
</tr>
<tr>
<td>Banana</td>
<td>75,000</td>
<td>62,228,887</td>
</tr>
<tr>
<td>Strawberry</td>
<td>117,000</td>
<td>47,927,430</td>
</tr>
<tr>
<td>Plum</td>
<td>200,000</td>
<td>37,442,395</td>
</tr>
<tr>
<td>Sour cherries</td>
<td>120,000</td>
<td>34,407,648</td>
</tr>
<tr>
<td>Almond</td>
<td>42,000</td>
<td>32,557,469</td>
</tr>
<tr>
<td>Chestnuts</td>
<td>47,000</td>
<td>30,853,081</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>135,000</td>
<td>22,221,230</td>
</tr>
<tr>
<td>Quinces</td>
<td>102,000</td>
<td>19,355,104</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>60,000</td>
<td>13,844,679</td>
</tr>
<tr>
<td>Loquat</td>
<td>11,500</td>
<td>4,009,864</td>
</tr>
<tr>
<td>Persimmon</td>
<td>13,500</td>
<td>3,633,803</td>
</tr>
</tbody>
</table>

Source: State Institute of Statistics

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Hazelnuts plantation in Trabzon-Turkey.
2002, 4,852 t of tea was exported with a value of 244 million US$. Recent studies have been underway to increase production and improve quality by replacing old plantations. Organic tea production has been initiated in the private sector.

FLORICULTURE

Turkey has rich floral resources due to its geographical and climatic conditions. Many native genera are suitable for ornamental production. Despite this richness, the Turkish floriculture sector has not performed up to its potential. According to 1999 data, the total area devoted to floriculture was 2,173 ha, of which 1,528 ha was occupied by cut flowers. The total value of the floriculture sector was 65.4 million US$ of which 13.5 million came from cut flowers. Carnation accounts for more than 90% of the cut flower exports. Main importers are The United Kingdom (65-70%) and the Netherlands (20%). Izmir (Aegean Region), Antalya (Mediterranean Region), and Yalova and Istanbul (Marmara Region) are key provinces. Geophytes, which are represented by more than 500 species belonging to 30-40 genera, are another source of floricultural revenue. Between 1989 and 1990 over 64 million bulbs and tubers were exported. However, the number of exported bulbs and tuber has decreased due to government measures to protect native species under risk. Some exported bulbs and tuberous flowers, in descending order of importance, are species of Galanthus, Anemone, Eranthis, Leucojum and Cyclamen.

HORTICULTURAL RESEARCH

Horticultural research in Turkey has been carried out by various organisations, mainly at universities and research institutes but also from the private sector. These research institutes are state owned organisations, which belong to different general directorates of either the Ministry of Agriculture and Rural Affairs, or the Ministry of Energy and Natural Resources. The funds for research come mainly from the state budget. Universities and nearly all of the research institutes are state funded. Some cooperative unions as TARIS and FISKOBIRLIK working on raisin, fig, and hazelnut have their own research groups as well. Also Turkish Scientific and Technical Research Council (TUBITAK) and State Planning Organization (DPT) give financial support for projects. The Turkish Society for Horticultural Science was founded in 1992.

CONCLUSION

Due to its geographical position, many horticultural crops can be grown in Turkey. With completion of the Southeast Anatolia Project (GAP), the cultivated area will increase. The GAP region extends over an area of 75,000 km² and a wide range of crops each requiring different climatic conditions are raised in this area including olive, pistachio, hazelnut and persimmon. The region has 3.2 million ha of land fit for crop culture. Upon the completion of irrigation projects in GAP, the area brought under irrigation will be equal in size to the total area so far brought under irrigation by the State. This will bring along significant changes in agricultural outputs and crop design.

References


About the Author

Dr. Semiha Güler is a researcher at the Black Sea Agricultural Research Institute, Samsun/Turkey, email: semihag@yahoo.com. For many years she worked as a soil science specialist in Alata Horticultural Research Institute, Mersin. She works on fertigation with cucumber and tomatoes in the field and under cover and is a co-ordinator of organic farming and EU projects.
Fruit has long been a perennial source of inspiration for poets all around the world. In English literature, we find fruit ranging from the mention made by Andrew Marvell in *The Garden* (1652):

The nectarine, and curious peach,  
Into my hands themselves do reach;

to the more than 20 different fruits quoted by Christina Rossetti at the beginning of the *Goblin Market* (1862):

Come buy, come buy:  
Our grapes fresh from the vine,  
Pomegranates full and fine,  
Dates and sharp bullaces,  
Rare pears and greengages.  
Damsons and bilberries,  
Taste them and try:

It is, however, unusual for a great poet to be simultaneously a fruit grower and a fruit exporter, but this was the case with the Portuguese poet Cesário Verde (1855-1886). During his short lifetime - he died at the age of 31 - Cesário’s talents went largely unnoticed. His poetry was too much of an innovation for his own time.

Today Cesário is recognised as one of the most important Portuguese poets. Portuguese literature is particularly rich in poetry, with authors ranging from the 16th-Century classical lyric poet Luis de Camões to the 20th-Century Fernando Pessoa, a poet currently enjoying worldwide recognition. Critics highlight Cesário’s realism and his accurate and detailed description of town life: he is a great poet of Lisbon, as well as of the countryside. The pictorial quality of his poetry caused one author to say that Cesário was a painter born a poet.

Cesário’s main source of income came from his father’s hardware shop in Lisbon, but the family also owned a farm near the Portuguese capital, where Cesário was a keen grower of fruit, mainly apples and table grapes, which he exported to England and other countries in Northern Europe. In his last poem Nós (We), an autobiography, Cesário shows a true and strong love for the country life, as well as a love for his own family. He refers tenderly to the sight of his sister, who also died young, helping to pack the table grapes. The English market once refused his Muscat grapes as being too sweet.

The grapes of a lofty muscatel vine  
Have been considered too sweet to embark:  
The poor palaces surrounding Hyde Park  
Will never taste a honey so divine!

He also exported the ‘Espelho’ apple, a large and very acid fruit, which can still be found in local Portuguese markets today.

Ah! Glorious coloured apples of Espelho sweet  
Whenever at my command and my suggestion  
Paper is wrapped around the apples in question  
That Herbert Spencer may have had the chance to eat!

For Cesário, just as for Portuguese fruit growers 120 years later, competition from Spain was the main problem. He also complains about the difficulties of hail and orchard pests.

And the aphids, worms and snails never vanish,  
And then, of course, to add to all this great trouble,  
There will be storms, hailstones and burning stubble,  
Not to mention competition from the Spanish.

With the recent enlargement of the EU, Portugal, always a country for poets, is no longer the poorest member. It has one of the highest annual world fruit consumptions per capita (132 kg) although Portugal is also a heavy importer of fruit. One third of the national market consists of imported fruit.

From Almeria the winemakers come to sell,  
Competing against our local suppliers,  
By auctioning their fruit to foreign buyers,  
At prices that cause our courage to dispel!

E o pulgão, a lagarta, os caracóis,  
E há inda, além do mais com que se ateima,  
As intempéries, o granizo, a queima,  
E a concorrência com os espanhóis.

From Almeria the winemakers come to sell,  
Competing against our local suppliers,  
By auctioning their fruit to foreign buyers,  
At prices that cause our courage to dispel!

Dr. João Matos Silva is Associate Professor of Pomology at Lisbon Technical University, 1349-017 Lisboa, Portugal, email: j.matos_silva@sapo.pt, and Dr. John Elliott is Lecturer in English at Lisbon University, 1600-214 Lisboa, Portugal, email: jde@netcabo.pt.
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


John E. Jackson has compiled an outstanding work integrating apple and pear biology and horticulture. It is clearly written, up-to-date, and covers an enormous amount of material. The book consists of 14 chapters that cover history and trade, taxonomy and cultivars (both scion and rootstocks), root systems, graftage, rootstock effects, shoot systems, leaves, canopies and light interception, photosynthesis, respiration and carbohydrate partitioning, flowers and fruits, fruit quality, mineral nutrition, water relations, diseases and pests, and finally biotechnology. Each chapter contains recommended readings and a list of references that represent a world approach. There is both a cultivar (scion and rootstock) and general index. The book is very well written and each statement is referenced. Although the book was written for undergraduate and postgraduate students of horticultural science it will surely become a handbook and first reference for all workers in pome fruits. It is unfortunate that the relatively high price will limit its use.


This book is derived from an International Conference on Vegetables (ICV-2002) during November 2002, with participation of 700 delegates from 37 countries, principally Asia. The book includes 28 papers under four headings: Food and Nutrition Security and Vegetables (10 papers), Nutrition and Vegetables (5 papers), Programmes and Policies in Selected Countries (11 papers), and Vegetable Network (2 papers). Its purpose according to Dr. Prem Nath, the Chairman of an Agricultural Science Foundation that carries his name, is to recognize the role of vegetables as a major supplement to food and nutrient security and to form a Vegetable Science International Network to be called VEGINET. The theme of the book was articulated in a chapter entitled Food and Nutrition Security towards Human Security by Louise O. Fresco and Wilfried O. Baudoin, of the FAO that includes a discussion of vegetables in human nutrition and health, a theme reinforced by most of the other papers. The ambitious network (VEGINET) is based on the formation of a new international organization based on vegetables and devoted to policy development, production technology, genetic improvement, and marketing and trade. A complex infrastructure is proposed and it will be interesting to see if support can be generated in this climate of reduced international agricultural funding.


This is an expanded edition of a work published in 1991 entitled Uncommon Fruits Worth of Attention: A Gardeners Guide. It will be a welcome addition for North American homeowners who are desirous of planting an edible landscape in cold winter climates. A number of the fruits may well be known to European or Asian gardeners. The work is gracefully written with much historical and horticultural information. Crops covered include juneberry (Amelanchier spp.), Beach plum (Prunus maritima), Alpine and musk strawberries (Fragaria vesca and F. moschata), pawpaw (Asimina triloba), Raisin Tree (Hovenia dulcis), lingonberry (Vaccinium vitis-idaea), Actinidia species, mulberry (Morus species), persimmons ( Diospyros kaki and D. virginiana), Elaeagnus species, gooseberry (Ribes uva-crispa and R. hirtellum), maypop (Passiflora incarnate), Cher (Cudrania tricuspidata), black currant (Ribes spp.), Nanking cherry (Prunus tomentosa), cornelian cherry (Cornus mas), red and white currants (Ribes spp.), Asian pear (Pyrus spp.), jostaberry (Ribes nidigrolaria), lowbush blueberry (Vaccinium angustifolium), jujube (Ziziphus jujuba), shipova (Sorbuspyrus auricularis), and medlar (Mespilus germanica). Mail order sources for seed or plants are provided. Although the order of entries does not make a lot of sense and the lack of references was disappointing, this book will be a valued addition to my library.

NEW TITLES


WEBSITES


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

Annual Meeting of the Interamerican Society for Tropical Horticulture, 24-29 October 2004, Guacimo, Costa Rica. Info: Prof. Carlos Demerutis, EARTH University, Las Mercedes de Guacimo, Limon, Costa Rica. Phone: (506) 713 0000, Fax: (506) 713 0001, email: 50isth@earth.ac.cr, abstract@earth.ac.cr and http://www.earth.ac.cr

International Conference on Horticultural PhD. Study Systems and Conditions in Europe, 17-19 November 2004, LEDNICE, Czech Republic. Info: Ass. Prof. Robert Pokluda, Prof. Frant. Kobza, Mendel Univ. of Agric. and Forestry Brno, Faculty of Horticulture Lednice, Phone: +420519367234 or 232, Fax: +420519367222, email: pokluda@zf.mendelu.cz and www.zf.mendelu.cz/cshs/conference04/conference2004.htm

20ème Salon du Végétal, 16-18 February 2005, Angers, France. Info: B.H.R. - Centre Régional Horticole, Avenue Amiral Chauvin, 49130 Les Pont-de-Cé, France. Phone: +33 (0)2 41 79 14 17, Fax: +33 (0)2 41 45 29 05, e-mail: salon@bhr-vegetal.com and www.salon-du-vegetal.com

New Ag International Conference, 16-18 March 2005, Antalya, Turkey. Info: Jean Pierre Leymonie, Editorial Director, New Ag International, 12 rue du Haguenueck, 68000 Colmar, France. Phone: +33 (0)3 89 30 51 20, Fax:+33 (0)3 89 30 51 34, email: newagedit@calixo.net and www.newaginternational.com

V Congreso Ibérico de Ciencias Hortícolas, 22-27 May 2005, Porto, Portugal. Info: Meeting Point Travel Agency Ltd., R. Marcelino Mesquita, nº13, Loja 3, Alto de Santa Catarina, 2795-134 Linda-a-Velha, Portugal, Phone: +351 214 159 900, Fax: +351 214 159 909, e-mail: meetingpoint@netcabo.pt, iberico.organiz@esa.ipvc.pt, iberico.cientif@esa.ipvc.pt and www.ci.esapl.pt/congiberico

**Courses and Meetings**

**From the Secretariat**

**New ISHS Members**

We are pleased to welcome the following new members:

**NEW ORGANISATION MEMBERS:**

- **Australia:** Agronico Pty. Ltd.
- **Italy:** University of Perugia
- **Puerto Rico:** University of Puerto Rico
- **South Africa:** Stargrow Cultivar Development
- **United States of America:** Elisabeth C. Miller Library (University of Washington), Eye Lighting

**NEW INDIVIDUAL MEMBERS:**

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In Memoriam

REMMIE BOOIJ
(6 OCTOBER 1953 - 10 DECEMBER 2003)

On 10 December 2003 our highly respected colleague Dr. Remmie Booij passed away. Two years before his death Remmie became aware that he was ill and that he would not recover from his disease. Until the very last moment he continued to dedicate his life to research in an admirable manner without losing his sense of humour.

As a researcher Remmie has made important contributions to the application of science into practice. He did his PhD on the inflorescence and timing of flowering of cauliflower at the Research Station for Arable Farming and Field Grown Vegetables (PAGV) in Lelystad. The title of his thesis was “Development of cauliflower and its consequences for cultivation”. Soon after completing his thesis Remmie moved to the Center for Agrobiological Research (CABO) in Wageningen. This center was the predecessor of the Research Institute for Agrobiology and Soil Fertility (AB-DLO, 1993-1999) and Plant Research International (as from 2000). In Wageningen Remmie developed a decision support system for supplemental nutrient dressings in potatoes and vegetables. He was a much-sought expert of crop physiology in vegetable production and reviewed many scientific papers. The gentle way Remmie was able to make contacts and to gain confidence made him the ideal person to co-ordinate large and complex research programmes on precision agriculture, starch potato production and organic farming. Remmie inspired people, delivered positive critique, was able to bring people together. He was fully involved in his research and continuously aimed to get his results used by growers. His great sense of humour was well-known. Colleagues also found support and comfort in personal matters.

Remmie was a very active member of the International Society of Horticultural Science for twenty-five years, especially of the Section Vegetables. He was a member of the organising committee of the Society’s symposia “Timing of field vegetable production (1989)”, “Brassica’s (2000)” and “Towards an ecologically sound fertilisation in field vegetable production (2000)”.

The international scientific vegetable community has lost an outstanding member, both in scientific and personal respect. We wish his wife Jette and their children Chris and Marga the strength to overcome the great loss.

Anton Haverkort and Jacques Neertens, Plant Research International, Wageningen
## Calendar of ISHS Events

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

### YEAR 2004

- **October 20-23, 2004**, Chaves (Portugal): **III International Chestnut Symposium.** Info: Dr. Carlos Abreu, Departamento de Tras-Os-Montes e Alto Douro, Apartado 202, 5000-911 Vila Real, Phone: (351)259350508, Fax: (351)259350480, email: cagabreu@utad.pt web: www.utad.pt/eventos/chestnut congress
- **October 24-28, 2004**, Daejon (Korea): **IV ISHS Symposium on Brassica and XIV Crucifer Genetics Workshop.** Info: Prof. Dr. Yong Pyo Lim, Dept. of Horticulture, Chungnam National University, Kung-Dong 220, Yusong-Gu, Taejon 350-764, South Korea. Phone: (82)428215739, Fax: (82)428231382, email: ypllim@cnu.ac.kr web: www.brasica2004.org
- **November 7-14, 2004**, Sorrento, Naples (Italy): **V International Walnut Symposium.** Info: Dr. Damiano Avanzato, MiPAF, Istituto Sperimentale per la Frutticoltura di Roma, Via di Fioranello 52, 00134 Roma, Italy. Phone: (39)06759348186, Fax: (39)06759340158, email: davananzato@mclink.it or Dr. Maria-Emilia Malvolti, CNR, Istituto per la Biologia Agroambientale e Forestale, Viale Marconi, 205010 Porano (Terni), Italy. Phone: (39)0763374913, Fax: (39)0763374980, email: mimil@ibaf.cnr.it or walnut2004@sistemacongressi.com web: (active March 2004) www.walnut2004.sistemacongressi.com
- **November 10-12, 2004**, Sydney (Australia): **Postharvest Unlimited Downunder Conference 2004.** Info: Dr. David Tanner, Manager Supply Chain Innovation, Food Science Australia, PO Box 52, North Ryde, NSW 1670, Sydney, Australia. Phone: (61)294908472, Fax: (61)294908593, email: david.tanner@csiro.au or Carolyn Moorshead, AIRAH, Level 7, 1 Elizabeth Street, Melbourne, VIC 3000, Australia. Phone: (61)396148868, Fax: (61)396149849, email: carolyn@airah.org.au web: www.airah.org.au/posthar vest2004
- **November 14-21, 2004**, Almería (Spain): **IX International Symposium on Soilless Culture and Hydroponics.** Info: Dr. Miguel Unrestarazu Gavilán, Dpto. Producción Vegetal, Universidad de Almería, La Canada de San Urbano, 04120 Almería, Spain. Phone: (34)950015929, Fax: (34)950015939, email: mgavilain@ual.es web: nevada.uas.es/agb198/doc/agr198.html
- **November 15-18, 2004**, Melbourne (Australia): **IX International Symposium on Processing Tomatoes.** Info: Mr. Bill Ashcroft, Institute for Sustainable Irrigated Agriculture, Ferguson Road, Tatura, VIC 3616, Australia. Phone: (61)358335253, Fax: (61)358335299, email: bill.ashcroft@dpi.vic.gov.au web: www.worldtomatoconference.com.au
- **November 22-26, 2004**, The River Maya - Cancun (Mexico): **II International Symposium on Acclimatization and Establishment of Micropropagated Plants.** Info: Dr. Jorge Santamaria, Centro de Investigación Científica de Yucatán, Dept. Biotecnología, Calle 43 No. 130 Col. Chuburna de Hidalgo, 97200 Mérida, Yucatán, Mexico. Phone: (52)999813923, Fax: (52)999813900, email: jorgesm@cicy.mx web: www.cicy.mx/eventos/simp2004/simposium.htm

### YEAR 2005

- **January 9-13, 2005**, Santiago (Chile): **VI International Symposium on Peach.** Info: Dr. Rodrigo Infante, Santa Rosa 11.315, Departamento de Produccion Agrícola, Universidad de Chile, Santiago, Chile. Phone: (56)26785813, Fax: (56)26785626, email: rinfante@uchile.cl web: www.peach2005.cl
- **January 16-21, 2005**, Talca (Chile): **V International Symposium on Mineral Nutrition of Deciduous Fruit Crops.** Info: Dr. Felix Lippert, Institut für Obstbau und Gemüsebau, Universität Bonn, Auf dem Hügel 6, 53121 Bonn, Germany. Phone: (49)228735139, Fax: (49)228735764, email: lippert@uni-bonn.de web: www.gartenbauwissenschaft.uni-bonn.de/vegetrop2005
- **April 11-15, 2005**, East London (South Africa): **II International Pineapple Symposium.** Info: Prof. Dr. José Leitão, FERN, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal. Phone: (351)289800939, Fax: (351)289818419, email: jleitao@ualg.pt or fig2005@ualg.pt web: www.ualg.pt/fig2005
- **May 20-26, 2005**, Tehran (Iran): **IV International Symposium on Pistachio and Almond.** Info: Dr. A. Javanshah, Iran Pistachio Research Institute, PO Box 77175/435 Rafsanjan, Iran. Phone: (98)3914225202, Fax: (98)3914225208, email: javanshah@pri.ir web: www.pri.ir
- **May 29 - June 2, 2005**, Leuven (Belgium): **Model-IT 2005. Applications of Modelling as an Innovative Technology in the Agri-Food Chain.** Info: Prof. Dr. Bart Nicolai, Laboratory of Postharvest Technology, KU Leuven, W. Decrolylaan 42, 3001 Heverlee, Belgium. Phone: (32)16322375, Fax: (32)16322955, email: bart.nicolai@ag.kuleuven.ac.be web: www.model-it-2005.be
- **June 6-10, 2005**, Bursa (Turkey): **V International Cherry Symposium.** Info: Prof. Dr. Atilla Eris, Uludag Universitesi, Ziraat Fakültesi, Bahce Bitkileri Bolumu Baskani, 16059 Bursa, Turkey. Phone: (90)2244428001, Fax: (90)2244428120, email: info5ics.org or atillaer@ulu dag.edu.tr and Co-convenor Dr. Masum Burak, Ataturk Central Horticultural Research Institute, 77102 Yalova, Turkey. Phone: (90)2268142520, Fax: (90)2268141146, email: masum_burak@yalova.tagem.gov.tr web: www.5ics.org
- **June 13-17, 2005**, Murcia (Spain): **XIII International Symposium on Apricot Breeding and Culture.** Info: Dr. Felix Romojar and Dr. Federico Dicenta, CEBAS-CSIC, PO Box 164, 30100 Espinar do (Murcia), Spain. Phone: (34)968396328 or (34)968396309, Fax: (34)968396213, email: apricot@cebas.csic.es Symposium Secretariat: Viajes CajaMurcia, Gran Via Escultor Salzillo 5. Entlo. Dcha., 30004 Murcia, Spain. Phone: (34)968225476, Fax: (34)968223101, email: congressos@viajescajamurcia.com web: apricot.viajescajamurcia.com
- **June 14-17, 2005**, Kuala Lumpur (Malaysia): **II International Symposium on Sweetpotato and Cassava - 2ISSC.** Info: Dr. Tan Swee Lian, MARDI, Rice & Industrial Crops Research Centre, PO
Box 12301, 50774 Kuala Lumpur, Malaysia. Phone: (60)389437516, Fax: (60)38942578, email: siltan@mardi.my web: http://www.mardi.my


June 21-24, 2005, Aas (Norway): V International Symposium on Artificial Lighting. Info: Prof. Dr. Hans R. Gislerod, Dept. of Plant and Environmental Sciences, Agricultural University of Norway, PO Box 5022, 1432 Aas, Norway. Phone: (47)64947800 or (47)64947824, Fax: (47)64947802, email: hans.gislerod@ipf.nlh.no or lightsym2005@nlh.no web: www.lightsym2005.no


July 5-10, 2005, East Lansing, MI (USA): IX International Controlled Atmosphere Research Conference. Info: Dr. Randolph M. Beaudry, Michigan State University, Department of Horticulture, A22 Plant & Soil Sci. Building, East Lansing, MI 48824-1325, USA. Phone: (1)517 355 5191 x303 or x339, Fax: (1)517 353 0890, email: beaudry@msu.edu or allens@msu.edu

July 6-9, 2005, Columbus, Ohio (USA): International Symposium on Herbaceous Ornamental Plant Germplasm Conservation and Utilization. Info: Dr. David Tay, Director, Ornamental Plant Germplasm Center (OPGC), Ohio State University, 670 Tharp Street, Columbus, OH 43210-1086, USA. Phone: (1)614-292-1941, Fax: (1)614-292-3768, email: opgc@osu.edu web: opgc.osu.edu

September 1-4, 2005, Singapore (Singapore): International Conference & Exhibition on Soilless Culture - Singapore 2005 (ICSC-2005). Info: Dr. Malik F. Rahman M., Chairman Conference Organizing Committee, Block 461 #13-75 Crawford Lane, Singapore 190461. Phone: (65)62918153, Fax: (65)62987978, email: ICESC2005@singaporehydroponics.com web: www.singaporehydroponics.com

September 4-10, 2005, Angers (France): International Symposium on Growing Media. Info: Dr. Jean-Charles Michel, National Institute of Horticulture, INH, Research Unit A-462, SAGAH, 2 rue Le Notre, 49045 Angers Cedex 01, France. Phone: (33)241225422, Fax: (33)241225553, email: jean-charles.michel@inr.fr or ishs-angers2005@inr.fr web: ishs-angers.agrena.org

September 12-16, 2005, Townsville, North QLD (Australia): III International Symposium on Cucurbitis. Info: Dr. Gordon Rogers, Horticultural Research and Development, PO Box 552 Sutherland NSW 2232, Australia. Phone: (61)295270826, Fax: (61)295443782, email: gordon@ahr.com.au

September 12-16, 2005, California (USA): IV International Symposium on Rose Research and Cultivation. Info: Dr. H. Brent Pemberton, Texas Agricultural Experiment Station, Texas A&M University Agricultural Research and Extension Center, PO Box 200, 1710 N. Highway 3053, Overton, TX 75684-0200, USA. Phone: (1)9038346191, Fax: (1)9038347140, email: b-pemberton@tamu.edu

September 15-17, 2005, Venosa (Italy): International Symposium on Advances in Grapevine and Wine Research. Info: Dr. Vitale Nuzzo, Dipartimento di Scienze dei Sistemi Culturali, Forestali e dell’Ambiente, Viale dell’Ateneo Lucano, 10, 85100 Potenza, Italy. Phone: (39)0971205263 or (39)3293660254, Fax: (39)0971205378, email: nuzzo@uniba.it

October 10-14, 2005, Daytona Beach (USA): International Symposium on Biotechnology of Temperate Fruit Crops and Tropical Species. Info: Dr. Ralph Scorza, USDA-ARS Appalachian Fruit Research Station, 2217 Willshire Rd., Kearneysville, WV 25430, USA. Phone: (1)3044723545, Fax: (1)3044728340, email: rscorza@ars.usda.gov or Dr. Richard Litz, University of Florida/IFAS, Horticultural Sciences Department, 18905 SW 280 St., Homestead, FL 33031-3314, USA. Phone: (1)3054670013, Fax: (1)3052467603, email: rel@ifas.ufl.edu web: conference.ifas.ufl.edu/ishscrops

October 20-28, 2005, Lilongwe (Malawi): High Value Indigenous Fruit Trees in the Tropics and Subtropics: Production, Utilisation and Marketing. Info: Dr. Festus K. Akinifesi, SADC-ICRAF Agroforestry Programme, Makoka Agricultural Research Station, PO Box 134, Zomba, Malawi. Phone: (265)01534203, Fax: (265)01534283, email: f.akinifesi@cigiar.org

November 2005, Kuala Lumpur (Malaysia): I International Symposium on Papaya. Info: Dr. Abd. Shukor Abd. Rahman, Horticulture Research Centre, MARDI, GPO Box 12301, 50774 Kuala Lumpur, Malaysia. Phone: (603)89437263, Fax: (603)89487590, email: arshukor@mardi.my

December 5-7, 2005, Santiago (Chile): IX International Rubus and Ribes Symposium. Info: Dr. Maria Pilar Banados, Universidad Catolica de Chile, Departamento de Fruticultura y Enologia, Casilla 306-22, Vicuna Mackenna 4860, Santiago, Chile. Phone: (56)26864305, Fax: (56)25554130, email: pbanados@puc.cl

YEAR 2006

February 5-10, 2006, Sandton, Johannesburg (South Africa): VIII International Mango Symposium. Info: Dr. Richard Elphick, 48, Malelane 1320, South Africa. Phone: (27)137260089, Fax: (27)1372600113, email: elphickr@iafrica.com

February 19-24, 2006, Agadir (Morocco): International Symposium on New Crop Technologies in Soil and Soilless Cultivation under Protected Environment. Info: Conveners Dr. A. Hanafi and Dr. W.H. Schnitzler, Institut Agronomique et Vétérinaire Hassan II, Complexe Horticole, PO BOX 12042, Cité Baléaïre, Agadir 8000, Morocco. Phone: (212)42428152 or 61177968, Fax: (212)42428152, email: hanafi@lavcha.ac.ma

March 28-31, 2006, Lorca - Murcia (Spain): VI International Symposium on Artichoke, Cardoon and their Wild Relatives. Info: Dr. 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)963825446, Fax: (34)963825435, email: juan.fernandez@upct.es Symposium Secretariat: Viajes CajaMurcia, Gran Via Escultor Salzillo 5. Entlo. Orcha., 30004 Murcia, Spain. Phone: (34)968225476, Fax: (34)968223101, email: congressos@viajescajamurcia.com web: www.viajescajamurcia.com/artichoke

April 1-5, 2006, Guangzhou (China): II International Symposium on Artichoke, Cardoon and their Wild Relatives. Info: Dr. Shunquan Lin, College of Horticulture, South China Agricultural University, Guangzhou 510642, Wushan, China. Phone: (86)2085282626, Fax: (86)2085282107, email: cmliu@scau.edu.cn

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- October 28-30, 2006, Mashhad (Iran): II International Symposium on Saffron Biology and Technology - ISSBT. Info: Prof. Dr. A. Koocheki, CESC, Faculty of Agriculture, Ferdowsi University of Mashhad, PO Box 91775-1163, Mashhad, Iran. Phone: (98)5117610760 or (98)5118788494, Fax: (98)5118787430, email: a.kooch@ferdowsi.um.ac.ir or saffron-ir@ferdowsi.um.ac.ir web: saffron-ir.um.ac.ir
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556 V International Congress on Hazelnut 96
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